Floyd Bennet Field
Hangars 3 & 4 Rehabilitation
Brooklyn, NY

Final Construction Documents
GATE 308504

PROJECT SPECIFICATIONS

REGISTERED ARCHITECT
ANN K. DILCHER
042287-01
STATE OF NEW YORK

STATE OF NEW YORK
JOHN A. MATTEO
077905
LICENSED PROFESSIONAL ENGINEER

NATIONAL PARK SERVICE (NPS)
DENVER SERVICE CENTER (DSC)

STATE OF NEW YORK
JOHN J. DUFFY, JR.
071146
LICENSED PROFESSIONAL ENGINEER

12/19/2025

STATE OF NEW YORK
RICHARD J. SNYDER
No. 66242
LICENSED PROFESSIONAL ENGINEER

December 12, 2025

STATE OF NEW YORK
CHRISTOPHER LONGO
083709
LICENSED PROFESSIONAL ENGINEER

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- Structural Probe Report, April 29, 2025
- Environmental Hazardous Materials Survey, June 11, 2025
- Geotechnical Investigation Report, June 25, 2025
- Seismic Evaluation Report, December 19, 2025

DIVISION 01 -- GENERAL REQUIREMENTS

SECTION 01 11 00 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Work Covered by Contract Documents
2. Work Under Other Contracts
3. Construction Contractor Use of Site
4. Public Use of Site
5. Conduct of Operations
6. Work Restrictions
7. Special Construction Requirements
8. Soils Investigation Report
9. Additional Reports

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Location: Floyd Bennett Field, 3159 Flatbush Ave, Brooklyn, NY 11234, Hangars 3 and 4.

B. The Work consists of:

1. Demolition
   a. Removal of the existing roofs and roof decks (superstructure to remain in place).
   b. Removal of specific existing masonry interior walls.
   c. Removal of concrete slabs in Hangars 3 and 4 and select damaged areas.
   d. Dismantling of exterior masonry walls for rebuilding.

2. Exterior Restoration
   a. Repairing and rebuilding portions of all masonry facades.
   b. Repair and replacement of all windows.
   c. Restoration of the rolling hangar doors.
   d. Restoration of the painted friezes above the hangar doors.
   e. Replacement roofs.

3. Interior Restoration
   a. Restoration and replication of interior doors and windows.
   b. Replacement of concrete slabs.
   c. Interior masonry wall restoration.

4. Systems
   a. Installation of lighting and electrical.

b. Installation of unit heaters in utility and restroom spaces.
c. Installation of two single-user restrooms.
d. Rerouting of utilities around the buildings.

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

D. Hangars 3 and 4 is a Contributing Structure within a National Register Designated Historic District and is subject to following the Secretary of Interior Standards for the Treatment of Historic Properties. Care must be taken to limit damage to historic fabric during construction.

1.3 WORK UNDER OTHER CONTRACTS

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

B. Preceding Work: Government has awarded separate contract(s) for the following construction operations at Project site. Those operations are scheduled to be substantially complete before work under this Contract begins.

1. Early Hazmat and Demolition: A separate contract was previously awarded to RAAD Construction Group **for** Hazmat remediation and selective demolition of interior elements and trash. This work was completed in the late winter/early spring of 2025.
   a. Please note that additional demolition and hazardous materials remediation and/or appropriate disposal work WILL be part of this project and was not part of the Early Hazmat and Demolition work.

C. Concurrent Work: There may be ongoing adjacent work performed by other contractors at Floyd Bennett Field. The contractor for this project is responsible for coordinating with the other contractors, as necessary, in order to complete the work.

1.4 CONSTRUCTION CONTRACTOR USE OF SITE

A. General: Construction Contractor shall have limited use of site for construction operations. Limit use of premises to areas within the Contract Construction limits indicated on drawings. Do not disturb portions of Project site beyond areas in which the Work is indicated.

B. Storage of Materials: Confine storage of materials to fenced construction area shown on plans.

C. Parking: Confine parking to staging areas as shown on drawings. Overflow parking shall be in designated existing parking areas as noted on drawings.

D. Stockpiling: Confine stockpiling to staging areas as shown on drawings.

E. Preservation of Natural Features:
1. Tree Protection: If needed, contractor shall comply with NYC tree protection policy.

F. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Government employees, and emergency vehicles at all times. Do not use for parking or storage of materials.

1. Schedule deliveries to minimize use of driveways and entrances.
2. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

G. Construction Camp: Establishment of a camp within park will not be permitted.

H. Hauling Restrictions: Comply with legal load restrictions in hauling of materials. Load restrictions on park roads are identical to state load restrictions with such additional regulations as may be imposed by the Park Superintendent. Information regarding rules and regulations for vehicular traffic on park roads may be obtained from the Office of the Park Superintendent. A special permit will not relieve Construction Contractor of liability for damage which may result from moving of equipment.

I. Bridge Restrictions: Identify jurisdictions, load restrictions, permit requirements, time and calendar restrictions as outlined.

1.5 PUBLIC USE OF SITE

A. The building will be closed to the public during construction. However, the site outside of the construction limits will remain open to the public.
1. Construction Contractor shall conduct his operations to ensure the least inconvenience to public.
2. Road closures are not permitted.

1.6 CONDUCT OF OPERATIONS

A. Construction Contractor shall conduct his operations in conformance with rules and regulations promulgated by the Secretary of the Interior for the National Park Service, and applicable park rules and regulations prescribed by Park Superintendent.

B. Work on Saturdays, Sundays, Federal holidays or at night may not be performed unless stated in the Work Restrictions below or without prior consent from the Contracting Officer. Submit requests 3 business/calendar days in advance of the work to the Contracting Officer for approval.

C. No signs or advertisements (except those specified herein) shall be displayed on the construction site or within the park unless approved by the Contracting Officer.

1.7 WORK RESTRICTIONS

A. On-Site Work Hours: Work shall be generally performed during normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, except when otherwise indicated. Alternate work schedules may be considered pending approval from the Government.

B. Existing Utilities

1. Existing Utilities: Notify Contracting Officer and utility companies of proposed locations and times for excavation.
2. Construction Contractor shall be responsible for locating and preventing damage to known utilities. If damage occurs, repair utility at no additional expense to the Government.

3. If damage occurs to an unknown utility, repair utility. An equitable adjustment will be made in accordance with the Changes clause of the contract.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Government or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Contracting Officer not less than five business days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Contracting Officer's written permission.
3. Durations of utility shutdowns must be minimized and coordinated with Contracting Officer. After hours work will be required to minimize utility interruptions that affect NPS and non-NPS tenants of Floyd Bennett Field.

D. Nonsmoking Building/Tobacco Use/Vaping: Smoking is not permitted within building or within 25 feet of entrances, operable windows, or outdoor air intakes of this building or any other buildings on site.

1.8 SPECIAL CONSTRUCTION REQUIREMENTS

A. Project Management and Communication Software: Software administered by NPS shall be used to manage communication and document sharing during construction.

1. See Section 01 31 00 "Project Management and Coordination" for requirements on using NPS project management and communication software.

B. If work will be implemented during the period of March 15 to September 1, park Natural Resource Stewardship Division Manager must be contacted, and the Contractor may be required to have a qualified biologist conduct an inspection of the work area prior to initiating work to determine if there is any nesting activity that could be impacted by the project. If nest building begins, birds must not be harassed in any manner to deter nesting activity. Park approval is required prior to placement of any structures to deter nesting and any such structure may only be put in place between September 2 and March 14.

1.9 SOILS INVESTIGATION REPORT

A. The report Geotechnical Investigation Report NPS Floyd Bennett Field Hangars 3 & 4 Rehabilitation, June 25, 2025, prepared by GHD is available as part of this deliverable.

B. In case of conflict between report and drawings or specifications, the drawings and specifications govern.

1.10 ADDITIONAL REPORTS

A. The letter regarding the results of the Hydrant Flow Test dated 12/18/2024 prepared by NYDEP is an appendix with this package.

B. The report "Field Report – Structural Probes" dated 04/29/2025 prepared by Matteo Ferran Structural engineers is an appendix with this package.

C. The report “Environmental Hazardous Materials Survey_Rev.03” dated 06/11/2024 prepared by GHD is an appendix with this package.

D. The report “Seismic Evaluation Report” dated 12/19/2025 prepared by Matteo Ferran Structural Engineers is an appendix with this package.

E. In case of conflict between report and drawings or specifications, drawings and specifications govern.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 11 00

SECTION 01 26 01 – CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section consists of administrative and procedural requirements for contract modifications.

1.2 DEFINITIONS AND ALLOWANCES

A. Home Office Overhead: Costs incurred in support of all of a contractor's projects and not attributable to a specific job. The cost for home office overhead is only allowed as a percentage of all direct work excluding profit. The following items represent allowable home office overhead costs identified in Part 31 of the Federal Acquisition Regulation (FAR):

1. Rent
2. Utilities
3. Furnishings
4. Office equipment
5. Executive and management staff not exclusively assigned to the project
6. Support, accounting, and administrative staff
7. Preparation of cost proposals, estimating, and schedule analyses connected with Modifications
8. Estimating and preconstruction services
9. Mortgage costs
10. Real estate and corporate taxes
11. Automobile maintenance and travel costs for home office personnel
12. Home office insurances i.e. structure, automotive, umbrella, flood, etc.
13. Depreciation of equipment and other assets
14. Home office supplies (paper, staples, etc.)
15. Legal services
16. Accounting and data processing
17. Professional fees/registration

B. General Conditions (Field Office Overhead): Management and administrative costs incurred on site for the designated project. Costs associated with preparation of modifications will not be allowed. Costs for these items are to be included only in the general conditions of the modification estimate. Only in the case of a contract time extension are additional general conditions included in modifications. The following items, if applicable, are considered allowable costs for calculating General Conditions:

1. Project Manager (PM), Assistant Project Manager
2. Superintendent, Assistant Superintendent
3. Quality Control, Safety Officer, Environmental Manager, etc.
4. Engineers

5. Travel, lodging, and per diem (as established by Federal Travel Regulations)
6. Scheduling
7. Field Office Trailers and associated temporary utilities
8. Field office supplies

    a. Mailing and couriers
    b. Reproduction costs
    c. Storage
    d. Phones
    e. Computers
    f. Copiers

9. Personal vehicles i.e. Superintendent Pickup trucks

C. General Requirements: Costs directly associated with the project and are necessary to perform the actual work of the modification. These costs shall be shown as direct costs in the estimate. The following items, if applicable, are considered allowable costs for calculating General Requirements:

1. Hoisting
2. Material handling
3. Temporary fencing
4. Port-a-lets
5. Trash removal, dumpsters
6. Barricades
7. Small tools
8. Safety supplies
9. Scaffolding
10. Daily cleaning
11. Traffic control
12. Temporary signage
13. Temporary heating and power

D. Personnel Costs: Costs included in the modification must only be for General Conditions staff and workers actually present and working on project site. Modification costs for salaried workers are only allowed within the structure of a 40-hour week and no overtime or holiday pay will be allowed.

1. Worker Hourly Rates are costs directly associated with the individual worker and consist of the following:

    a. Base Rate: The hourly rate paid directly to the worker
    b. Labor Burden: Employer payments of all applicable burdens; includes insurance and taxes the business must pay on behalf of the worker to government entities and educational forums, such as:

        1) Social Security
        2) Medicare
        3) Workers Compensation – Policy and company calculation to be made available.
        4) Federal Unemployment Tax Act (FUTA) - Cap Rate and percentage to be proportionally allocated over one year.

5) State Unemployment Tax Act (SUTA) - Cap Rate and percentage to be proportionally allocated over one year.
6) Union agreement costs - Other costs required under an enforceable collective bargaining agreement.

c. Fringe Benefits: Various non-wage compensations provided to employees such as:

1) Health Care Insurance Premiums
2) Cell Phone
3) Clothing
4) 401K and Pensions
5) Vehicle allowances
6) Gas allowance
7) Life insurance premiums
8) Disability insurance
9) Other Fringe Benefits required under an enforceable collective bargaining agreement

E. Bonuses or Deferred Compensation: No Bonus or Deferred Compensation will be allowed within any components of pricing including Home Office Overhead, General Conditions, General Requirements, Hourly Worker Rates, or the direct costs of work.

F. General Liability Insurance: An insurance policy that protects Contractor from claims resulting from bodily injury or property damage to a third party. Include as a separate line item within all modification proposals and provide a current insurance quote upon request.

G. Performance and Payment Bonds: A performance bond is a surety bond issued by an insurance company or bank to guarantee satisfactory completion of a project. The Payment Bond guarantees the Contractor will pay the labor and material costs incurred. Banks and Insurance companies charge a premium for individual project based on a sliding scale related to the size of the project. Include as a separate line item in modification proposals and provide current company bonding rates upon request.

H. Builder's Risk Insurance: Covers the contractor's loss due to fire, high winds, or other natural forces. Not reimbursed by the National Park Service (NPS) and shall not be included in modification proposals.

1.3 MODIFICATION PROPOSAL PRICING REQUIREMENTS

A. General:

1. Proposal be received in the format and within the time frame specified in the Request for Proposal (RFP) letter. Costs or delays resulting from failure of contractor to submit within the time frame specified will not be compensable.
2. Proposal shall be detailed with itemized lists of equipment, materials, labor, production rates, overhead, profit, and bond markup for each item. Labor costs must be itemized by craft and hourly rate, including Fringe Benefits and Labor Burden. If the costs of Fringe Benefits and Labor Burden are not itemized, it is assumed they are included in the hourly rate shown, or contractor is not requesting reimbursement. Contractor may

utilize the government provided Contractor Estimate Form, or their own form, provided that it contains the same information and level of detail as the Government's form.

3. Requests for extensions of contract time as a result of change must be justified with a Time Impact Analysis (TIA). Refer to Section 01 32 16 "Construction Schedule", for time impact analysis requirements. TIA and associated costs shall be received with the proposal by the date shown within the Request for Proposal letter. Contractor's failure to submit within the specified time frame will be construed as the Contractor waiving right for additional time and no time extension will be allowed.
4. All supporting documentation used to justify the proposed modification will be made available to the Contracting Officer (CO) upon request.
5. Contractor shall review and approve all subcontractor/supplier pricing in detail for proper format, scope, production rates, and pricing prior to submission to NPS. All delay costs associated with not reviewing and approving subcontractor/supplier pricing will be borne by the Contractor.
6. All pricing and production rates within the estimate must be based on fair and reasonable pricing and cannot include built-in contingency.

B. Labor:

1. Contractor shall estimate cost of labor by itemizing each craft involved, indicating worker hourly rate (base rate + labor burden + fringe benefits) for each and itemizing hours required for each craft directly engaged in modification work. Any work proposed requiring overtime work or premium pay shall be itemized separately. Rates shall be in accordance with the Davis-Bacon Act as incorporated herein. Labor Burden may include payroll taxes, Social Security, unemployment insurances, workers compensation insurance, Federal Insurance Contributions Act (FICA), FUTA, and other direct costs resulting from Federal, State or local laws.
2. Itemize labor costs for equipment operators separate from equipment costs.
3. Labor cost for foremen shall only be costs for related work required for the modification.

C. Materials:

1. Estimated cost for materials shall include quotes from multiple sources. Material prices shall include applicable fees and credits, including but not limited to, sales tax, freight and delivery charges, and tax rebates.
2. No markup shall be applied to any material provided by NPS.

D. Equipment:

1. Equipment used for the project must be appropriately sized for work being performed.
2. Do not include costs for "miscellaneous tools and equipment", in your proposal for a replacement value of $500 or less. Costs shown in excess of $500 shall be broken out separately.
3. Regardless of ownership, rates to be used in determining equipment rental costs shall be the lowest cost from one of the following sources:

   a. United States (U.S.) Army Corps of Engineers, Ownership and Operating Expense Schedule (use latest edition and applicable region)
   b. Construction Blue Book

c. Local equipment rental rates, documented by actual invoice charges, or itemized vendor quotes.

4. Estimated equipment rates shall include operating costs of all fuel, oil, lubrication, supplies, small tools, necessary attachments, ground engaging components, tires and tracks, routine repairs and maintenance (cost of major repair and overhaul is not allowed per Federal Acquisition Regulation (FAR) 31.105(d)(2)), depreciation, storage, insurance, and all incidentals. Mobilization, if applicable, may be included for equipment solely used on the modification work but must be listed separately.
5. Estimate full rate for equipment only for duration that equipment will be utilized to accomplish work of the modification.
6. Standby unit rates used in accordance with paragraph 1.3, D, 2, above. If the U.S. Army Corp of Engineers is utilized then their standby rates prevail. If Bluebook or local equipment pricing is accepted, then 1/2 of equipment costs minus any operating costs, major repair and overhaul will be accepted.
7. If equipment is in standby mode due solely to a documented NPS delay, established standby rate shall apply from the first day of the delay.
8. Equipment not used and on job site for up to five consecutive days may be classified at standby rates, provided the equipment is or has been used solely to perform work on the modification and will be necessary to complete additional modification work. Equipment still on the jobsite but not in use after five consecutive days will not be considered in the modification pricing.
9. Requests for compensation for equipment stand by time must be justified, documented and itemized separately.
10. The estimated timeframe (daily, weekly, monthly) for use of the equipment must reflect the lowest cost to the Government.

E. Establishment and Application of Overhead and Profit Percentages:

1. Home Office Overhead and Profit (OH&P) shall be applied to direct costs only. Profit shall not be applied to overhead amounts; and overhead shall not be applied to profit. Home office overhead shall contain only allowable, allocable, and reasonable costs per the contract documents and FAR Part 31. Profit percentages are based on risk factors found in FAR Part 31which have been applied to the specific type of work included in this project. Negotiated rates shall not exceed the following percentages for OH&P for contractor self-performed work:

   Overhead……10%
   Profit……**8.75**%

2. Total aggregate limit of markup (OH&P) for Contractor and Subcontractors on modification work shall not exceed 25%. The NPS will not be responsible for allocation of percentages between contractor and subcontractors at any tier.
3. If Contractors form a partnership, partnership may only receive home office overhead and profit in same amount as an individual Contractor (refer to paragraph 1.3,E,1 above). It is the responsibility of the partners to decide on division of revenue.
4. Combined Increases and Decreases: On proposals involving both increases and decreases in the Contract Price, overhead and profit mark-ups are required on net increases and deducted on net decreases.
5. At no time can profit be calculated on Overhead or itself, it must be calculated on direct costs of work only.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 012601

SECTION 01 27 00 – DEFINITION OF CONTRACT LINE ITEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section explains in general, what is and is not included in a contract line item, and limits or cut-off points where one item ends and another begins.

B. If no contract line item exists for a portion of work, include costs in a related item.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 LIST OF CONTRACT LINE ITEMS

A. Contract Line Item Number 0001: Hangar Restoration.

1. This item consists of contractor general requirements including but not limited to, contractor trailer, construction fencing, etc.
2. Measurement for payment will be lump sum.
3. Payment will be made at the contract lump sum price.

END OF SECTION 01 27 00

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. Definitions
2. Construction Coordination
3. Submittals
4. Coordination Drawings
5. Requests for Information (RFIs)
6. NPS Project Management and Communication Software
7. Project Meetings
8. Environmental Coordination
9. Permits

B. Related Requirements:

1. Section 01 32 16 "Construction Schedule" for preparing and submitting Construction Contractor's construction schedule.
2. Section 01 73 40 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 01 77 00 "Closeout Procedures" for coordinating closeout of the Contract.

1.2 DEFINITIONS

A. Agency with Jurisdiction
B. Construction Permits – Contractor Provided
C. Government Furnished Permits

1.3 CONSTRUCTION COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, which depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

2. Coordinate installation of different components with other Construction Contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make provisions to accommodate items scheduled for later installation.
4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of components, including mechanical and electrical.
5. Properly plan construction operations to include permit requirements. Allow enough time to execute permit provisions to maintain work schedule, site visits, inspections, and reporting deadlines.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other Construction Contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to:

1. Preparation of Construction Contractor Construction Schedule
2. Preparation of the Schedule of Values
3. Installation and removal of temporary facilities and controls
4. Delivery and processing of submittals
5. Progress meetings
6. Permit requirements
7. Pre-installation conferences
8. Project closeout activities

1.4 SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of Contract Documents or standard printed data. Include following information, as applicable:

a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
b. Indicate dimensions shown on Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Contracting Officer (CO) for resolution of such conflicts.
c. Indicate space requirements for routine maintenance and anticipated replacement of components during the life of the installation.
d. Show location and size of access doors required for access to concealed dampers, valves, and controls.
e. Indicate required installation sequences.

2. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.
3. Follow **NPS DSC Electronic Drawing Standards.** See CAD/BIM (Computer Aided Design/Building Information Modeling) & Drafting Standards page > **DSC Requirements** section.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural, structural, mechanical, plumbing, fire-protection, fire-alarm, and electrical elements. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate sub-framing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work:

    a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    c. Fire-rated enclosures around ductwork.

7. Electrical Work:

    a. Runs of vertical and horizontal conduit 1-1/4 inches (32 millimeters) in diameter and larger.
    b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
    c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
    d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System:

    a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

9. Review: Contracting Officer will review coordination drawings to confirm Work is being coordinated; details of coordination are Construction Contractor's responsibility. If Contracting Officer determines coordination drawings are not prepared in scope or detail, or are otherwise deficient, Contracting Officer will inform Construction Contractor, who shall make changes and resubmit.

10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 33 23 "Submittal Procedures."

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following:

1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
2. File Submittal Format: Submit or post coordination drawing files using Portable Document Format (PDF) file format.

D. Division 1 documents:

1. Letter designating Project Superintendent
2. Construction Schedule
3. A Comprehensive Schedule of Values
4. Accident Prevention Plan
5. A List of Subcontractors for this project
6. Written statements from Subcontractors certifying compliance with applicable labor standard clauses.
7. Certificates of Insurance and Standard Form SF1413 for Contactor and all Subcontractors
8. Waste Management Plan
9. Quality Control Plan
10. Temporary Storm Water Pollution Prevention Plan (SWPP or UPPP)
11. Historic Preservation Treatment Plan (HPTP)
12. List of Required Construction Permits. Include the following information for each permit:
    a. Name of Permit
    b. Agency(ies) with Jurisdiction issuing the permit
    c. Information required from Government to complete permit application

E. Provide items listed to Contracting Officer at least one week prior to Pre-Construction Conference, or as directed by Contracting Officer.
1. Failure to submit items may result in:
    a. Construction conference may be cancelled, Notice to Proceed may not be issued, and Contracting Officer will consider other contractual remedies.
    b. Work shall not commence until written Notice to Proceed has been issued and Certificates of Insurance and SF1413 documents are received for Construction Contractor and all Subcontractors.

1.5 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of Contract Documents, Construction Contractor shall prepare and submit an RFI utilizing form created on NPS project management and communication software.

1. Contracting Officer will not respond to RFIs submitted by other entities controlled by Construction Contractor.
2. Coordinate and submit RFIs in a prompt manner to avoid delays in the work.

B. Content of RFI: Include detailed, legible description of item needing information or interpretation and the following:

1. RFI number, numbered sequentially
2. Date
3. RFI subject
4. Specification Section number and title and related paragraphs, as appropriate.
5. Drawing number and detail references, as appropriate.
6. Field dimensions and conditions, as appropriate.
7. Construction Contractor's suggested resolution: If suggested resolution impacts Contract Time or Contract Sum, Construction Contractor shall state impact in RFI.
8. Construction Contractor's signature
9. Requested date for response
10. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Form: Complete and submit on NPS project management and communication software.

D. Contracting Officer’s Action: Contracting Officer will review each RFI, determine action required, and respond. Contracting Officer will determine critical nature of each RFI and issue response accordingly.

1. The following are not considered to be RFIs and will receive no action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Construction Contractor's means and methods.
    d. Requests for coordination information already indicated in Contract Documents.
    e. Requests for adjustments in Contract Time or Contract Sum.
    f. Requests for interpretation of Architect's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.

2. Contracting Officer's action may include a request for additional information; time for response will date from time of receipt of additional information.
3. Contracting Officer's action on RFIs may result in need for a change to Contract Time or Contract Sum. All contract changes will be processed following terms and conditions of contract.

1.6 PROJECT MANAGEMENT AND COMMUNICATION SOFTWARE

A. Use to manage project communication and document sharing during contract period on:

1. Project directory
2. Project correspondence
3. Meeting agendas and minutes
4. Contract modifications forms and logs
5. RFI form and processing
6. Task and issue management
7. Photo documentation

8. Baseline schedule, schedule updates and calendar management
9. Submittal form and processing
10. Payment coordination documentation
11. Reminder and tracking functions
12. Archiving functions
13. Notification of submittal and RFI statuses and current responsible party
14. Permits and addendums

B. Some documents are not suitable to be shared using NPS project management and communication software. Documents containing Personal Identifying Information (PII) (i.e. certified payrolls) shall not be shared and shall be coordinated with project team as appropriate.

1.7 PROJECT MEETINGS

A. Preconstruction Conference: Before start of construction, Contracting Officer will arrange an on-site meeting with Construction Contractor. Meeting agenda will include the following as a minimum:

1. Roles & Responsibilities / Lines of Authority
2. Park rules and regulations
3. Jobsite Safety
4. Resolution of comments on required Division 1 documents
5. Coordination of Subcontractors
6. Labor law application
7. Modifications
8. Payments to Construction Contractor
9. Payroll reports
10. Contract time
11. Liquidated damages
12. Construction Contractor Performance Evaluation
13. Display of Hotline posters
14. Notice to proceed
15. Correspondence procedures
16. NPS project management and communication software
17. Acceptance/rejection of work
18. Progress meetings
19. Submittal procedures
20. NPS Final Accessibility Inspection
21. Environmental requirements
22. Permit requirements
23. As-constructed drawings/operation and maintenance (O&M) manuals.
24. Saturday, Sunday, holiday and night work.
25. Reference materials
26. Value engineering
27. Schedule of Values

B. Progress Meetings: Contracting Officer will schedule weekly meetings with Construction Contractor.

1. Attendees: In addition to Government Representatives, each Construction Contractor, Subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented. Participants at meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Meeting agenda will include:

    a. Approval of minutes of previous meetings
    b. Submittal status
    c. Review of off-site fabrication and delivery schedules.
    d. Requests for information (RFI) and other issues.
    e. Modifications
    f. Work in progress and projected.
        1) Status of required inspections (Special Inspections, Accessibility, etc.)
    g. Inspections of work in progress and projected (Special inspections, Accessibility, etc.)
    h. Construction Schedule update (provide updated Critical Path Method (CPM)).
    i. Status of Project Record Drawings and O&M manuals.
    j. Other business relating to work.
    k. Permit requirements

C. Preinstallation Conferences: Conduct at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend meeting. Advise Contracting Officer of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for particular activity under consideration, including requirements for:

    a. Contract Documents
    b. Options
    c. Related RFIs
    d. Related Change Orders
    e. Purchases
    f. Deliveries
    g. Submittals
    h. Review of mockups
    i. Possible conflicts
    j. Compatibility requirements
    k. Time schedules
    l. Weather limitations
    m. Manufacturer's written instructions
    n. Warranty requirements
    o. Compatibility of materials
    p. Acceptability of substrates
    q. Temporary facilities and controls
    r. Space and access limitations
    s. Regulations of agency(ies) with jurisdiction

t. Testing and inspecting requirements
u. Installation procedures
v. Coordination with other work
w. Required performance results
x. Protection of adjacent work
y. Protection of construction and personnel

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of Work and reconvene conference at earliest feasible date.

1.8 ENVIRONMENTAL COORDINATION

A. Construction Contractor's Environmental Manager: Designate on-site party responsible for overseeing Construction Contractor's conformance to environmental goals for project and implementing procedures for environmental protection.

1. Qualifications: Minimum 3 years Construction experience on projects of similar size and scope; with environmental procedures similar to this project; familiar with environmental regulations applicable to construction operations.
2. Responsibilities: Responsibilities shall include:

a. Compliance with applicable Federal, State, and local environmental regulations, including maintaining required documentation.
b. Implementation of Waste Management Plan (WMP).
c. Implementation of Indoor Air Quality (IAQ) Management Plan.
d. Implementation of Storm Water Pollution Prevention Plan (SWPPP).
e. Present overview of environmental issues and summarize site specific procedures relating to management plans at Preconstruction conference.
f. Training for Construction Contractor personnel in accordance with position requirements.
g. Monitoring and documentation of environmental procedures.

B. Perform project quality control in accordance with requirements specified in Related Sections, including:

1. Quality Requirements
2. Regulatory Requirements
3. Indoor Air Quality (IAQ) Management
4. Noise and Acoustics Management
5. Temporary Storm Water Pollution Prevention Environmental Management
6. Construction Waste Management

C. Construction Contractor's Environmental Training Program: Construction Contractor shall provide environmental training for workers performing work on project site. Training shall include:

1. Overview of environmental issues related to building industry.
2. Overview of environmental issues related to Project.
3. Review of site-specific procedures and management plans:

    a. Construction Waste Management
    b. Indoor Air Quality (IAQ) Management
    c. Noise and Acoustics Management
    d. Temporary Storm Water Pollution Prevention

4. Pollution Prevention (P2) practices: Submit evidence of familiarity with P2 practices.
5. Compliance with environmental regulations: As specified in Regulatory Requirements. Submit Construction Contractor 40 CFR (Code of Federal Regulations) employee training records upon request of Contracting Officer.

D. Provide documentation for environmental procedures as specified herein and in accordance with approved Waste Management Plan, IAQ Management Plan, and Storm Water Pollution Prevention Plan.

1.9 PERMITS

A. General:

1. Permits and Responsibilities: Construction Contractor shall, without additional expense to the Government, be responsible for obtaining necessary licenses and permits, and for complying with Federal, State and municipal laws, codes, and regulations applicable to the performance of the work. Construction Contractor shall also be responsible for damages to persons or property that occur as a result of Construction Contractor's fault or negligence; and for materials delivered and work performed until completion and acceptance of the work.
2. For the purpose of this contract, Construction Contractor will not be considered an agent of the Government. Construction Contractor shall comply with appropriate Federal, State and local laws.

B. Potential Permits: Permits listed below were identified during the design process as likely to be required based on typical means and methods of construction. The list is provided to assist Construction Contractor in determining which permits will be required for contract's chosen means and methods. The list shall not be considered complete; it is the Construction Contractors' responsibility to determine means and methods and obtain required permits. Construction Contractor shall obtain all permits required to legally conduct work.
1. Electrical Utility Hookup – **ConEdison.**
2. Sewer Hookup – **NYDEP.**
3. New Water Meter – **NYDEP.**
4. Construction trailer, Utilities hookup permit – **ConEdison, NYDEP.**
5. New Stationary Air Pollution Source – **NYDEP.**
6. Stormwater Pollution Prevention Permit - **NYDEP**
7. MS4 Stormwater Permit - **NYDEP**

C. Coordination with Agency(ies) with Jurisdiction Issuing Permits

1. Coordination: Contact the Agency(ies) with Jurisdiction as needed and sufficiently in advance to avoid delaying work: Coordinate meetings, reporting requirements, inspections, and other requirements.

D. Administrative Procedures:

1. Coordinate scheduling and timing of required administrative provisions of project permits with Agency(ies) with Jurisdiction, Construction Manager, and Park to avoid conflicts.
2. Supply needed information to Agency(ies) with Jurisdiction issuing permits, pay fees required and provide material needed to comply with permit's conditions and provisions.
3. Upload permits to NPS project management and communication software when permits are obtained.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

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SECTION 01 32 16 – CONSTRUCTION SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

A. Section consists of Construction Schedule requirements including:

1. Schedule of Values
2. Construction Schedule Requirements.
3. Construction Schedule Updates.
4. Time Impact Analysis.

B. Purpose: The Construction Schedule ensures adequate planning, coordination, scheduling, and reporting during execution of the work by the Construction Contractor. It shall assist the Construction Contractor and Contracting Officer (CO) in monitoring the progress of the work, evaluating proposed changes, and processing Construction Contractor's monthly progress payments. It shall include the dates in the contract, phases, milestones, occupancies, holidays, weather consideration, a critical path, and the requirements of this section.

1.2 DEFINITIONS

A. Activity: A discrete part of a project identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical activities are activities on the critical path. They start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: Allocation of the Schedule of Values for completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by the Contracting Officer.

C. Critical Path Method (CPM): Method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

D. Critical Path: Longest connected chain of interdependent activities through the network schedule that establishes minimum overall Project duration and contains no float.

E. Float: Measure of leeway in starting and completing an activity.

1. Float: Not for the exclusive use or benefit of the Government or Construction Contractor but is jointly owned.
2. Free Float: Amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total Float: Measure of leeway in starting or completing an activity without adversely affecting planned Project completion date.

F. Resource Loading: Allocation of manpower and equipment necessary for completion of an activity as scheduled.

G. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

1.3 SUBMITTALS

A. Electronic Copies: Schedules and reports submitted shall be posted on the NPS project management and communication software as PDF (portable document format) files. The intent of the Government is to limit the number of printed reports to those determined by the project team as essential.

B. Schedule of Values: After contract award and before Pre-Construction conference, submit schedule of dollar values based on Contract Price Schedule.

C. Construction Baseline Schedule: After contract award and before Pre-Construction conference, submit two paper copies of baseline schedule, large enough to show entire schedule for entire construction period. Utilize Schedule of Values in preparation of Construction Baseline Schedule.

D. Critical Path Method (CPM) Reports: Concurrent with CPM schedule, submit three paper copies of the following computer-generated reports. For each activity, include activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of predecessor and successor tasks for activities sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of activities sorted in ascending order of total float.

E. Construction Schedule Updates: On or before 7th day preceding progress payment request date, submit estimates of percent completion of each schedule activity and necessary supporting data. Provide two paper copies.

F. Construction Schedule Revisions and Time Impact Analysis: For each Construction Schedule revision, submit two paper copies of a Time Impact Analysis. Incorporate a Fragmentary Network (Fragnet) into currently accepted Construction Schedule demonstrating proposal to incorporate a modification, change, delay, or Construction Contractor request.

1.4 QUALITY ASSURANCE

A. Construction Contractor shall meet with Contracting Officer on day of the preconstruction conference to go over:

1. Review software limitations, content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including work stages, area separations, interim milestones, and substantial completions.
4. Review schedule for work of separate Government contracts.
5. Review time required for review of submittals and re-submittals.
6. Review requirements for tests and inspections by independent testing and inspecting agencies.
7. Review time required for completion and startup procedures.
8. Review time required for obtaining and activating permits.
9. Review and finalize list of construction activities to be included in schedule.
10. Review baseline schedule comments, resolve issues and progress on incorporating them
11. Review procedures for updating schedule.
12. Discuss reporting requirements and establish protocol for naming and transmitting electronic schedules.

B. Construction Contractor's Schedule Representative: Before the preconstruction conference, designate an authorized representative to be responsible for preparing and maintaining the Construction Schedule. Submit resume outlining qualifications of Scheduler to Contracting Officer for acceptance. Scheduler shall have prepared and maintained at least 5 previous schedules of similar size and complexity similar to this Contract, demonstrating proficiency of using scheduling software. Authorized representative will be responsible for preparing the Baseline Schedule, required updates, revisions, Time Impact Analyses, and reports.

1.5 COORDINATION

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

B. Coordinate Construction Baseline Schedule with Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

1. In developing Construction Baseline Schedule, ensure Subcontractor’s work at all tiers, and prime Construction Contractor’s work, is included and coordinated.
2. Secure time commitments for performing critical elements of work from parties involved.
3. Coordinate each construction activity in network with other activities and schedule in proper sequence.

PART 2 - PRODUCTS

2.1 SCHEDULE OF VALUES

A. Breakdown each lump-sum item into component work activities used in the schedule for which progress payments may be requested. Work activities broken out within schedule of values shall be integrated into and made a logical part of the construction baseline schedule. Total costs for the component work activities shall equal contract price for that lump-sum item. Contracting Officer may request data to verify accuracy of dollar values. Include mobilization, general condition costs, overhead and profit in the total dollar value of unit price items and in the component work activities for each lump-sum item. Do not include mobilization, general condition costs, overhead or profit as a separate item.

B. Do not break down unit price items. Use only the contract price for unit price items.

C. Total cost of all items shall equal the contract price. The Schedule of Values will form the basis for progress payments and the Construction Schedule.

2.2 CONSTRUCTION SCHEDULE REQUIREMENTS

A. Construction Baseline Schedule: Prepare Construction Baseline Schedule using a computerized, cost and resource-based**,** time-scaled Critical Path Method network analysis diagram for the Work.

1. Develop and finalize Construction Baseline Schedule so it can be accepted for use no later than 30 days after date established for the Notice of Award.

    a. Failure to include any work item required for performance of this Contract shall not excuse Construction Contractor from completing work within applicable completion dates, regardless of Governments acceptance of schedule.

2. Establish procedures for monitoring and updating Construction Baseline Schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.

B. Construction Baseline Schedule Preparation: Prepare a list of all activities required to complete the Work. Using preliminary Critical Path Method network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate estimated duration, sequence requirements, and relationship of each activity in relation to other activities.
2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the Critical Path Method schedule within the limitations of the Contract Time.

4. Show sequence and interdependence of activities required for completion of work. Ensure work sequences are logical and Construction Baseline Schedule shows a coordinated plan of the work.
5. Resource loading of each activity shall include personnel by labor category and equipment type and capacity proposed to complete the activity in duration shown.
6. Consider seasonal weather conditions in planning and scheduling work influenced by high and low ambient temperatures, wind, or precipitation to ensure completion of work within contract time.
7. Time Frame: Proposed duration assigned to each activity shall be Construction Contractor's best estimate of time required to complete activity considering the scope and resources planned for activity.

    a. An early finish date may be shown but the late finish date shall be same date as last day of contract period. An early completion schedule shall contain:

        1) Insert an activity titled "Project Float" as a successor to last activity in early project completion schedule network.
        2) Add a milestone titled "Contract End Date" as a successor to the activity "Project Float".
        3) Add duration to the activity "Project Float" as required so the milestone "Contract End Date" equals the last day of Contract Period.

    b. Contract completion date shall not be changed by submission of a schedule that shows an early completion date.
    c. Construction Contractor shall limit use of lead or lag duration’s between schedule activities.
    d. Project Calendars: Develop and incorporate the following calendars:

        1) Administrative Calendar: Include calendar based on a 7-day week to be used on activities based on calendar days. Apply this calendar to administrative tasks or other tasks not affected by non-working days (Federal Holidays, weather, etc.).
        2) Project Calendar: Include calendar based on planned work week for the project. Include Federal Holidays, weekends, and non-workdays indicated in contract documents. Apply this calendar to activities not anticipated to be affected by weather. Be clear when identifying number of work days in work week.
        3) Weather Calendar: Utilize Project Calendar and show anticipated normal downtime related to weather as non-working time. Weather days shall be based on data for local area from a reliable source like the National Oceanic and Atmospheric Administration (NOAA), National Park Service records, or source acceptable to Contracting Officer. Apply this calendar to activities anticipated to be affected by weather.

    e. Activity Duration: Define so no activity is longer than 14 days, except for non-construction activities including mobilization, shop drawings and submittals, fabrication and delivery of materials and equipment.
    f. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 calendar days, as separate activities in the schedule. Procurement cycle activities can include submittals, approvals, purchasing, fabrication, and delivery.

1) Electrical equipment.

g. Submittal Review Time: Include review and re-submittal times indicated. Coordinate submittal review times in Construction Baseline Schedule.
h. Startup and Testing Time: Include not less than 7 days for startup and testing and commissioning activities.
i. Substantial Completion: Allow time for Government administrative procedures necessary for certification of Substantial Completion. (For more information, refer to Specification 01 77 00 "Closeout Procedures.")

8. Constraints: Include constraints and work restrictions indicated in Contract Documents and as follows in schedule and show how the sequence of Work is affected.

a. Work Restrictions: Show effect of the following on the schedule:

1) Coordination with existing construction
2) Uninterruptible services
3) Use of premises restrictions
4) Provisions for future construction
5) Seasonal variations
6) Environmental control
7) Permit provisions

b. Work Stages: Indicate important stages of construction for each major portion of the Work.

1) Subcontract awards
2) Submittals
3) Purchases
4) Mockups
5) Fabrication
6) Sample testing
7) Deliveries
8) Installation
9) Tests and inspections
10) Adjusting
11) Curing
12) Building flush-out.
13) Building commissioning activities.

~~9.~~ Milestones: Include milestones indicated in Contract Documents in schedule, including, but not limited to, Notice to Proceed, Substantial Completion.

C. Joint Review, Revision, and Acceptance:

1. Within seven calendar days of receiving Construction Contractor's proposed Construction Baseline Schedule, Contracting Officer shall review initial Construction Baseline Schedule.
2. Within seven calendar days after review, Construction Contractor shall revise and resubmit Construction Baseline Schedule in accordance with comments presented from review.

3. In the event the Construction Contractor fails to define any element of work, activity, or logic and the Contracting Officer review does not detect this omission or error, such omission or error, when discovered by Construction Contractor or Contracting Officer, shall be corrected by Construction Contractor within seven calendar days and shall not affect contract period.
4. Upon acceptance of the Construction Baseline Schedule, Contracting Officer saves schedule as a baseline and updates on a monthly basis. Construction schedule update will be used to evaluate Construction Contractor's monthly applications for payment based upon information developed at monthly Construction Schedule update meeting.

D. Cost Correlation: In the heading of the schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of Work performed as of dates used to prepare payment requests.

1. Construction Contractor shall assign cost to construction activities on Construction Baseline Schedule. Costs shall not be assigned to submittal activities unless specified otherwise but may, with Contracting Officer's approval, be assigned to fabrication and delivery activities. Costs shall be included for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project Record Documents, and demonstration and training (if applicable).
2. Each activity cost shall reflect an accurate value based on the Contract Price Schedule.
3. Total cost assigned to activities shall equal total Contract Price.

E. Recovery Schedule: When periodic schedule update indicates Work is 14 or more calendar days behind current accepted schedule, a separate recovery schedule indicating means by which Construction Contractor intends to regain compliance with the schedule shall also be submitted. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery shall be accomplished.

F. Computer Software: Prepare schedules using a program developed specifically to manage construction schedules.

PART 3 - EXECUTION

3.1 CONSTRUCTION SCHEDULE UPDATES

A. Progress Meeting Updates: Provide a 2 week look-ahead schedule, derived from the currently accepted schedule, before each weekly progress meeting. Utilize look-ahead schedule to facilitate and take notes on discussions held during progress meeting.

B. Monthly Schedule Updates:

1. General: Update Construction Schedule on monthly basis to reflect construction progress and activities throughout entire contract period and until project substantial completion. The status date of each schedule update shall be the 7th day preceding the progress payment request date.
2. Procedure: Construction Contractor shall meet with Contracting Officer each month at Construction Schedule update meeting to review progress made through the status date of

the Construction Schedule update, including dates activities were started or completed and percentage of work completed on each activity started or completed.

3. Reports: Concurrent schedule revisions, prepare tabulated reports showing:

    a. Identification of activities that have changed
    b. Changes in early and late start dates
    c. Changes in early and late finish dates
    d. Changes in activity durations in workdays
    e. Changes in the critical path
    f. Changes in total float or slack time
    g. Changes in the Contract Time

4. Narrative: Report shall include a brief description of actual progress made during update period; actual and potential delaying activities; impediments to progress; issues related to inclement weather; progress toward established milestones and project float. Report shall include a brief description of work anticipated to be performed in the next month. Minor revisions to the schedule should be identified for evaluation and acceptance or rejection.
5. As Work progresses, indicate Actual Completion percentage for each activity.
6. If schedule update shows a late finish date after contract completion date, include:

    a. Known delays
    b. Actions to get back on schedule
    c. Pending modifications
    d. Impediments or constraints affecting progress

7. Progress Payments: Monthly updating of the currently accepted Construction Schedule shall be an integral part of the process upon which progress payments will be made. If Construction Contractor fails to provide schedule updates or revisions, a portion of the monthly payment may be retained until corrections have been made.

C. Distribution: Distribute copies of accepted schedule to Contracting Officer, Contracting Officers Representative, Construction Management Representative, Subcontractors, testing and inspecting agencies, and other parties identified by Construction Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to same parties and post in same locations. Delete parties from distribution when they have completed their assigned portion of the Work.

D. Construction Schedule Revisions:

1. Required Revisions: If, as a result of the monthly schedule update, it appears the currently accepted Construction Schedule no longer represents actual prosecution and progress of the work, Contracting Officer will request, and Construction Contractor shall submit, a revision to the Construction Schedule. Construction Contractor may also request reasonable revisions to currently accepted Construction Schedule in event the Construction Contractor's planning for the work is revised. If Construction Contractor desires to make changes, Construction Contractor shall notify Contracting Officer in writing, stating reason for proposed revision. Accepted revisions shall be incorporated into currently accepted Construction Schedule for next monthly schedule update.

2. Procedure: If revision to currently accepted Construction Schedule is contemplated, Construction Contractor or Contracting Officer shall advise the other in writing at least seven calendar days prior to next monthly schedule update meeting, describing revision and reasons for the revision. Government-requested revisions will be presented in writing to the Construction Contractor, who shall respond in writing within seven calendar days.
3. Reports: Concurrent with making revisions to schedule, prepare tabulated reports showing:

    a. Identification of activities changed
    b. Changes in early and late start dates
    c. Changes in early and late finish dates
    d. Changes in activity durations in workdays
    e. Changes in critical path
    f. Changes in total float or slack time

3.2 TIME IMPACT ANALYSIS FOR CONTRACT MODIFICATIONS CHANGES DELAYS AND CONSTRUCTION CONTRACTOR REQUESTS:

1. Requirements: When contract modifications or changes are initiated, delays experienced, or Construction Contractor desires to revise currently accepted Construction Schedule, Construction Contractor shall submit to Contracting Officer a written time impact analysis illustrating the influence of modification, change, delay, or Construction Contractor request on contract time.
2. Time Extensions: Activity delays, resulting in a late completion date projection, shall not automatically mean an extension of contract time is warranted or due to Construction Contractor. It is possible a modification, change, or delay will not affect existing critical path activities or cause non-critical activities to become critical. A modification, change, or delay may result in absorbing a part of available total float that may exist within an activity chain of the Schedule, not causing any effect on contract time. Time extensions will be granted in accordance with terms of contract.
3. Extension of contract time will be granted only to the extent the equitable time adjustments to activity or activities affected by modification, change, or delay exceeds total (positive or zero) float available on a particular activity.
4. Procedure: Each time impact analysis shall be submitted within time period stated in a request for proposal, or time period designated under the clauses entitled Changes or Default. In cases where Construction Contractor does not submit a written request for extension of time and a time impact analysis within the designated time, it is mutually agreed that the particular modification, change, delay, or Construction Contractor request does not require an extension of the contract time. Upon acceptance, time impact analysis shall be incorporated into currently accepted Construction Schedule at next monthly schedule update.
5. Contract Modifications: Prepare time-impact analysis using fragnets to demonstrate effect of proposed change on overall Construction Schedule for each proposed contract modification concurrent with submission.

END OF SECTION 01 32 16

SECTION 01 32 33 – PHOTO DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for:

1. Existing condition images
2. Periodic construction images

B. See Section 01 77 00 "Closeout Procedures" for a complete listing of closeout documents.

C. See Section 01 79 00 "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of National Park Service (NPS) personnel.

1.2 SUBMITTALS

A. Construction Images: Submit images electronically within three days of taking the image. Include:

1. Date, time and number (sequentially number all images) in filename.
2. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
3. Submit digital images exactly as originally recorded in digital camera, without alteration, or modifications using image-editing software.

B. Closeout: Submit complete set of digital image electronic files as a Project Record Document**.** Submit on Digital Video Disc (DVD).

1. Provide index as separate file on Disc. List each image as a file name with number, date, and time. Include description and or vantage point image was taken.
2. Submit images that have the same aspect ratio as the sensor, un-cropped.

PART 2 - PRODUCTS

2.1 FORMAT REQUIREMENTS

A. Media: DVD-R Archival Gold

B. Media Labels: Archival DVD labeling markers, archival labels, or direct print.

C. Images: Provide sRGB (standard Red Green Blue) color images in JPEG (Joint Photographic Experts Group) format. Minimum sensor size of 8 megapixels, and at image resolution of not less than 3200 by 2400, and 300 dpi (dots per inch).

PART 3 - EXECUTION

3.1 CONSTRUCTION IMAGES

A. General: Take digital images using the maximum range of depth of field, in-focus, to clearly show the Work. No blurry or out-of-focus areas accepted.

1. Maintain index with each set of Construction images and identify the number, date, time, and description for each.
2. Maintain one set of images accessible in field office at Project site available for reference.

B. Existing Condition Images: Before commencement of demolition and starting construction, take color digital images of Project site and surrounding properties, including existing items to remain during construction, from different vantage points.

1. Flag construction limits before recording construction images.
2. Take twelve exterior and twelve interior images to show existing conditions adjacent to property before starting Work.
3. Take eight separate images of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.

C. Periodic Construction Images: Take 12 color, digital images weekly, with cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last images were taken.

D. Additional Images: Contracting Officer may issue requests for additional images.

1. Three days advance, where feasible.
2. In emergency situations, take additional images within 24 hours of request.
3. Additional images include, but are not limited to:

a. Immediate follow-up when on-site events result in construction damage or losses.
b. Fabrication locations away from Project site.
c. Substantial Completion of a major phase or component of Work.
d. Extra record images at time of final acceptance.

END OF SECTION 01 32 33

SECTION 01 33 23 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

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

B. Informational Submittals: Written information that does not require Government's responsive action. Submittals may be rejected for not complying with requirements.

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.3 GENERAL SUBMITTAL PROCEDURES

A. General: Prepare and submit submittals required by individual Specification Sections and in some cases as requested in drawings. Types of submittals are indicated in individual specific sections.

1. Contracting Officer (CO) reserves right to require submittals in addition to those called for in individual sections.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Review for legibility, accuracy, completeness, and compliance with Contract Documents.

1. Coordinate submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related parts of Work so processing will not be delayed because of need for concurrent review coordination.

a. Contracting Officer reserves right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Submittal List: Submittal list is attached to the end of this Specification Section. The intent is to provide an overall summary of submittal requirements. The requirements of individual Specification Sections and terms and conditions of the Contract still apply regardless of what is shown on submittal list.

D. Processing Time: Allow enough time for submittal review and re-submittals. Contract time extensions will not be authorized if submittals are not transmitted with enough time to permit processing, including re-submittals.

1. Action Submittals

a. Initial Review: Allow 30 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required.
b. Re-submittal Review: Allow 15 days for review of each re-submittal.

2. Informational submittals

a. Review: Allow 10 days for review of each submittal.

E. Approved Equal Submittal Requirements:

1. For each item proposed, submit supporting data, including:

a. Drawings and samples as appropriate.
b. Comparison of the salient characteristics of the proposed item with that specified.
c. Changes required in other elements of the work because of the substitution.
d. Name, address, and telephone number of vendor.
e. Manufacturer's literature regarding installation, operation, and maintenance, including schematics for electrical and hydraulic systems, lubrication requirements, and parts lists. Describe availability of maintenance service, and state source of replacement materials.

2. A request for approval constitutes a representation that Construction Contractor:

a. Has investigated the proposed item and determined that it is equal or superior in all respects to that specified.
b. Will provide the same warranties for the proposed item as for the item specified.
c. Has determined that the proposed item is compatible with interfacing items.
d. Will coordinate installation of an approved item and make changes required in other elements of the work because of the substitution.
e. Waives claims for additional expenses that may be incurred as a result of the substitution.

F. Submittals: Identify and incorporate information in each submittal file as follows:

1. Transmittal Form (CM-16): Utilize NPS Transmittal Form for all submittals. No action will be taken on a submittal item unless accompanied by this Transmittal Form.

2. Physical samples: Complete Transmittal Form and deliver physical sample to the Contracting Officer (or designee) on site for processing. All comments and actions will be documented on the Transmittal Form.

G. Identification: Submittal number or other unique identifier, including revision identifier.

1. Submittal number shall use a sequential number (e.g. .001). Re-submittals shall include alphabetic suffix after another decimal point (e.g. .001.A).

H. Re-submittals: Make re-submittals using same process used with initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in the title block on the Transmittal Form (CM-16) and clearly indicate extent of revision.
3. Re-submit submittals until they are marked "Approved" or "Approved with notations".

I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, and others as necessary for performance of construction activities.

J. Use for Construction: Use only final submittals with mark indicating "Approved" or "Approved with notations". Ensure notations have been incorporated and, at a minimum, keep one copy of final approved submittal on site for use during construction.

1.4 CONSTRUCTION CONTRACTOR'S USE OF CAD/BIM FILES

A. General: At Construction Contractor's written request, copies of CAD/BIM (Computer Aided Design/Building Information Modeling) files will be provided to Construction Contractor for use in connection with Project, subject to:

1. Files provided as is; no format or other changes to files or changes to objects in the drawing will be done by the Government.

2. Files are not to be used directly for dimensioning from, creating shop drawings, or any other design work.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each submittal to show which products and options are applicable.
3. As applicable, include:

a. Manufacturer's product specifications.

b. Manufacturer's installation instructions: When Contract Documents require compliance with manufacturer's printed instructions, provide one complete set of instructions to Contracting Officer and keep another complete set of instructions at the project site until substantial completion.
c. Manufacturer's catalog cuts: Submit only pertinent pages; mark each page of standard printed data to identify specific products proposed for use.
d. Wiring diagrams showing factory-installed wiring.
e. Printed performance curves.
f. Operational range diagrams.
g. Compliance with specified referenced standards.
h. Testing by recognized testing agency.

4. Submit product data in PDF (portable document format) file format before or concurrent with samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data as noted in section 1.4.A.2 above.

1. Preparation: Fully illustrate requirements in Contract Documents. As applicable, include:

a. Dimensions
b. Identification of products
c. Fabrication and installation drawings
d. Roughing-in and setting diagrams
e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring
f. Shopwork manufacturing instructions
g. Templates and patterns
h. Schedules
i. Notation of coordination requirements
j. Notation of dimensions established by field measurement
k. Relationship to adjoining construction clearly indicated
l. Seal and signature of professional engineer if specified
m. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring

2. Submit shop drawings as PDF electronic file

C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Complete and post the Transmittal Form (CM-16) on the NPS project management and communication software website for processing and documentation of action on submitted samples.
3. Identification: Attach label on unexposed side of Samples that includes:

a. Generic description of Sample
b. Product name and name of manufacturer

c. Sample source
d. Submittal Number and title of appropriate Specification Section

4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing full range of colors, textures, and patterns available.

   a. Number of Samples: Submit two full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Contracting Officer will return with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

   a. Number of Samples: Submit four sets of Samples. Contracting Officer will retain three Sample sets; remainder will be returned. Retain Sample set as a Project Record Sample.

D. Construction Materials: Construction Contractor is encouraged to submit products made out of recycled or environmentally responsible material. Every effort will be made by NPS to approve these materials.

2.2 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by individual Specification Sections.

1. Post informational submittals as PDF electronic files directly to the NPS project management and communication software.
2. Certificates and Certifications: Provide a notarized statement with signature of entity responsible for preparing certification. Certificates and certifications shall be signed by officer or other individual authorized to sign documents on behalf of that entity.
3. Informational submittals that do not comply with requirements specified in Contract Documents will be rejected and one copy will be returned.

B. Coordination Drawings: Comply with requirements specified in Section 01 31 00 "Project Management and Coordination."

C. Construction Contractors Construction Schedule: Comply with requirements specified in Section 01 32 16 "Construction Schedule."

D. Accident Prevention Plan: Comply with requirements specified in Section 01 35 23 "Safety Requirements."

E. Schedule of Values: Comply with requirements specified in Section 01 32 16 "Construction Schedule."

F. Waste Recycling Plan: Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."

G. Quality Control Plan: Comply with requirements specified in Section 01 40 00 "Quality Requirements."

H. Storm Water Pollution Prevention Plan: Comply with requirements specified in Section 01 57 23 "Temporary Storm Water Pollution Prevention" and storm water permit requirements identified in Section 01 31 00 "Project Management and Coordination."

I. Indoor Air Quality Management Plan: Comply with requirements specified in Section 01 57 19.11 "Indoor Air Quality Management."

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

K. Welding Certificates: Prepare written certification that welding procedures and personnel comply with Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on American Welding Society (AWS) forms. Include names of firms and personnel certified.

L. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying Installer complies with Contract Documents and, where required, is authorized by manufacturer for this specific Project.

M. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying manufacturer complies with Contract Documents. Include evidence of manufacturing experience where required.

N. Product Certificates: Prepare written statements on manufacturer's letterhead certifying product complies with Contract Documents.

O. Material Certificates: Prepare written statements on manufacturer's letterhead certifying material complies with Contract Documents.

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

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

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

S. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in Contract Documents.

T. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

U. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in Contract Documents.

V. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Section 01 78 23 "Operation and Maintenance Data."

W. Design Data: Prepare written and graphic information, including: performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

X. Manufacturer's Instructions: Prepare written or published information documenting manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer.

Y. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. As applicable, include:

1. Statement on condition of substrates and their acceptability for installation of product.
2. Summary of installation procedures being followed, compliance with requirements and, if not, what corrective action was taken.
3. Results of operational and other tests and a statement of whether observed performance complies with the requirements.

Z. Permit Compliance Products: Prepare required information for compliance with permit provisions. Products include written notification of project startup, suspension, and completion of work; photo documentation of site conditions; reports; and drawings.

PART 3 - EXECUTION

3.1 CONSTRUCTION CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of Contract and for compliance with Contract Documents. Note corrections and field dimensions.

3.2 CONTRACTING OFFICER'S ACTION

A. General: Submittals will be disapproved without technical review if identification information is missing, not filled in, or if placed on back of submittal; an incorrect format of submittals is provided; transmittal form is incorrectly filled out; submittals are not coordinated; or submittals do not show evidence of Construction Contractor's approval.

   1. Any work done or orders for materials or services placed before approval shall be at Construction Contractor's own risk.

B. Action Submittals: Contracting Officer will review each submittal, generate comments on corrections or modifications required, and indicate appropriate action on the Transmittal Form (CM-16). Submittal will be marked as defined below:

   1. APPROVED: Acceptable with no corrections.
   2. APPROVED WITH NOTATIONS: Minor corrections or clarifications required. Comments are clear and no further review is required. Construction Contractor shall address review comments when proceeding with the work.
   3. DISAPPROVED - RESUBMIT: Rejected as not in accordance with the contract or as requiring major corrections or clarifications. Contracting Officer will identify reasons for disapproval. Construction Contractor shall revise and resubmit with changes clearly identified.

C. Informational Submittals: Contracting Officer will review each submittal and will either accept or reject it.

D. Partial submittals are not acceptable, will be considered non-responsive, and will be returned without review.

END OF SECTION 01 33 23

Submittal List with Review Estimate Template

National Park Service (NPS) - Denver Service Center (DSC) | 1-27-21

SUBMITTAL LIST

Park Acronym/Project Management Information System (PMIS) Number: **GATE 308504**

Project Title: **HANGARS 3 & 4 REHABILITATION**

ACTION SUBMITTAL REVIEW ESTIMATE

(Complete this portion for Architect / Engineer (A/E) construction service task order negotiation.)

SUBMITTAL			REQUIREMENTS (Indicate with **X**)								ARCHITECT / ENGINEER REVIEW TIME (Indicate in whole or partial hours.)							
			INFORMATIONAL				ACTION											
SPECIFICATION SECTION	PARAGRAPH NUMBER	DESCRIPTION	CERTIFICATIONS OR LABORATORY TESTS	REPORTS OR CALCULATIONS OR PLAN	MANUFACTURER DATA AND INSTRUCTIONS	OTHER	SAMPLES	SHOP DRAWINGS	MANUFACTURER DATA AND INSTRUCTIONS	OTHER	ARCHITECT	CIVIL ENGINEER	STRUCTURAL ENGINEER	MECHANICAL ENGINEER	ELECTRICAL ENGINEER	PLUMBING ENGINEER	PROJECT MANAGER COORDINATION	HAZMAT ENGINEER
01 31 00	1.4.D.1	Letter Designating Project Superintendent				X											1	
01 31 00	1.4.D.5	List of Subcontractors				X											1	
01 31 00	1.4.D.6	Written statements from Subcontractors certifying compliance				X											1	
01 31 00	1.4.D.7	Certificates of Insurance, Standard form SF1413	X														1	
01 31 00	1.4.D.12	List of Required Construction Permits				X											1	
01 32 16	1.3.B	Schedule of Values		X													1	
01 32 16	1.3.C	Construction Baseline Schedule		X													1	
01 32 16	1.3.D	Critical Path Method (CPM) Reports		X													1	
01 32 16	1.3.E	Construction Schedule Updates (Ongoing)		X													1	
01 32 16	1.3.F	Construction Schedule Revisions and Time Impact Analysis (Ongoing)		X													1	
01 32 33	1.2.A	Construction Images (Ongoing)				X											1	
01 35 13.22	1.3.A	Daily Work Schedule (ongoing)		X													1	
01 35 23	1.3.A	Accident Prevention Plan		X													1	
01 35 91	1.3.A	Historic Preservation Treatment Plan (HPTP)		X													1	
01 35 91	1.3.B	Alternative Methods and Materials				X											1	
01 35 91	1.3.C	Photographs or Video				X											1	
01 40 00	1.4.A	Quality Control Plan		X													1	
01 40 00	1.4.C	Contractor Quality Control (CQC) Daily Reports (Ongoing)		X													1	

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01 40 00	1.4.E	Accessibility Inspection Report		X													1	
01 56 39	1.6.A	Product Data							X		1	2					1	
01 56 39	1.6.B	Shop Drawings						X			1	4					1	
01 56 39	1.6.C	Samples					X				1	2					1	
01 56 39	1.6.D	Tree Preservation Schedule								X	1	2					1	
01 56 39	1.7.A	Qualification Data			X						1	1					1	
01 56 39	1.7.B	Arborist Certification	X								1	1					1	
01 56 39	1.7.C	Maintenance Recommendations			X						1	1					1	
01 56 39	1.7.D	Existing Conditions Documentation				X					1	1					1	
01 56 39	1.7.E	Quality Control Program		X							1	1					1	
01 57 23	1.3.A	Temporary Storm Water Pollution Prevention Plan (UPPP)		X							1	2					1	
01 57 23	1.3.B	Inspection Schedule - Pollution Prevention		X							1	1					1	
01 57 23	1.3.C	Inspection Schedule - Storm Water Pollution Prevention		X							1	1					1	
01 57 23	1.3.D	Erosion Control Products			X						1	1					1	
01 73 40	1.2.A	Certificates	X								1	1					1	
01 73 40	1.2.B	Landfill Receipts				X					1	1					1	
01 73 40	1.2.C	Certified Surveys				X					1	1					1	
01 73 40	1.2.D	Quantity Surveys				X					1	1					1	
01 74 19	1.4.A	Waste Management Plan		X							1	2					1	
01 74 19	1.4.B	Qualification Data		X							1	1					1	
01 74 19	1.4.C	Statement of Refrigerant Recovery	X								1	1					1	
01 74 19	1.4.D	Progress Payment Requirements				X					1	1					1	
											1	1					1	

SUBMITTAL LIST

Park Acronym/Project Management Information System (PMIS) Number: **GATE 308504**

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			INFORMATIONAL				ACTION											
SPECIFICATION SECTION	PARAGRAPH NUMBER	DESCRIPTION	CERTIFICATIONS OR LABORATORY TESTS	REPORTS OR CALCULATIONS OR PLAN	MANUFACTURER DATA AND INSTRUCTIONS	OTHER	SAMPLES	SHOP DRAWINGS	MANUFACTURER DATA AND INSTRUCTIONS	OTHER	ARCHITECT	CIVIL ENGINEER	STRUCTURAL ENGINEER	MECHANICAL ENGINEER	ELECTRICAL ENGINEER	PLUMBING ENGINEER	PROJECT MANAGER COORDINATION	HAZMAT ENGINEER
02 41 00	1.04.A	Site Plan		X							2	1					1	
02 41 00	1.04.B	Demolition Plan		X							2	1	1	1	1	1	1	
02 82 13	1.9.B	Affidavits				X					1						1	1
02 82 13	1.9.C	Notification of Asbestos Removal				X					1						1	1
02 82 13	1.9.E	Hazard Communication Program		X							1						1	1
02 82 13	1.9.F	Respirator Program		X							1						1	1
02 82 13	1.9.G	Training				X					1						1	1
02 82 13	1.9.H	Logs (Ongoing)				X					1						1	1
02 82 13	1.9.I	Landfill Receipts				X					1						1	1
02 82 13	1.9.J	Air Monitoring Firm Submittals				X					1						1	1
02 82 13	1.1	Daily Activity Reports (Ongoing)				X					1						1	1
02 83 33	1.5.B.1	Manufacturer's Literature and Data							X		1						1	2
02 83 33	1.5.B.2	Safety Data Sheets							X		1						1	2
02 83 33	1.5.B.3	Installation Instructions							X		1						1	2
02 83 33	1.5.B.4	Certificates	X								1						1	1
02 83 33	1.5.B.5	Qualifications	X								1						1	1
02 83 33	1.5.B.6	Paint Disposal Facility				X					1						1	1
02 83 33	1.5.C.1	Test Reports (Ongoing)	X								1						1	1
02 83 33	1.5.C.2	Daily Reports (Ongoing)				X					1						1	1
03 01 00	1.06.B	Product Data							X		2						1	
03 30 53	1.2.A	Product Data							X		1		2				1	
03 30 53	1.2.B	Design Mixtures								X	1		2				1	

SUBMITTAL LIST

Park Acronym/Project Management Information System (PMIS) Number: **GATE 308504**

Project Title: **HANGARS 3 & 4 REHABILITATION**

ACTION SUBMITTAL REVIEW ESTIMATE

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SPECIFICATION SECTION	PARAGRAPH NUMBER	DESCRIPTION	CERTIFICATIONS OR LABORATORY TESTS	REPORTS OR CALCULATIONS OR PLAN	MANUFACTURER DATA AND INSTRUCTIONS	OTHER	SAMPLES	SHOP DRAWINGS	MANUFACTURER DATA AND INSTRUCTIONS	OTHER	ARCHITECT	CIVIL ENGINEER	STRUCTURAL ENGINEER	MECHANICAL ENGINEER	ELECTRICAL ENGINEER	PLUMBING ENGINEER	PROJECT MANAGER COORDINATION	HAZMAT ENGINEER
04 03 00	1.07.B	Product Data							X		2						1	
04 03 00	1.07.D	Shop Drawings						X			6						1	
04 03 00	1.07.E	Repointing Schedule		X							1						1	
04 03 00	1.07.F	Samples					X				2						1	
04 03 00	1.07.I	Manufacturer's Instructions			X						1						1	
04 03 00	1.07.J	Conservation Treatment Quality Control Plan		X							1						1	
04 03 00	1.07.K	Restorer's Qualification Statement	X								1						1	
04 03 00	1.07.L	Testing Agency Qualification Statement	X								1						1	
05 03 00	1.06.B	Restoration Schedule		X							1						1	
05 03 00	1.06.C	Product Data							X		2						1	
05 03 00	1.06.D	Shop Drawings						X			6						1	
05 03 00	1.06.E	Patterns for Casting Molds					X				2						1	
05 03 00	1.06.F	Samples							X		2						1	
05 03 00	1.06.G	Manufacturer's Instructions			X						1						1	
05 03 00	1.06.H	Conservation Treatment Quality Control Plan		X							1						1	
05 03 00	1.06.I	Restorer's Qualification Statement				X					1						1	
05 12 00	1.5.A	Product Data							X		1		4				1	
05 12 00	1.5.B	Shop Drawings						X			2		6				1	
05 12 00	1.6.A	Qualification Data			X						1		1				1	
05 12 00	1.6.B	Welding Certificates	X								1		1				1	
05 12 00	1.6.C	Mill Test Reports		X							1		1				1	
05 12 00	1.6.D	Product Test Reports		X							1		1				1	
05 12 00	1.6.E	Survey of Existing Conditions				X					1		1				1	
05 12 00	1.6.F	Source Quality-Control Reports		X							1		1				1	
05 12 00	1.6.G	Field Quality-Control and Special Inspection Reports		X							1		1				1	

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06 10 00	1.04.B	Product Compatability Testing Certificates	X								1						1	
06 10 00	1.04.C	Product Data							X		2						1	
07 51 00	1.04.B	Product Data							X		2						1	
07 51 00	1.04.C	Shop Drawings						X			6						1	
07 62 00	1.04.B	Shop Drawings						X			6						1	
07 62 00	1.04.C	Samples for Initial Selection					X				2						1	
07 62 00	1.04.D	Samples for Verification					X				2						1	
07 92 00	1.04.B	Product Data							X		2						1	
07 92 00	1.04.C	Color Samples					X				2						1	
07 92 00	1.04.D	Staining and Compatibility Testing	X								1						1	
07 92 00	1.04.E	Mockups								X	2						1	
08 11 13	1.04.B	Product Data							X		2						1	
08 11 13	1.04.C	Shop Drawings						X			6						1	
08 11 13	1.04.D	Samples					X				2						1	
08 11 13	1.04.E	Installation Instructions			X						1						1	
08 11 13	1.04.F	Manufacturer's Certificate	X								1						1	
08 11 13	1.04.G	Manufacturer's Qualification Statement	X								1						1	
08 11 13	1.04.H	Installer's Qualification Statement	X								1						1	
08 51 23	1.04.B	Product Data							X		2						1	
08 51 23	1.04.C	Shop Drawings						X			6						1	
08 51 23	1.04.D	Samples					X				2						1	

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Park Acronym/Project Management Information System (PMIS) Number: **GATE 308504**

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08 51 23	1.04.E	Test Reports		X							1						1	
08 51 23	1.04.F	Field Quality Control Testing Reports		X							1						1	
08 51 23	1.04.G	Manufacturer's Qualification Statement				X					1						1	
08 51 23	1.04.H	Installer's Qualification Statement				X					1						1	
08 52 00	1.05.B	Product Data							X		2						1	
08 52 00	1.05.C	Shop Drawings						X			4						1	
08 52 00	1.05.D	Samples					X				2						1	
08 52 00	1.05.E	Operating Hardware					X				2						1	
08 52 00	1.05.F	Manufacturer's Certificate	X								1						1	
08 52 00	1.05.G	Grade Substantiation	X								1						1	
08 52 00	1.05.H	Test Reports	X								1						1	
08 52 00	1.05.I	Field Quality Control Submittals	X								1						1	
08 52 00	1.05.J	Manufacturer's Qualification Statement				X					1						1	
08 52 00	1.05.K	Installer's Qualification Statement				X					1						1	
08 71 00	1.05.B	Product Data							X		2						1	
08 71 00	1.05.C	Shop Drawings						X			6						1	
08 71 00	1.05.D	Manufacturer's Installation Instructions			X						1						1	
08 71 00	1.05.G	Manufacturer's Qualification Statement				X					1						1	
08 71 00	1.05.H	Installer's Qualification Statement				X					1						1	
08 80 00	1.06.B,C	Product Data							X		4						1	
08 80 00	1.06.D,E	Samples					X				4						1	
08 80 00	1.06.F	Installer's Qualification Statement				X					1						1	
09 21 16	1.05.B	Product Data							X		2						1	

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09 21 16	1.05.C	Shop Drawings						X			4						1	
09 21 16	1.05.D	Steel Framing Industry Association (SFIA) Certification	X								1						1	
09 21 16	1.05.E	Delegated Design Submittal				X					1						1	
09 21 16	1.05.F	Test Reports	X								1						1	
09 21 16	1.05.G	Qualification Statements				X					1						1	
09 30 00	1.04.B	Product Data							X		2						1	
09 30 00	1.04.C	Samples					X				2						1	
09 30 00	1.04.D	Manufacturer's Certificate	X								1						1	
09 30 00	1.04.E	Installer's Qualification Statement				X					1						1	
09 91 23	1.04.B	Product Data							X		2						1	
09 91 23	1.04.C	Samples					X				2						1	
09 91 23	1.04.D	Certification	X								1						1	
09 91 23	1.04.E	Manufacturer's Instructions			X						1						1	
09 96 00	1.04.B	Product Data							X		2							
09 96 00	1.04.C	Samples					X				2							
09 96 00	1.04.D,E	Manufacturer's Certificate	X								1						1	
09 96 00	1.04.F	Manufacturer's Installation Instructions			X						1						1	
10 28 00	1.05.A	Product Data							X		2						1	
10 28 00	1.05.B	Manufacturer's Installation Instructions							X		1						1	
22 05 29	1.4.A	Product Data							X		1					2	1	
22 05 33	1.3.A	Manufacturer's Technical Data and Installation Instructions			X													

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22 05 33	1.3.B	Shop Drawings						X			1					4	1	
22 05 53	1.2.A	Product Data							X		1					2	1	
22 05 53	1.2.B	Valve Schedule		X							1					1	1	
22 05 53	1.2.C	Samples					X				1					2	1	
22 07 00	1.5.A	Product Data							X		1					4	1	
22 11 14	1.6.A	Manufacturer's Technical Data							X		1					2	1	
22 11 14	1.6.B	Shop Drawings						X			1					4	1	
22 11 18	1.5.A	Manufacturer's Technical Data							X		1					2	1	
22 11 18	1.5.B	Shop Drawings						X			1					4	1	
22 13 14	1.5.A	Manufacturer's Technical Data							X		1					2	1	
22 40 00	1.3.A	Manufacturer's Technical Data							X		1					2	1	
22 40 00	1.3.B	Shop Drawings						X			1					4	1	
23 05 13	1.2.A	Product Data							X		1			2			1	
23 05 29	1.4.A	Product Data							X		1			2			1	
23 05 50	1.3.A	Product Data							X		1			2			1	
23 05 50	1.3.A	Shop Drawings						X			1			4			1	
23 05 53	1.2.A	Product Data							X		1			2			1	

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23 05 53	1.2.B	Valve Schedules								X	1			2			1	
23 05 53	1.2.C	Samples					X				1			2			1	
23 05 95	1.3.B	Quality Assurance				X					1			1			1	
23 05 95	1.3.C	Planning Report		X							1			1			1	
23 05 95	1.3.D	Initial Test Report		X							1			1			1	
23 05 95	1.3.E	Final Report		X							1			1			1	
23 09 02	1.3.A	Product Data							X		1			2			1	
23 09 02	1.3.B	Shop Drawings						X			1			4			1	
23 09 02	1.3.C	Schedules								X	1			2			1	
23 31 14	1.2.A	Schedules								X	1			2			1	
23 31 14	1.2.B	Testing Methods								X	1			2			1	
23 31 14	1.2.C	Shop Drawings						X			1			4			1	
23 33 14	1.2.A	Shop Drawings						X			1			4			1	
23 34 00	1.2.A	Shop Drawings						X			1			4			1	
23 37 13	1.1.A	Shop Drawings						X			1			4			1	
26 05 13.16	1.5.A	Product Data							X		1				2		1	
26 05 13.16	1.5.B	Material Certificates	X								1				1		1	
26 05 13.16	1.5.C	Manufacturer Testing Certificate	X								1				1		1	
26 05 13.16	1.5.D	Quality Control Test Reports		X							1				1		1	
26 05 13.16	1.5.E	Qualification Data				X					1				1		1	

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26 05 13.16	1.5.F	Manufacturer's Installation Instructions			X						1				1		1	
26 05 13.16	1.5.G	Installation Guide			X						1				1		1	
26 05 19	1.5.A	Product Data							X		1				2		1	
26 05 19	1.5.B	Manufacturer's Installation Instructions			X						1				1		1	
26 05 19	1.5.C	Test Reports		X							1				1		1	
26 05 26	1.6.A	Product Data							X		1				2		1	
26 05 26	1.6.B	Plans						X			1				4		1	
26 05 26	1.6.C	Field QC Test Reports	X								1				1		1	
26 05 29	1.5.A	Product Data							X		1				2		1	
26 05 29	1.5.B	Shop Drawings						X			1				4		1	
26 05 33	1.5.A	Product Data							X		1				2		1	
26 05 33	1.5.B	Manufacturer's Installation Instructions			X						1				1		1	
26 05 43.13	1.5.A	Material List				X					1				1		1	
26 05 43	1.5.A	Product Data							X		1				2		1	
26 05 43	1.5.B	Manufacturer's Installation Instructions			X						1				1		1	
26 05 48	1.6.A	Product Data							X		1				2		1	
26 05 48	1.6.B	Shop Drawings						X			1				4		1	
26 05 53	1.5.A	Product Data							X		1				2		1	
26 05 53	1.5.B	Torque Log				X					1				1		1	

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26 05 53	1.5.C	Nameplate Schedule								X	1				2		1	
26 05 53	1.5.D	Samples					X				1				2		1	
26 05 73	1.5.A	Product Data							X		1				2		1	
26 05 73	1.5.B	Product Certificates	X								1				1		1	
26 05 73	1.5.C	Qualification Data				X					1				1		1	
26 05 73	1.5.D	Other Action Submittals						X			1				4		1	
26 05 93	1.5.A	Product Data							X		1				2		1	
26 05 93	1.5.B	Shop Drawings						X			1				4		1	
26 05 93	1.5.C	Manufacturer's Installation Instructions			X						1				1		1	
26 05 93	1.5.D	Material SDS							X		1				1		1	
26 05 93	1.5.E	Certification of Code Compliance	X								1				1		1	
26 05 93	1.5.F	Inspection Reports		X							1				1		1	
26 05 93	1.5.G	Onsite Training Letter				X					1				1		1	
26 08 12	1.5.A	Test Reports		X							1				1		1	
26 08 12	1.5.B	List of Testing Equipment				X					1				1		1	
26 09 23	1.5.A	Product Data							X		1				2		1	
26 09 23	1.5.B	Shop Drawings						X			1				4		1	
26 09 23	1.5.C	Manufacturer's Installation Instructions			X						1				1		1	
26 09 23	1.5.D	Test Reports		X							1				1		1	
26 22 00	1.5.A	Product Data							X		1				2		1	
26 22 00	1.5.B	Shop Drawings						X			1				4		1	
26 22 00	1.5.C	Floor Plans						X			1				4		1	

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26 22 00	1.5.D	Manufacturer's Installation Instructions			X						1				1		1	
26 22 00	1.5.E	Test Reports		X							1				1		1	
26 22 00	1.5.F	Output Settings Report		X							1				1		1	
26 24 13	1.5.A	Product Data							X		1				2		1	
26 24 13	1.5.B	Shop Drawings						X			1				4		1	
26 24 13	1.5.C	Manufacturer's Installation Instructions			X						1				1		1	
26 24 13	1.5.D	Test Reports		X							1				1		1	
26 24 13	1.5.E	Specification Review								X	1				2		1	
26 24 16.13	1.5.A	Product Data							X		1				2		1	
26 24 16.13	1.5.B	Shop Drawings						X			1				4		1	
26 24 16.13	1.5.D	Manufacturer's Installation Instructions			X						1				1		1	
26 24 16.13	1.5.E	Test Reports		X							1				1		1	
26 27 13	1.5.A	Product Data							X		1				2		1	
26 27 13	1.5.B	Shop Drawings						X			1				4		1	
26 27 13	1.5.C	Manufacturer's Installation Instructions			X						1				1		1	
26 27 13	1.5.D	Test Reports		X							1				1		1	
26 27 26	1.5.A	Product Data							X		1				2		1	
26 27 26	1.5.B	Shop Drawings						X			1				4		1	
26 27 26	1.5.C	Samples					X				1				2		1	
26 27 26	1.5.D	Manufacturer's Installation Instructions			X						1				1		1	
26 27 26	1.5.E	Test Reports		X							1				1		1	
26 28 13	1.5.A	Product Data							X		1				2		1	

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26 28 16	1.5.A	Product Data							X		1				2		1	
26 28 16	1.5.B	Manufacturer's Installation Instructions			X						1				1		1	
26 28 16	1.5.C	Test Reports		X							1				1		1	
26 33 53.23	1.5.A	Cover Letter				X					1				1		1	
26 33 53.23	1.5.B	Product data							X		1				2		1	
26 33 53.23	1.5.C	Shop Drawings						X			1				4		1	
26 33 53.23	1.5.D	Manufacturer's Installation, Start Up and Application Instructions			X						1				1		1	
26 43 00	1.5.B	Shop Drawings						X			1				4		1	
26 43 00	1.5.C	ANSI/UL 1449 Listing Documentation								X	1				2		1	
26 50 00	1.7.D.1	Product Data							X		1				2		1	
26 50 00	1.7.D.2	Installation Instructions			X						1				1		1	
26 50 00	1.7.D.3	Maintenance Data			X						1				1		1	
26 50 00	1.7.D.4	Parts List								X	1				2		1	
26 50 00	1.7.D.5	Photometric Data							X		1				2		1	
26 50 00	1.7.D.6	Driver Schedule								X	1				2		1	
26 50 00	1.7.D.7	Driver Cut Sheets							X		1				2		1	
26 50 00	1.7.D.8	Product Colors/Finishes							X		1				2		1	
27 10 00	1.5.A.1	Contractor Certification Documents	X								1				1		1	
27 10 00	1.5.A.2	Pre-Construction Meeting Agenda		X							1				1		1	
28 20 00	1.5.A	Shop Drawings						X			1				4		1	
28 20 00	1.5.C	Product Data							X		1				2		1	

SUBMITTAL LIST

Park Acronym/Project Management Information System (PMIS) Number: **GATE 308504**

Project Title: **HANGARS 3 & 4 REHABILITATION**

ACTION SUBMITTAL REVIEW ESTIMATE

(Complete this portion for Architect / Engineer (A/E) construction service task order negotiation.)

SUBMITTAL			REQUIREMENTS (Indicate with **X**)								ARCHITECT / ENGINEER REVIEW TIME (Indicate in whole or partial hours.)							
			INFORMATIONAL				ACTION											
SPECIFICATION SECTION	PARAGRAPH NUMBER	DESCRIPTION	CERTIFICATIONS OR LABORATORY TESTS	REPORTS OR CALCULATIONS OR PLAN	MANUFACTURER DATA AND INSTRUCTIONS	OTHER	SAMPLES	SHOP DRAWINGS	MANUFACTURER DATA AND INSTRUCTIONS	OTHER	ARCHITECT	CIVIL ENGINEER	STRUCTURAL ENGINEER	MECHANICAL ENGINEER	ELECTRICAL ENGINEER	PLUMBING ENGINEER	PROJECT MANAGER COORDINATION	HAZMAT ENGINEER
28 20 00	1.5.D	Installer's Qualification Statement	X								1				1		1	
28 20 00	1.5.E	Manufacturer's Installation Instructions			X						1				1		1	
28 20 00	1.5.F	Field Quality Control Test Reports		X							1				1		1	
31 10 00	1.3.B	Site Plan						X			1	2					1	
31 10 00	1.3.C	Clearing and Demolition Permits				X					1	1					1	
31 10 00	1.3.D	Certificates of Utility Service Severances	X								1	1					1	
31 10 00	1.3.E	Transport and Disposal of Debris Permits				X					1	1					1	
31 10 00	1.3.F	Demolition Procedures and Operational Sequence		X							1	2					1	
31 22 00	1.05.A	Proposed Equipment				X					1	2					1	
31 22 00	1.05.B	Gradation Curves (if imported fill is used)				X					1	2					1	
31 23 00	1.05.A	Proposed Methods, Equip, and Sequence of Operations		X							1	2					1	
31 23 33	1.05.A	Shop Drawings/Design Calculations						X			1	4					1	
31 23 33	1.05.A	Gradation Curves - Stone Bedding				X					1	1					1	
31 23 33	1.05.A	Proposed Equipment - Backfill				X					1	1					1	
31 23 33	1.05.B	Gradation Curves - Backfill				X					1	1					1	
31 23 33	1.05.A	Compaction Test Results	X								1	1					1	
31 25 00	1.03.A	Storm Water Pollution Prevention Plan (SWPPP)		X							1	2					1	
31 25 00	1.03.B	Erosion Control Plan		X							1	2					1	
31 25 00	1.03.C	Shop Drawings						X			1	4					1	
31 25 00	1.03.D	Material Certificates	X								1	1					1	
32 01 17.63	1.3.A	Proposed Product Data - Asphalt Mix and Aggregate							X		1	2					1	

SUBMITTAL LIST

Park Acronym/Project Management Information System (PMIS) Number: **GATE 308504**

Project Title: **HANGARS 3 & 4 REHABILITATION**

ACTION SUBMITTAL REVIEW ESTIMATE

(Complete this portion for Architect / Engineer (A/E) construction service task order negotiation.)

SUBMITTAL			REQUIREMENTS (Indicate with **X**)								ARCHITECT / ENGINEER REVIEW TIME (Indicate in whole or partial hours.)							
			INFORMATIONAL				ACTION											
SPECIFICATION SECTION	PARAGRAPH NUMBER	DESCRIPTION	CERTIFICATIONS OR LABORATORY TESTS	REPORTS OR CALCULATIONS OR PLAN	MANUFACTURER DATA AND INSTRUCTIONS	OTHER	SAMPLES	SHOP DRAWINGS	MANUFACTURER DATA AND INSTRUCTIONS	OTHER	ARCHITECT	CIVIL ENGINEER	STRUCTURAL ENGINEER	MECHANICAL ENGINEER	ELECTRICAL ENGINEER	PLUMBING ENGINEER	PROJECT MANAGER COORDINATION	HAZMAT ENGINEER
32 13 13	1.5.A	Product Data							X		1	2					1	
33 13 13	1.5.B	Design Mixtures								X	1	2					1	
34 13 13	1.6.A	Qualification Data	X								1	1					1	
35 13 13	1.6.B	Material Certificates	X								1	1					1	
36 13 13	1.6.C.1	Curing Compounds Material Test Reports: Concrete Design Mix		X							1	1					1	
36 13 13	1.6.C.2	Curing Compounds Material Test Reports: Foundation Material		X							1	1					1	
37 13 13	1.6.D	Field Quality-Control Reports		X							1	1					1	
38 13 13	1.7.A	Concrete Paving Installer Qualifications	X								1	1					1	
39 13 13	1.7.B	Ready-Mix-Concrete Manufacturer Qualifications	X								1	1					1	
40 13 13	1.7.C	Testing Agency Qualifications	X								1	1					1	
32 14 23	1.4.A,B	Product Data							X		1	2					1	
32 14 23	1.4.C	Manufacturer's Installation Instructions			X						1	1					1	
32 16 13	1.04.A	Concrete Design Mix								X	1	2					1	
32 16 13	1.04.B	Material Certificates	X								1	1					1	
32 16 13	1.04.C	Product Data							X		1	2					1	
33 01 00	1.04A	Material Certificates	X								1	1					1	
33 11 16	1.03.A	Methods and Procedures for Performing Leakage Tests		X							1	2					1	
33 11 17	1.03.A	Product Data							X		1	2					1	
33 11 17	1.03.A	Manufacturer's Material Certificate	X								1	1					1	
33 12 16	1.05.A	Shop Drawings						X			1	4					1	

SUBMITTAL LIST

Park Acronym/Project Management Information System (PMIS) Number: **GATE 308504**

Project Title: **HANGARS 3 & 4 REHABILITATION**

ACTION SUBMITTAL REVIEW ESTIMATE

(Complete this portion for Architect / Engineer (A/E) construction service task order negotiation.)

SUBMITTAL			REQUIREMENTS (Indicate with **X**)								ARCHITECT / ENGINEER REVIEW TIME (Indicate in whole or partial hours.)							
			INFORMATIONAL				ACTION											
SPECIFICATION SECTION	PARAGRAPH NUMBER	DESCRIPTION	CERTIFICATIONS OR LABORATORY TESTS	REPORTS OR CALCULATIONS OR PLAN	MANUFACTURER DATA AND INSTRUCTIONS	OTHER	SAMPLES	SHOP DRAWINGS	MANUFACTURER DATA AND INSTRUCTIONS	OTHER		ARCHITECT	CIVIL ENGINEER	STRUCTURAL ENGINEER	MECHANICAL ENGINEER	ELECTRICAL ENGINEER	PLUMBING ENGINEER	PROJECT MANAGER COORDINATION	HAZMAT ENGINEER
33 12 16	1.05.A	Catalog Cuts (Product Data)							X			1	2					1	
33 41 01	1.03.A	Catalog Cuts (Product Data)							X			1	2					1	
33 41 01	1.03.A	Specifications								X		1	2					1	
33 41 01	1.03.A	Method of Installation			X							1	1					1	
33 41 07	1.05.A	Certificates of Compliance with Referenced Standards	X									1	1					1	
33 41 07	1.05.B	Catalog Cuts (Product Data)							X			1	2					1	
33 42 00	1.04	Shop Drawings						X				1	4					1	
33 46 14	1.03.A	Product Data							X			1	2					1	
33 49 10	1.04.A	Foundry Certificates	X									1	1					1	
											Total:	383	111	22	49	169	36	321	20

Closeout and Operation & Maintenance (O&M) Requirements **Template**

National Park Service (NPS) - Denver Service Center (DSC) | 1-27-21

Topic	Specification Section	Requirement	Submittal Date	Completed	Received by Park
Project Record Drawings	01 32 33	Digital Image Files			
	02 41 00	Project Record Documents			
	08 71 00	Project Record Documents			
	22 00 00	Project Record Documents			
	23 00 00	Project Record Documents			
	26 05 13.16	Project Record Documents			
	26 05 19	Project Record Documents			
	26 05 33	Project Record Documents			
	26 05 43	Project Record Documents			
	26 09 23	Project Record Documents			
	26 22 00	Project Record Documents			
	26 24 13	Project Record Documents			
	26 24 16.13	Project Record Documents			
	26 27 13	Project Record Documents			
	26 27 26	Project Record Documents			
	26 28 13	Project Record Documents			
	26 28 16	Project Record Documents			
	26 33 53.23	As-built Shop Drawings			
	28 20 00	Project Record Documents			
System Demonstration and Training	28 20 00	Operation Demonstration			
	28 20 00	Owner's Personnel Training			
Tools Spare Parts Equipment	08 71 00	Maintenance Tools			
Extra Stock	08 71 00	Maintenance Materials			
	08 80 00	Maintenance Materials			
	32 14 23	Maintenance Materials			
Reports	01 74 19	Project Waste Management Plan Summary			
	02 83 33	Hazardous Waste Manifest			
	02 83 33	Toxicity Characteristic Leaching Procedure (TCLP) Test Results			
	02 83 33	Paint Disposal Facility Receipts and Disposition Reports.			
	02 83 33	Landfill Receipts/Waste Manifests			
	02 83 33	Personal Exposure and Environmental Sample Results			
Keys & Keying Schedule	08 71 00	Keys to Owner			
	02 83 33	Warranty of Construction			
	06 10 00	Manufacturer Warranty			
	07 92 00	Manufacturer Warranty			

Topic	Specification Section	Requirement	Submittal Date	Completed	Received by Park
O&M Data Warranties Guarantees	08 51 23	Manufacturer Warranty			
	08 52 00	Manufacturer Warranty			
	08 71 00	Manufacturer Warranty			
	08 71 00	Maintenance Data			
	08 80 00	Warranty Documentation			
	09 30 00	Maintenance Data			
	09 96 00	Maintenance Data			
	23 05 95	Final Report			
	26 05 13.16	Operation and Maintenance Data			
	26 05 13.16	Manufacturer Warranty			
	26 05 19	Operation and Maintenance Data			
	26 05 19	Manufacturer Warranty			
	26 05 26	Operation and Maintenance Manuals			
	26 05 26	Manufacturer Warranty			
	26 05 33	Operation and Maintenance Data			
	26 05 33	Manufacturer Warranty			
	26 05 43	Operation and Maintenance Data			
	26 05 43	Manufacturer Warranty			
	26 05 93	Manufacturer Warranty			
	26 09 23	Operation and Maintenance Data			
	26 09 23	Manufacturer Warranty			
	26 22 00	Operation and Maintenance Data			
	26 22 00	Manufacturer Warranty			
	26 24 13	Operation and Maintenance Data			
	26 24 13	Manufacturer Warranty			
	26 24 16.13	Operation and Maintenance Data			
	26 24 16.13	Manufacturer Warranty			
	26 27 13	Operation and Maintenance Data			
	26 27 26	Operation and Maintenance Data			
	26 27 26	Manufacturer Warranty			
	26 28 16	Operation and Maintenance Data			
	26 33 53.23	Operations and Maintenance (O&M) Manual			
	26 33 53.23	Manufacturer Warranty			
	26 43 00	Manufacturer Warranty			
	26 50 00	Manufacturer Warranty			
	28 20 00	Operation and Maintenance Data			
	28 20 00	Executed Warranty			
	28 20 00	Specimen Warranty			
	28 20 00	Manufacturer Warranty			
	32 14 23	Maintenance Data			

GATE 308504

SECTION 01 35 13.22 – ARCHEOLOGICAL PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section consists of protecting archeological resources contained in soil deposits.

1.2 DEFINITIONS

A. Archeological Resources: Archeological resources are physical evidences of past human activity, including evidences of effects of that activity on the environment. Archeological resources represent both prehistoric and historic time periods, found above and below ground and under water.

B. Archeologically Sensitive Areas: Areas having potential to contain significant (National Register eligible) archeological resources. If National Register eligible or listed archeological resources could not be avoided, an appropriate mitigation strategy would be developed in consultation with state historic preservation officer and, if necessary, associated American Indian tribes.

C. Non-sensitive Areas: Areas with little potential of containing significant (National Register eligible) archeological resources.

D. Archeological Monitor: Representative of Government (National Park Service) designated to oversee construction activities that could disturb archeological resources.

E. Archeological Resources Protection Act (ARPA) of 1979 (Public Law (P.L.) 96-95; 93 United States Statues at Large (Stat.) 712): defines archeological resources as any material remains of past human life or activities that are of archeological interest and at least 100 years old; Section 4 of the statute describes the requirements that must be met before Federal authorities can issue a permit to excavate or remove any archeological resource on Federal or Indian lands; the curatorial requirements of artifacts, and other materials excavated or removed.

1.3 SUBMITTALS

A. Daily Work Schedule: Detail construction work in archeologically sensitive areas. Submit to Contracting Officer (CO) 30 days before start of ground disturbing site work.

1.4 QUALITY ASSURANCE

A. At least one week before on-site work begins, Contractor shall meet with Contracting Officer and Archeological Monitor to discuss Daily Work Schedule, equipment, and special methods used in

archeologically sensitive areas. Contractor shall ensure approved Daily Work Schedule is followed throughout construction.

PART 2 - PRODUCTS

2.1 DAILY WORK SCHEDULE

A. Daily Work Schedule is required for work occurring within archeologically sensitive areas. Include all work that is to occur within the area and key the schedule to the drawings to include:

1. Starting and ending dates of ground-disturbing construction.
2. Locations of temporary facilities, such as barriers, field offices, staging areas, sanitary facilities, borrow pits, and haul and access roads.
3. Types of construction, such as clearing, topsoil stripping, structure or trench excavation, landscaping, and post construction clean-up.
4. Methods and equipment used for each type of construction.
5. Plan for relocating work in the event of temporary work stoppages at each archeologically sensitive area

PART 3 - EXECUTION

3.1 BARRICADES

A. Comply with requirements specified in Section 01 50 00 "Temporary Facilities and Controls."

3.2 OBSERVATION

A. Contractor will be required to coordinate with Contracting Officer at least 7 days in advance for all in-ground disturbance to ensure NPS-provided archeological monitor is scheduled.

B. Archeological Monitor will observe ground-disturbing site work, including construction of temporary facilities, at archeologically sensitive areas, from a safe location mutually agreed on by Contractor and Monitor. As new ground is broken, Monitor will examine excavated materials, using construction layout centerline and perimeter staking as a reference point to record locations of findings.

3.3 DISCOVERY OF RESOURCES

A. Contractor must follow guidance in the Inadvertent Discovery Plan (NAGPRA).

B. If Archeological Monitor discovers resources, immediate relocation of work to a non-sensitive area may be required for Monitor to identify and document resources and, if necessary, develop appropriate mitigation plan. While Archeological Monitor is documenting resources in sensitive areas, Contractor shall relocate work to non-sensitive areas where monitoring is not normally required.

C. If resources are discovered, immediately report the discovery to the Contracting Officer.

3.4 WORK STOPPAGE

A. Contractor shall plan, schedule, and execute work to prevent stoppages at one area from stopping all work at construction site.

END OF SECTION 01 35 13.22

SECTION 01 35 23 - SAFETY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes establishing an effective accident prevention program and providing a safe working environment for personnel and visitors.

1.2 CONDITIONS PRESENT FOR PROJECT

A. Hazardous materials are present in this building and include mold, ACMs and Lead Paint. Refer to HazMat Report, specifications and drawings for more information. Contractor shall utilize temporary safety measures, as necessary, to complete the contract work.

B. This building has been unoccupied and open to the elements for several years. Additionally, fire has damaged parts of the building including the roof deck. If at any time during construction there are structural concerns, stop work immediately and alert the Contracting Officer for this project.

C. Standing water along with exposed electrical wires could pose a potential electrocution risk. Confirm all utilities are shut off prior to commencement of the work.

1.3 SUBMITTALS

A. Accident Prevention Plan (APP): Submit APP after contract award and before Pre-Construction conference. Contracting Officer (CO) will review proposed APP. If APP requires any revisions or corrections, Contractor shall resubmit Plan within 10 days. No progress payments will be made until the APP is accepted.

1.4 QUALITY ASSURANCE

A. Comply with contract clauses "Accident Prevention" and "Permits and Responsibilities." In case of conflicts between Federal, State, and local safety and health requirements, the most stringent shall apply. Onsite equipment shall meet 29 CFR 1926 (Code of Federal Regulations) (Occupational Safety and Health Administration (OSHA)) requirements. Failure to comply with requirements of this section and related sections may result in suspension of work.

B. Site Safety Supervisor:

1. Designate authorized onsite representative for preparation and maintenance of the APP.
2. Shall be responsible for:

    a. Implementation and enforcement of the APP

b. Daily safety inspections
c. Conducting and documenting weekly and monthly safety meetings
d. Review of safety requirements at progress meetings
e. Compilation and maintenance of Safety Data Sheets (SDS) and safety reference materials
f. Tracking and resolution of safety violations
g. Site personnel and visitor compliance with site safety and health requirements and APP
h. Investigation and reporting of accidents and injuries

C. Qualifications of Employees:

1. Physically and able to perform their assigned duties in a safe manner.
2. Do not allow employees whose ability or alertness is impaired because of prescription or illegal drug use, fatigue, illness, intoxication, or other conditions that may expose themselves or others to injury to perform work.
3. Provide operating instructions for equipment. Operators of vehicles, hoisting equipment, and hazardous plant equipment shall be able to understand signs, signals, operating instructions, and be fully capable of operating such equipment. Retain copies of operator licenses and certifications onsite.

1.5 ACCIDENT REPORTING

A. Reportable Accidents: Defined as: death, occupational disease, and/or traumatic injury to employees or the public; fires; and/or property damage by accident in excess of $100.

1. Notify Contracting Officer immediately in the event of a reportable accident.
2. Fill out and forward an Accident/Property Damage Report Form (CM-22) to Contracting Officer within 7 days of a reportable accident. Obtain form from Contracting Officer.

PART 2 - PRODUCTS

2.1 ACCIDENT PREVENTION PLAN (APP)

A. APP shall be written to comply with OSHA and project requirements (generic plan is not acceptable) including but not limited to:

1. Name and qualifications of supervisor responsible to carry out program.
2. Weekly and monthly safety meetings shall be documented with topics and attendees.
3. First aid and rescue procedures.
4. Job Hazard Analysis (JHA) for each major phase. List of hazards associated and methods proposed to provide for property protection and safety of the public, National Park Service personnel, and Contractor's employees. Include initial and continuing training.
5. Planning for possible emergency situations, as detailed in Article 1.2. Such planning shall take nature of construction, site conditions, and degree of exposure of persons and property into consideration.
6. Infectious Disease Preparedness:

a. Contractors are responsible for their employees' safety and the safety of job site visitors during the performance of this contract. We encourage Contractors to follow guidance from the Department of Labor (DOL), Occupational Safety and Health Administration (OSHA), the Centers for Disease Control and Prevention (CDC), and all other applicable local, city, and state mandates. We encourage Contractors to develop policies for infection prevention and an Infectious Disease Preparedness and Response Plan.
b. To the extent appropriate, Contractors should include the protective health and safety measures they intend to implement in any accident prevention or safety submittals required under this contract. These plans should contain preventive measures the Contractor intends to follow while performing work on government property as well as responsive and corrective actions to be taken if an employee exhibits symptoms or tests positive for contagion.
c. Upon contract award, Contractors should communicate with Contracting Officer regarding Contractor decisions and actions to protect the health and safety of workers for the duration of contract performance under which pandemic conditions exist.

2.2 FIRST AID FACILITIES

A. Provide adequate facilities for number of employees and appropriate to construction hazards.

2.3 PERSONNEL PROTECTIVE EQUIPMENT (PPE)

A. Selection shall conform to OSHA Subpart E.

PART 3 - EXECUTION

3.1 DAILY SAFETY INSPECTIONS

A. Conduct daily safety inspections and maintain daily safety reports which include:
1. Area/operation inspected
2. Date of inspection
3. Identified hazards
4. Corrective actions taken

3.2 EMERGENCY INSTRUCTIONS

A. Post telephone numbers and reporting instructions for ambulance, physician, hospital, fire department, and police in conspicuous locations at work site.

3.3 FIRE AND LIFE SAFETY

A. Comply with requirements of 2024 International Fire Code, Chapter 33 Fire Safety During Construction and Demolition.

3.4 HAZARDOUS MATERIALS

A. Hazardous materials: Explosive, flammable, poisonous, corrosive, oxidizing, irritating, or otherwise harmful substances that could cause death or injury.

B. Store hazardous materials in accordance with manufacturer's and OSHA Subpart D requirements. Maintain Safety Data Sheets (SDS) for each chemical readily available on site.

1. Immediately report spills of hazardous materials to the Park.
2. Maintain a spill emergency response kit.
3. Train employees how to respond to a spill and use emergency response kit.

3.5 PROTECTIVE EQUIPMENT

A. Inspect personal protective equipment daily and maintain in a serviceable condition. Clean, sanitize, and repair personal items as appropriate before issuing to another individual.

3.6 SAFETY MEETINGS

A. As a minimum, conduct one weekly 15-minute "toolbox" safety meeting conducted by a foreman or supervisor and attended by construction personnel at worksite. Topics shall coincide with work scheduled for following week. Document and submit meeting minutes to Contracting Officer within one day after meeting.

B. Conduct monthly safety meetings for personnel, contractors, and subcontractors performing work on the site. Notify Contracting Officer of meeting dates and times. Meetings shall be used to: review effectiveness of Contractor's safety effort; resolve current health and safety problems; provide a forum for planning safe construction activities, and for updating Accident Prevention Plan. Contracting Officers Representative will attend meetings and enter results of meetings into the daily log.

3.7 HARD HATS AND PROTECTIVE EQUIPMENT AREAS

A. A hard hat use area shall be designated by Contractor. Hard hat area shall be posted by Contractor in a manner satisfactory to Contracting Officer.

B. It is Contractor's responsibility to require persons working on or visiting site to wear hard hats and PPE in good repair at all times. As a minimum, maintain six hard hats and other APP required equipment.

3.8 TRAINING

A. First Aid: Provide training to personnel to ensure prompt and efficient first aid.

B. Hazardous Material: Train and instruct each employee exposed to hazardous material in safe and approved methods of handling and storage.

END OF SECTION 01 35 23

SECTION 01 35 91 - HISTORIC PRESERVATION TREATMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes special procedures for historic treatment on Project including, but not limited to:

1. Definitions
2. Submittals
3. Quality Assurance
4. Storage and protection of existing historic materials
5. Project site conditions
6. Historic Preservation Treatment Plan
7. Protection, General
8. Protection during application of chemicals
9. Protection during use of heat-generating equipment
10. Historic preservation treatment procedures

1.2 DEFINITIONS

A. "Preservation" - To apply measures necessary to sustain existing form, integrity, and materials of historic property. Work may include preliminary measures to protect and stabilize the property.

B. "Rehabilitation" - To make possible a compatible use for property through repair, alterations, and additions while preserving those portions or features that convey its historical, cultural, or architectural values.

C. "Restoration" - To accurately return form, features, and character of a property to its appearance at a particular period of time by means of removal of features from other periods in its history and repair and reconstruction of missing and deteriorated features from the restoration period.

D. "Reconstruction" - To reproduce in exact form and detail, a building, structure, or artifact as it appeared at a specific period in time. Reconstructed elements do not possess historic integrity in their own right since they are-not original fabric.

E. "Stabilize" - To apply measures designed to reestablish a weather-resistant enclosure and structural reinforcement of an item or portion of the building while maintaining essential form as it exists at present. This level of intervention is aimed at retarding or arresting adverse impacts to structures.

F. "Protect and Maintain" - To remove deteriorating corrosion, reapply protective coatings, and install protective measures such as temporary guards; to provide the least degree of intervention.

G. "Repair" - To stabilize, consolidate, or conserve; to retain existing materials and features while employing as little new material as possible. Repair includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials. Within restoration, repair also includes limited replacement in kind, rehabilitation, and reconstruction, with compatible substitute materials for deteriorated or missing parts of features when there are surviving prototypes.

H. "Replace" - To duplicate in its entirety, a historic element or feature by matching its historic pattern, detail and appearance. Replacement is justified when original or historic elements are damaged beyond repair or are missing. Replacement conditions and methods include:

1. Replacement with Original or Historic Fabric: Includes fabric salvaged from other locations or projects having identical architectural qualities. Duplication of appearance using identical material possessing historical significance.
2. Replacement with New Materials: Includes replacement with new material of like kind (custom fabricated of manufactured). Duplication of appearance using like material.
3. Replacement with Substitute Materials: Includes replacement with a compatible substitute that is frequently contemporary and unlike the historic fabric. Duplication of appearance using modern (non-traditional) material Use of substitute materials is not approved unless matching materials are not available.

I. "Remove" - To demolish or detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

J. "Remove and Salvage" - To detach items from existing construction and deliver them ready for reuse to Contracting Officer (CO) or designee.

K. "Remove and Reinstall" - To detach items from existing construction, repair and prepare for reuse, and reinstall where indicated.

L. "Existing to Remain" or "Retain" - Existing items of construction not to be removed and not otherwise indicated to be removed and salvaged or removed and reinstalled.

M. "Material in Kind" - Material that closely matches existing materials through comparison of architectural qualities and salient characteristic such as species, cut, color, grain, dimension, profile, thickness, and finish.

1.3 SUBMITTALS

A. Historic Preservation Treatment Plan:

1. After contract award and before Pre-Construction conference, submit for approval a written Historic Preservation Treatment Plan (HPTP).
2. If the plan requires revisions or corrections, Contractor shall resubmit plan within 10 days.
3. No change in approved plan may be made without written concurrence by Contracting Officer.

B. Alternative Methods and Materials: If alternative methods and materials to those indicated are proposed for any phase of work, provide a written description including evidence of successful

use on other, comparable projects, and program of testing to demonstrate effectiveness for use on this Project.

C. Photographs or Video~~tape~~: In accordance with Section 01 32 33 "Photographic Documentation," show existing conditions of adjoining construction and site improvements including finish surfaces that might be misconstrued as damage caused by historic treatment operations. Submit before work begins.

1.4 QUALITY ASSURANCE

A. Historic Preservation Treatment Specialist Qualifications: Experienced firm with required certifications and training able to demonstrate through past performance they are qualified to perform this work.

1.5 STORAGE AND PROTECTION OF HISTORIC MATERIALS

A. Removed and Salvaged Historic Materials:

1. Clean salvaged historic items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in secure area until delivery to Contracting Officer.
4. Transport items to storage area as determined by Contracting Officer.
5. Protect items from damage during transport and storage.
6. Do not dispose of items removed from existing construction without prior written consent of Contracting Officer.

B. Removed and Reinstalled Historic Materials:

1. Clean and repair historic items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use as designed.

C. Existing Historic Materials to Remain: Protect construction indicated to remain against damage and soiling during historic treatment. When permitted by Contracting Officer, items may be removed to suitable, protected storage location during historic treatment **and cleaned** and reinstalled in their original locations after historic treatment operations are complete.

D. Storage and Protection: When removed from existing location, store historic materials within weather-tight enclosure protected from wetting by rain, snow, or ground water, and temperature variations. Secure stored materials to protect from theft.

1. Identify removed items with an inconspicuous mark indicating original location.
2. Develop key plan when many similar items are scheduled for removal and reinstallation.

1.6 PROJECT-SITE CONDITIONS

A. Exterior Cleaning and Repairing:

1. Proceed with work only when forecasted weather conditions are favorable.

   a. Wet Weather: Do not attempt repairs during rainy or foggy weather. Do not apply primer, paint, putty, or epoxy when relative humidity is above 80 percent. Do not remove exterior elements of structures when rain is forecast or in progress.
   b. Do not perform exterior wet work when air temperature is below 40 degrees Fahrenheit (5 degrees Celsius).
   c. Do not begin cleaning, patching, or repairing given likelihood of frost or freezing.
   d. Do not begin cleaning when either air or surface temperature is below 45 degrees Fahrenheit (7 degrees Celsius) unless approved means are provided for maintaining 45 degrees Fahrenheit (7 degrees Celsius) temperature of air and materials during, and for 48 hours subsequent to, cleaning.

2. Perform cleaning and rinsing of the exterior only during daylight hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 HISTORIC PRESERVATION TREATMENT PLAN

A. Review the existing Historic Preservation Treatment Plan as part of this project. Contractor to prepare written plan for preservation work covering preservation components of project. Plan shall verify construction strategy and intent is compatible with Department of the Interior's (DOI) standards for Treatment of Historic Properties, guidelines for Treatment of Cultural Landscapes, and National Park Service management policies for cultural resources. Plan shall satisfy both project scope and resource protection requirements. Plan shall include:

1. Organized list of preservation components of project, systems, and tasks
2. Staging and sequence of work
3. Disassembly and reassembly techniques and steps
4. Equipment and tools required
5. Supplies and materials with manufacturer or supplier identified including specific clean up/storage procedure including frequency and documentation of such.
6. Skilled trades and crafts required
7. Anticipated testing and analysis of fabric
8. Additional investigations for extents or magnitude of treatments needed
9. Protective measures
10. Seasonal limitations on work
11. Alternative means if primary treatment method is unfeasible
12. Work conducted off-site (Approval from Contracting Officer required prior to taking resources off-site).

3.2 PROTECTION, GENERAL

A. Comply with manufacturer's written instructions for precautions and effects of products and procedures on adjacent building materials, components, and vegetation.

B. Ensure supervisory personnel are present when work begins and during progress.

C. Temporary Protection of Historic Materials during Construction:

1. Protect existing materials during installation of temporary protections and construction. Do not deface or remove existing materials.
2. Attachments of temporary protection to existing construction shall be approved by Contracting Officer prior to installation.

D. Protect landscape work adjacent to or within work areas as follows:

1. Provide barriers to protect tree trunks.
2. Bind spreading shrubs.
3. Coverings shall allow plants to breathe. Remove coverings at end of day. Do not cover plant material with waterproof membrane more than 8 hours at a time.
4. Set scaffolding and ladder legs away from plants.

E. Existing Drains: Prior to start of work or cleaning operations, test drains and other water removal systems to ensure drains and systems function properly. Notify Contracting Officer immediately of stopped or blocked drains or systems. Do not begin Work of this Section until drains are in working order.

1. Provide method to prevent solids including stone or mortar residue from entering drains or drain lines. Clean out drains and drain lines blocked or filled because of work performed under this Contract.
2. Protect storm drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.

3.3 PROTECTION DURING APPLICATION OF CHEMICALS

A. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm or damage resulting from applications of chemical cleaners and paint removers.

B. Comply with requirements in Section 01 50 00 "Temporary Facilities and Controls."

C. Cover adjacent surfaces with materials proven to resist chemical cleaners selected for Project unless chemicals being used will not damage adjacent surfaces. Use covering materials containing only waterproof, UV (ultraviolet)-resistant adhesives. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. Promptly remove masking to prevent adhesive staining on completion.

D. Do not clean surfaces during winds of sufficient force to spread cleaning solutions to unprotected surfaces.

E. Neutralize and collect alkaline and acid wastes and dispose of outside park boundaries.

F. Dispose of runoff from chemical operations by legal means and in a manner preventing soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

G. Document daily clean-up, proper storage, and disposition of any flammable/combustible materials with daily reports.

3.4 PROTECTION DURING USE OF HEAT-GENERATING EQUIPMENT

A. Comply with following procedures while performing work with heat-generating equipment, including welding, cutting, soldering, brazing, paint removal with heat, and other operations where open flames or implements utilizing heat are used:

1. Obtain Contracting Officer's approval for operations involving use of open-flame or welding equipment.

    a. Notification shall be given for each occurrence and location of work with heat-generating equipment.
    b. Obtain appropriate permit from the park as required.

2. As far as practical, use heat-generating equipment in shop areas or outside building.
3. Before work with heat-generating equipment commences, furnish fire watch (or watches) for location(s) where work is to be performed.
4. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use combustible gas indicator test to ensure area is safe.
5. Remove and keep area free of combustibles, including, rubbish, paper, waste, etc., within area of operations.

    a. If combustible material cannot be removed, provide fireproof blankets to cover such materials.

6. Where possible, furnish and use baffles of metal or gypsum board to prevent spraying of sparks or hot slag into surrounding combustible material.
7. Prevent extension of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
8. Inspect each location of day's work not sooner than 30 minutes after completion of operations to detect hidden or smoldering fires; ensure proper housekeeping is maintained.

B. Where sprinkler protection exists and is functional, maintain without interruption while operations are performed. If operations are performed near automatic sprinkler heads, shield individual heads temporarily with guards.

3.5 HISTORIC PRESERVATION TREATMENT PROCEDURES

The principal aim of preservation work is to halt the process of deterioration and stabilize the item's condition to sustain the integrity of the historic element, feature or structure being preserved. Cyclic maintenance is often required as well as repair work. Repair is required where specifically indicated. The following procedures shall be followed:

1. Retain as much existing material as possible; repair and consolidate rather than replace.
2. Use additional material or structure to reinforce, strengthen, prop, tie, and support existing material or structure.
3. Use reversible processes wherever possible.
4. Use traditional replacement materials and techniques if possible. New work shall be distinguishable from old work and original materials and techniques.
5. Record repair work during construction with periodic construction photos and daily inspection reporting. Photo documentation is specified in Section 013233 "Photographic Documentation."

B. Prohibit smoking by personnel performing work on or near historic structures.

C. Notify Contracting Officer of visible changes in integrity of material or components due to environmental causes including biological attack, UV degradation, freezing, or thawing, or due to structural defects including cracks, movement, or distortion.

   1. Do not proceed with work in question until directed by Contracting Officer.

D. Where Work requires existing features to be removed, cleaned, and reinstalled, perform operations without damage to material itself, to adjacent materials, or to substrate.

E. Identify new or replacement materials and features with inconspicuous, permanent marks to distinguish from original materials. Record legend of identification marks and locations of these marks on Record Drawings.

F. When cleaning, match samples of existing materials that have been cleaned and identified for acceptable cleaning levels. Avoid over-cleaning to prevent damage. Use gentlest methods available. Initiate cleaning using hand cleaning methods before introducing power cleaning methods and equipment.

END OF SECTION 01 35 91

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

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

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with Contract Document requirements. Quality of work shall be responsibility of the Contractor.

1. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and control procedures that facilitate compliance with Contract Document requirements.

C. See Divisions 2 through 49 Sections for specific test and inspection requirements.

1.2 DEFINITIONS

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

B. Quality Control Services: Tests, inspections, procedures, and related actions during and after execution of the work to evaluate actual products incorporated into the work and completed construction comply with requirements.

C. Mockups: To include but not limited to: on site cleaning and repair testing of historic fabric, finishes, window and door installation. Mockups are constructed from selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Approved mockups establish the standard by which the Work will be judged, unless otherwise indicated.

D. Preconstruction Testing: Tests and inspections performed specifically for project before products and materials are incorporated into work to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections performed by a Nationally Recognized Testing Laboratory (NRTL), a National Voluntary Laboratory Accreditation Program (NVLAP), or a testing agency qualified to conduct product testing, to establish product performance and compliance with industry standards.

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

G. Field Quality Control Testing: Tests and inspections performed on-site for installation of work and for completed work.

H. Testing Agency or Laboratory: Entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

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

1. Using a term such as "carpentry" does not imply certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trades people of corresponding generic name.

1.3 CONFLICTING REQUIREMENTS

A. Reference Standards: If compliance with two or more standards is specified and standards establish different or conflicting requirements for minimum quality levels, comply with most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Contracting Officer before proceeding.

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

1.4 SUBMITTALS

A. Quality Control Plan:

1. After contract award and before Pre-Construction conference, submit a written Contractor Quality Control (CQC) plan.
2. If plan requires revisions or corrections, Contractor shall resubmit plan within 10 days.
3. Government reserves the right to require changes in plan during contract period as necessary to obtain the quality specified.
4. No change in the approved plan may be made without written concurrence by Contracting Officer.

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

C. Contractor Quality Control (CQC) Daily Reports: Submit showing inspections and tests on first workday following date covered by report. Quality Control Supervisor shall utilize DSC Forms.

1. Review Construction Management Representative (CMR) Daily report if applicable and reconcile any differences prior to posting.

D. Test Reports

1. Test reports shall be completed by person performing test.
2. Submit Daily Test Information Sheets with Quality Control Daily Reports.
3. Submit failing test results and proposed remedial actions within four hours of noted deficiency.
4. Submit three copies of complete test results no later than one calendar day after test was performed.

E. Accessibility Inspection Report:

1. Fill out applicable sections of the Accessibility Inspection Report and attach to Contractor Quality Control Daily Report.
2. Utilize attached Accessibility Inspection form to document compliance with Architectural Barriers Act Accessibility Standards (ABAAS).
3. Inspect at various stages of construction as needed to ensure finished product meets standards.
4. Submit report no later than one calendar day after inspection was performed.

F. Off-Site Inspection Reports: Submit prior to shipment.

G. If Contractor Quality Control plan and Quality Control Daily Reports are not submitted as specified, Contracting Officer may retain payments until such time plan(s) is/are accepted and implemented, or may retain payments for work completed on days with no Quality Control Daily Reports.

H. Permits, Licenses, and Certificates: For National Park Service (NPS) records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of work.

1.5 QUALITY ASSURANCE

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

B. Contractors Quality Control Staff:

1. Contractor's Quality Control Supervisor shall be assigned no other duties.
2. Contractor's designated Quality Control Supervisor shall be on the project site whenever contract work is in progress.
3. Contractor's job supervisory staff may be used to assist Quality Control Supervisor supplemented, as necessary, by additional certified testing technicians.

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

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

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

F. Professional Engineer Qualifications: Professional engineer legally qualified to practice in jurisdiction where Project is located and is experienced in providing engineering services of kind indicated (including Structural Tests and Special Inspections (STSI)). Engineering services are defined as those performed for installations of system, assembly, or products similar to those indicated for Project in material, design, and extent.

G. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for activities indicated.

1. Requirement for specialists shall not supersede building codes and regulations governing Work.

H. Testing Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL), a National Voluntary Laboratory Accreditation Program (NVLAP), or an independent agency with experience and capability to conduct testing and inspecting indicated, according to ASTM E 329; and with additional qualifications specified in individual Sections; and where required by Contract, is acceptable to Contracting Officer.

1. Nationally Recognized Testing Laboratory (NRTL): Nationally recognized testing laboratory according to 29 CFR 1910.7 (Code of Federal Regulations).
2. National Voluntary Laboratory Accreditation Program (NVLAP): Testing agency accredited according to National Institute of Standards and Technology's (NIST) National Voluntary Laboratory Accreditation Program.
3. Measuring devices, laboratory equipment, and instruments shall be calibrated at established intervals against certified standards in accordance with NIST requirements. Measuring and testing devices shall be made available for use by Government for verification tests.

I. Factory-Authorized Service Representative Qualifications: Authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products similar in material, design, and extent to those indicated for Project.

J. Mockups: Before installing portions of work requiring mockups, build mockups for each form of construction and finish required to comply with following requirements, using materials indicated for completed work:

1. Build mockups in location and of size indicated; if not indicated, as directed by Contracting Officer.
2. Notify Contracting Officer seven days in advance of dates and times when mockups will be constructed.
3. Demonstrate proposed range of aesthetic effects and workmanship.
4. Obtain Contracting Officer's approval of mockups before starting work, fabrication, or construction.

5. Maintain mockups in an undisturbed condition as a standard for judging the completed work.
6. Mockups may remain as part of finished work with Contracting Officer’s approval.

1.6 QUALITY CONTROL

A. Contractor is responsible for testing and inspections, including Structural Tests and Special Inspections (STSI), as identified in attached STSI. Inspect and test work as needed to ensure quality of materials, workmanship, construction, finish, and functional performance are in compliance with applicable specifications, drawings, and those required by the Building Code.

1. Engage qualified testing agency to perform quality-control services.
2. Submit appropriate report for each quality-control service.
3. Testing and inspecting requested by Contractor and not required by Contract Documents are Contractor's responsibility.
4. Contracting Officer may designate test locations.

B. Manufacturer's Field Services: Where indicated, engage factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.

C. Re-testing/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction of replaced work that failed to comply with Contract Documents.

D. Testing Agency Responsibilities: Cooperate with NPS and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Contracting Officer and Contractor promptly of irregularities or deficiencies observed in work during performance of services.
2. Determine location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections, State in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit 3 copies of certified written report of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase Contract Document requirements or approve or accept any portion of Work.

E. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide:

1. Access to Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for material mixes that require control by testing agency.
7. Security and protection for samples and testing and inspecting equipment at Project site.

F. Coordination: Coordinate sequence of activities to accommodate required quality assurance and control services with minimum delay and to avoid removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS

2.1 QUALITY CONTROL PLAN

A. Quality Control Plan shall include:

1. List of personnel responsible for quality control and assigned duties. Include each person's qualifications. Include alternate(s) and qualifications.
2. Copy of letter of direction to Contractor's Quality Control Supervisor(s) outlining assigned duties and authorities designated by principal or owner.
3. Names, qualifications / accreditations, and descriptions of laboratories to perform sampling and testing, and samples of proposed report forms from laboratories.
4. Methods of performing, documenting, and enforcing quality control of work including Contractor report forms and acknowledgment of NPS forms.
5. Methods of monitoring and controlling environmental pollution and contamination as required by regulations and laws.
6. Specific discussion regarding mockups, off-site visits, receiving inspections, manufacturers representation, startup requirements, and other aspects of performance specific to Project.
7. Provisions for substantial completion(s) and final inspection(s) per Contract.

PART 3 - EXECUTION

3.1 OFF-SITE CONTROL

A. Items fabricated or assembled off-site shall be inspected for quality control at place of fabrication.

3.2 ON-SITE CONTROL

A. Notification:

1. Notify Contracting Officer at least 48 hours in advance of preparatory phase meeting.
2. Notify Contracting Officer at least 24 hours in advance of initial and follow-up phases.

B. Preparatory Phase: Perform before beginning each feature of work.

1. Review control submittal requirements with personnel directly responsible for quality assurance and quantity control of the work. As a minimum, Contractor's Quality Control Supervisor and foreman responsible for feature of work shall be in attendance.
2. Review applicable specifications sections and drawings related to feature of work.

3. Ensure copies of referenced standards related to sampling, testing, and execution for feature of work are available on site.
4. Ensure provisions have been made for field control testing.
5. Examine work area to ensure preliminary work has been completed.
6. Verify field dimensions and advise Contracting Officer of discrepancies with contract documents.
7. Ensure necessary equipment and materials are at project site and they comply with approved shop drawings and submittals.
8. Document preparatory phase activities and discussions on Contractor's Quality Control Daily Report.

C. Initial Phase:

1. As soon as work begins, inspect and test representative portion of particular feature of work for quality of workmanship.
2. Review control testing procedures to ensure compliance with contract requirements.
3. Document initial phase activities and discussions on Contractor's Quality Control Daily Report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.

D. Follow-Up Phase: Inspect and test as work progresses to ensure compliance with contract requirements until completion of work.

E. Additional Preparatory and Initial Phases: Additional preparatory and initial phases may be required on same feature of work for following reasons:

1. Quality of on-going work is unacceptable.
2. Changes in quality control staff, on-site production supervision, or work crew.
3. Work on particular feature of work is resumed after substantial period of inactivity.

3.3 DOCUMENTATION

A. Maintain Quality Control Daily Reports, Daily Test Report Information Sheets, and Accessibility Inspection Reports of quality control activities and tests. (Download from DSC Workflows website > Forms/Templates/Samples/Guidelines page > Construction Forms section.)

B. Quality Control Daily Reports shall not be substituted for other written reports required under clauses of contract, such as Disputes, Differing Site Conditions, or Changes.

C. Quality Control Daily Reports shall accurately portray all work and materials. The materials shall match the materials as approved from the Construction Documents (CD) requirements. Combustible/flammable materials shall be documented as well.

3.4 ENFORCEMENT

A. Contractor shall stop work on any item or feature pending satisfactory correction of deficiency noted by quality control staff or Contracting Officer.

3.5 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Comply with Contract Document requirements for Section 01 73 29 "Cutting and Patching."

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

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

END OF SECTION 01 40 00

Accessibility Inspection Report - Buildings & Facilities

(Contractor Quality Control (CQC) & Final)

National Park Service (NPS) - Denver Service Center (DSC) | 10-25-24

Park: Click or tap here to enter text.
Project Title: Click or tap here to enter text.
PMIS Number: Click or tap here to enter text.
(Project Management Information System)
Contract Number: Click or tap here to enter text.
Date of Inspection: Click or tap here to enter text.
Report Number: Click or tap here to enter text.
Final Inspection: ☐Yes ☐No

Notes & Requirements

This report covers the most common accessibility requirements. Expand this form for elements not shown. Inspect for compliance with requirements of the International Building Code (IBC) and Architectural Barriers Act Accessibility Standards (ABAAS), latest available release. Use applicable sections for each inspection. The inspection form is not comprehensive for all IBC or ABAAS requirements or all designs. Refer to IBC Chapter 11 for additional requirements (possibly conflicting, use most restrictive requirements in this case).

Measuring Outdoor Improvements

A measuring device shall be capable of measuring to a precision of 1/16 inch. Angular or slope measuring devices shall be capable of measuring to a precision of 0.1 degree. Elevation measuring devices shall be capable of measuring to a precision of 0.01 feet. Measure slope/cross-slope by subtracting elevations and dividing by distance. Measure flatness using a 10-foot metal straightedge with not to exceed 1/4-inch space between hard surface and metal edge. **ABAAS requirements identified refer to post construction measurements which include construction tolerances.**

Upon completion of work, Construction Contractor shall complete a final accessibility inspection. List deficiencies in Section 10 and add to punch list. Correct deficiencies in a timely manner. ABAAS construction non-compliance will be replaced at Construction Contractor's expense unless authorized by Contracting Officer (CO). File this report with CQC Daily Report in official project files.

1. Parking Spaces & Passenger Loading Zones

ABA Acessibility Standards > Chapter 4 Accessible Routes > 406 Curb Ramps & Chapter 5 General Site and Building Elements > 502 Parking Spaces:

Procedure

Attach copy of grading plan with each accessible parking space and passenger loading zone running and cross slope readings noted. Measure slopes and cross-slopes at 3-foot intervals.

Location/Notes

Click or tap here to enter text.

A. ☐Yes ☐No ☐Not Applicable
Accessible spaces and access aisles running slope and cross slope is 1:48 (2%) or less. Measure at 3-foot intervals.

Click or tap here to enter text.

B. ☐Yes ☐No ☐Not Applicable
Car spaces are 96 inches wide minimum and van spaces 132 inches wide measured to striping centerline or face of curb.

Click or tap here to enter text.

C. ☐Yes ☐No ☐Not Applicable
Access aisles are 60 inches wide minimum measured to striping centerline and adjoin an accessible route.

Click or tap here to enter text.

D. ☐Yes ☐No ☐Not Applicable
Curb ramp running slope is 1:12 (8.33%) or less and cross slope is 1:48 (2%) or less. Measure at 3-foot intervals.

Click or tap here to enter text.

E. ☐Yes ☐No ☐Not Applicable
Curb ramp has a 36-inch minimum landing length at top and running slope and cross slope are 1:48 (2%) or less.

Click or tap here to enter text.

F. ☐Yes ☐No ☐Not Applicable
Curb ramp flared side slopes are 1:10 (10%) or less.

Click or tap here to enter text.

G. ☐Yes ☐No ☐Not Applicable
Passenger loading zone (drop-off area) running slope and cross slope are 1:48 (2%) or less. Area has flush curb.

Click or tap here to enter text.

Inspection Results
Click or tap here to enter text.

2. Walking Surfaces & Accessible Routes
ABA Accessibility Standards > Chapter 3 Building Blocks > 302 Floor or Ground Surfaces & 303 Changes in Level:

Procedure
The accessible route is the pedestrian route from accessible parking and passenger loading zones to and between accessible facilities and features. Attach accessible route and/or grading plan with accessible route highlighted and running and cross slope readings noted.

Location/Notes

Click or tap here to enter text.

A. ☐Yes ☐No ☐Not Applicable
Floor and ground surfaces are stable, firm, and slip resistant.
ABA Accessibility Standards > *Chapter 3 Building Blocks* > *302 Floor or Ground Surfaces*

Click or tap here to enter text.

B. ☐Yes ☐No ☐Not Applicable
Running slope of all walking surfaces on accessible route is 1:20 (5%) or less. Measure at 3-foot intervals.

Click or tap here to enter text.

C. ☐Yes ☐No ☐Not Applicable
Cross slope of walking surfaces is 1:48 (2%) or less. Measure at 3-foot intervals.

Click or tap here to enter text.

D. ☐Yes ☐No ☐Not Applicable
Clear widths of walking surfaces are 36 inches minimum.

Click or tap here to enter text.

E. ☐Yes ☐No ☐Not Applicable
Elongated openings in floor or ground surfaces are 1/2 inch wide or less.

Click or tap here to enter text.

F. ☐Yes ☐No ☐Not Applicable
Curb ramp flared side slopes are 1:10 (10%) or less.

Click or tap here to enter text.

G. ☐Yes ☐No ☐Not Applicable
Elongated openings are perpendicular to direction of travel.

Click or tap here to enter text.

H. ☐Yes ☐No ☐Not Applicable
Accessible route surface changes are 1/2 inch or less with 1/4-inch maximum vertical change.

Click or tap here to enter text.

I. ☐Yes ☐No ☐Not Applicable
Floor drains and grates on accessible route meet all above requirements.

Click or tap here to enter text.

Inspection Results

Click or tap here to enter text.

3. Ramps

ABA Accessibility Standards > Chapter 4 Accessible Routes > 405 Ramps:

Procedure

Ramps are walking surfaces on accessible route steeper than 1:20 (5%) but less than 1:12 (8.33%). Attach grading plan with running and cross slope readings noted.

Location/Notes:

Click or tap here to enter text.

A. ☐Yes ☐No ☐Not Applicable
Running slope is 1:12 (8.33%) or less. Measure at 3-foot intervals.

Click or tap here to enter text.

B. ☐Yes ☐No ☐Not Applicable
Cross slope is 1:48 (2%) or less. Measure at 3-foot intervals.

Click or tap here to enter text.

C. ☐Yes ☐No ☐Not Applicable
Clear width is 36 inches minimum and clear width between handrails is 36 inches minimum.

Click or tap here to enter text.

D. ☐Yes ☐No ☐Not Applicable
Rise for ramp run is 30 inches maximum.

Click or tap here to enter text.

E. ☐Yes ☐No ☐Not Applicable
Ramps have landings at top and bottom of each ramp run.

Click or tap here to enter text.

F. ☐Yes ☐No ☐Not Applicable
Landing clear length is 60 inches minimum and running slope and cross slope of landing is 1:48 (2%) or less.

Click or tap here to enter text.

G. ☐Yes ☐No ☐Not Applicable
Ramps with a rise greater than 6 inches have handrails.

Click or tap here to enter text.

H. ☐Yes ☐No ☐Not Applicable
Ramps and landings have edge protection on both sides preventing passage of 4-inch diameter sphere.

Click or tap here to enter text.

Inspection Results

Click or tap here to enter text.

4. Handrails

ABA Accessibility Standards > *Chapter 5 General Site and Building Elements* > *505 Handrails*

Procedure

Verify each handrail.

Location/Notes

Click or tap here to enter text.

A. ☐Yes ☐No ☐Not Applicable
Top of handrail is 34 inches minimum and 38 inches maximum vertically above walking surfaces.
Click or tap here to enter text.

B. ☐Yes ☐No ☐Not Applicable
Handrails extend 12 inches minimum beyond top and bottom of ramp runs.
Click or tap here to enter text.

C. ☐Yes ☐No ☐Not Applicable
Free standing handrails have edge protection preventing passage of 4-inch diameter sphere.
Click or tap here to enter text.

D. ☐Yes ☐No ☐Not Applicable
Handrails extend horizontally 12 inches minimum at top of stairs.
Click or tap here to enter text.

E. ☐Yes ☐No ☐Not Applicable
Handrails extend at slope of stair flight at bottom of stairs minimum one tread depth beyond last riser.
Click or tap here to enter text.

F. ☐Yes ☐No ☐Not Applicable
Handrail clearance is 1-1/2 inches clear minimum to walls and above horizontal attachments.
Click or tap here to enter text.

Inspection Results

Click or tap here to enter text.

5. Drinking Fountains

ABA Accessibility Standards > *Chapter 3 Building Blocks* > *307 Protruding Objects*

Procedure

Verify drinking fountains do not create a protruding object and include 2 spout heights.

Location/Notes
Click or tap here to enter text.

A. ☐Yes ☐No ☐Not Applicable
Spout outlet is 36 inches maximum above finish floor or ground for wheelchair accessible spout.
Click or tap here to enter text.

B. ☐Yes ☐No ☐Not Applicable
Spout outlet for standing persons is 38 inches minimum and 43 inches maximum above finish floor.
Click or tap here to enter text.

C. ☐Yes ☐No ☐Not Applicable
Drinking fountain is recessed or has exactly 27 inches maximum space from floor to bottom of fountain. (Fountain must meet ABA Accessibility Standards requirements for knee room and requirements for persons with visual disabilities using a cane.)
Click or tap here to enter text.

Inspection Results
Click or tap here to enter text.

6. Toilet Compartments

ABA Accessibility Standards > Chapter 6 Plumbing Elements and Facilities > 604 Water Closets and Toilet Compartments, 605 Urinals & 609 Grab Bars

Procedure
For toilet compartments, attach floor plan and note as-built dimensions on diagrams below. Use additional sheet for each restroom.

Location/Notes
Click or tap here to enter text.

A. ☐Yes ☐No ☐Not Applicable
Wheelchair accessible compartment is 60 inches wide minimum and 59 inches deep minimum with wheelchair clear space adjacent to toilet.
Click or tap here to enter text.

B. ☐Yes ☐No ☐Not Applicable
Ambulatory stall is 60 inches deep minimum, width of 35 inches minimum and 37 inches maximum, and toilet is centered in stall.
Click or tap here to enter text.

C. ☐Yes ☐No ☐Not Applicable
Accessible compartment has 32-inch wide door opening minimum with door opening outward, or additional wheelchair clear space for door opening inward.
Click or tap here to enter text.

D. ☐Yes ☐No ☐Not Applicable
Seat height is 17 inches minimum and 19 inches maximum measured to top of seat.

Click or tap here to enter text.

E. ☐Yes ☐No ☐Not Applicable
Urinal rim is 17 inches maximum above finish floor and 13-1/2 inches deep minimum.

Click or tap here to enter text.

F. ☐Yes ☐No ☐Not Applicable
Urinal has a clear floor space of 30 inches wide by 48 inches long minimum for forward approach.

Click or tap here to enter text.

G. ☐Yes ☐No ☐Not Applicable
Side wall grab bar is 42 inches long minimum, located 12 inches maximum from rear wall.

Click or tap here to enter text.

H. ☐Yes ☐No ☐Not Applicable
Rear wall grab bar is 36 inches long minimum, extends from toilet centerline 12 inches minimum one side towards partition or wall and 24 inches minimum other side.

Click or tap here to enter text.

I. ☐Yes ☐No ☐Not Applicable
Grab bar height is 33 inches minimum and 36 inches maximum to top of gripping surface.

Click or tap here to enter text.

J. ☐Yes ☐No ☐Not Applicable
Toilet paper dispensers are 7 inches minimum and 9 inches maximum in front of toilet to centerline of dispenser.

Click or tap here to enter text.

K. ☐Yes ☐No ☐Not Applicable
Toilet paper dispenser outlet is 15 inches minimum and 48 inches maximum above finish floor.

Click or tap here to enter text.

L. ☐Yes ☐No ☐Not Applicable
Centerline of wheelchair stall toilet is 16 inches minimum to 18 inches maximum from side wall.

Click or tap here to enter text.

M. ☐Yes ☐No ☐Not Applicable
Sinks and counters are 34 inches maximum above floor with 27 inches minimum knee space. Drainpipes are insulated or concealed.

Click or tap here to enter text.

N. ☐Yes ☐No ☐Not Applicable
Space between grab bar and wall/partition and projecting objects below is 1-1/2 inches minimum. Space above is 12 inches minimum.

Click or tap here to enter text.

O. ☐Yes ☐No ☐Not Applicable
Wheelchair accessible compartment and ambulatory stall have door pulls on both sides of door near latch.

Click or tap here to enter text.

P. ☐Yes ☐No ☐Not Applicable
Hand dryers, towel and soap dispenser outlets are 15 inches minimum and 48 inches maximum above floor. Bottom edge of reflecting mirror surface above sink or countertops are 40 inches maximum above finished floor.

Click or tap here to enter text.

Inspection Results

Click or tap here to enter text.

7. Service Counters and Dining and Work Surfaces

ABA Accessibility Standards > Chapter 9 Built-In Elements > 904 Check-Out Aisles and Sales and Service Counters & 902 Dining Surfaces and Work Surfaces:

Procedure

Service counters and dining and work surfaces are parallel or forward approach. NPS treats service counters as possible employee work areas which are required to be 34 inches maximum.

Location/Notes

Click or tap here to enter text.

A. ☐Yes ☐No ☐Not Applicable
Parallel Approach. Counter is 36 inches long minimum and 36 inches high maximum.

Click or tap here to enter text.

B. ☐Yes ☐No ☐Not Applicable
Forward Approach. Counter surface is 30 inches long minimum and 36 inches high maximum with knee space under counter. See 306 for adequate depth and toe clearance.

Click or tap here to enter text.

C. ☐Yes ☐No ☐Not Applicable
Tops of dining and work surfaces are 28 inches minimum and 34 inches maximum above finished floor with adequate knee and toe clearance.

Click or tap here to enter text.

Inspection Results

Click or tap here to enter text.

8. Doors

ABA Accessibility Standards > *Chapter 4 Accessible Routes* > *404 Doors, Doorways, and Gates*

Procedure:

Attach accessible route plan with accessible door dimensions and threshold heights.

Location/Notes

Click or tap here to enter text.

A. ☐Yes ☐No ☐Not Applicable
Door openings on accessible routes provide clear width of 32 inches minimum.
Click or tap here to enter text.

B. ☐Yes ☐No ☐Not Applicable
Door closers move door from open position of 90 degrees to 12 degrees from latch is 5 seconds minimum.
Click or tap here to enter text.

C. ☐Yes ☐No ☐Not Applicable
Spring hinge doors close from open position of 70 degrees to closed position in 1.5 seconds minimum.
Click or tap here to enter text.

D. ☐Yes ☐No ☐Not Applicable
Fire doors have minimum opening force allowable by appropriate administrative authority.
Click or tap here to enter text.

E. ☐Yes ☐No ☐Not Applicable
Interior door and gate hardware located 34 inches minimum and 48 inches maximum above finished floor and operable with hinged doors having opening force of 5 pounds maximum.
Click or tap here to enter text.

F. ☐Yes ☐No ☐Not Applicable
Thresholds at doors on accessible route are beveled 1/2 inch or less with 1/4-inch maximum vertical change.
Click or tap here to enter text.

G. ☐Yes ☐No ☐Not Applicable
Clear floor and wall space provide maneuvering clearances required (all doors on accessible route).
Click or tap here to enter text.

Inspection Results

Click or tap here to enter text.

9. Signs

ABA Accessibility Standards > Chapter 7 Communication Elements and Features > 703 Signs

Location/Notes

Click or tap here to enter text.

A. ☐Yes ☐No ☐Not Applicable
Parking space signs are 60 inches minimum above finish ground surface measured to bottom of sign.

Click or tap here to enter text.

B. ☐Yes ☐No ☐Not Applicable
Van parking space sign includes designation "van accessible."

Click or tap here to enter text.

C. ☐Yes ☐No ☐Not Applicable
Tactile characters on signs are 48 inches minimum from lowest tactile character and 60 inches maximum above finished floor from baseline of hightest tactile character.

Click or tap here to enter text.

D. ☐Yes ☐No ☐Not Applicable
Visual characters are 40 inches minimum above finished floor.

Click or tap here to enter text.

E. ☐Yes ☐No ☐Not Applicable
Sign is located alongside door at latch side.

Click or tap here to enter text.

F. ☐Yes ☐No ☐Not Applicable
Sign is located with clear floor space of 18 inches by 18 inches minimum.

Click or tap here to enter text.

Inspection Results

Click or tap here to enter text.

10. Other Accessible Features Not Covered by Report

Procedure

Inspect elevators, lifts, elements for children, etc. Inspect for compliance with ABA Accessibility Standards requirements.

Location/Notes

Click or tap here to enter text.

Inspection Results

Click or tap here to enter text.

11. Punch List Items - Summary of Non-Conforming Inspection Results

Add deficiencies. Correct deficiencies in timely manner.

1. Deficiency:

   Click or tap here to enter text.

   Corrective Actions Needed/Taken:

   Click or tap here to enter text.

2. Deficiency:

   Click or tap here to enter text.

   Corrective Actions Needed/Taken:

   Click or tap here to enter text.

3. Deficiency:

   Click or tap here to enter text.

   Corrective Actions Needed/Taken:

   Click or tap here to enter text.

4. Deficiency:

   Click or tap here to enter text.

   Corrective Actions Needed/Taken:

   Click or tap here to enter text.

5. Deficiency:

   Click or tap here to enter text.

   Corrective Actions Needed/Taken:

   Click or tap here to enter text.

6. Deficiency:

   Click or tap here to enter text.

   Corrective Actions Needed/Taken:

   Click or tap here to enter text.

7. Deficiency:

   Click or tap here to enter text.

Corrective Actions Needed/Taken:

Click or tap here to enter text.

8. Deficiency:

   Click or tap here to enter text.

   Corrective Actions Needed/Taken:

   Click or tap here to enter text.

9. Deficiency:

   Click or tap here to enter text.

   Corrective Actions Needed/Taken:

   Click or tap here to enter text.

10. Deficiency:

    Click or tap here to enter text.

    Corrective Actions Needed/Taken:

    Click or tap here to enter text.

12. Photographs & Sketches

Attach to report as needed. Identify location of photographs and sketches.

Certification

I certify this inspection report is complete and correct and in compliance with contract documents.

Inspector Name: Click or tap here to enter text.

Date: Click or tap here to enter text.

SECTION 01 42 00 – REFERENCE STANDARDS

PART 1 - GENERAL

1.1 ENVIRONMENTAL DEFINITIONS

A. Definitions pertaining to sustainable development: As defined in ASTM E2114 and as specified herein.

B. Biobased Materials: As defined in the Farm Security and Rural Investment Act, for purposes of Federal procurement of biobased products, "biobased" means a "commercial or industrial product (other than food or feed) that is composed, in whole or in significant part, of biological products or renewable domestic agricultural materials (including plant, animal, and marine materials) or forestry materials." Biobased materials also include fuels, chemicals, building materials, or electric power or heat produced from biomass as defined by The Biomass Research and Development Act of 2000.

1. Biobased content: Amount of biobased carbon in the material or product as a percentage of weight (mass) of total organic carbon in the material or product.

C. Chain-of-Custody: Process whereby a product or material is maintained under physical possession or control during its entire life cycle.

D. Deconstruction: Disassembly of buildings for purpose of recovering materials.

E. DFE (Design for the Environment): A technique that includes elements of resource conservation and pollution prevention as applied in various product sectors. A technique that incorporates approaches which are part of product (or assembly) concept, need and design. Considerations involve material selection, material and energy efficiency, reuse, maintainability and design for disassembly and recyclability. Refer to International Organization for Standardization (ISO) Guide 64 for additional clarification.

F. Environmentally preferable products: Products and services that have a lesser or reduced effect on the environment in comparison to conventional products and services. Refer to EPA's Final Guidance on Environmentally Preferable Purchasing Program.

G. Non-Renewable Resource: A resource that exists in a fixed amount that cannot be replenished on a human time scale. Non-renewable resources have potential for renewal only by geological, physical, and chemical processes taking place over of millions of years. Examples include iron ore, coal, and oil.

H. Perpetual Resource: A resource that is virtually inexhaustible on a human time scale. Examples include solar energy, tidal energy, and wind energy.

I. Recycled Content Materials: Products that contain pre-consumer or post-consumer materials as all or part of their feedstock. Recycled content claim shall be consistent Federal Trade Commission (FTC) Guide for Use of Environmental Marketing Claims.

J. Renewable Resource: A resource that is grown, naturally replenished, or cleansed, at a rate which exceeds depletion of the usable supply of that resource. A renewable resource can be exhausted if improperly managed. However, a renewable resource can last indefinitely with proper stewardship. Examples include trees in forests, grasses in grasslands, and fertile soil.

1.2 QUALITY ASSURANCE

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

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

C. Conflicting Requirements: Where compliance with two or more standards is specified, and standards may establish different or conflicting requirements for minimum quantities or quality levels, comply with most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Contracting Officer (CO) for decision before proceeding.

1.3 INDUSTRY STANDARDS

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

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

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities found in Section 01 42 00 Sources for Reference Publications, Unified Facilities Guide Specifications (UFGS) (accessible via Masters website > Downloads section > click on UFGS Master (WBDG Website).

Names, telephone numbers, and websites are subject to change and are believed to be accurate and up-to-date as of date of Contract Documents.

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

IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICC	International Code Council www.iccsafe.org	(888) 422-7233
ICC-ES	ICC Evaluation Service, Inc. icc-es.org	(800) 423-6587 (562) 699-0543

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

ABA & ABAAS United States Access Board	Architectural Barriers Act (ABA) Architectural Barriers Act Accessibility Standards (ABAAS) www.access-board.gov
CoE	Army Corps of Engineers www.usace.army.mil
CPSC	Consumer Product Safety Commission www.cpsc.gov
DOC	Department of Commerce www.commerce.gov
DOD	Department of Defense www.defense.gov
DOJ	Department of Justice www.justice.gov
DOE	Department of Energy www.energy.gov
EPA	Environmental Protection Agency www.epa.gov

FAA	Federal Aviation Administration www.faa.gov
FCC	Federal Communications Commission www.fcc.gov
FDA	Food and Drug Administration www.fda.gov
GSA	General Services Administration www.gsa.gov
HUD	Department of Housing and Urban Development www.hud.gov
LBL	Lawrence Berkeley National Laboratory www.lbl.gov
NCHRP	National Cooperative Highway Research Program (See TRB (Transportation Resource Board))
NIST	National Institute of Standards and Technology www.nist.gov
OSHA	Occupational Safety & Health Administration www.osha.gov
PHS	U.S. Department of Health and Human Services www.hhs.gov
RUS	Rural Utilities Service (See USDA (Department of Agriculture))
SD	State Department www.state.gov
TRB	Transportation Research Board www.nationalacademies.org/trb/transportation-research-board
USDA	Department of Agriculture www.usda.gov
USP	U.S. Pharmacopeia www.usp.org
USPS	Postal Service www.usps.com

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in

following list. Names, telephone numbers, and websites are subject to change and are believed to be accurate and up-to-date as of date of Contract Documents.

ABAAS	Architectural Barriers Act Accessibility Standards www.access-board.gov
CFR	Code of Federal Regulations Available from Government Printing Office www.govinfo.gov/app/collection/cfr
DOD	Department of Defense Military Specifications and Standards Available from Department of Defense Single Stock Point www.dsp.dla.mil/Specs-Standards/
DSCC	Defense Supply Center Columbus (See FS (Federal Specification))
FED-STD	Federal Standard (See FS (Federal Specification))
FS	Federal Specification Available from Department of Defense Single Stock Point www.dsp.dla.mil/Specs-Standards/ Available from General Services Administration www.gsa.gov Available from National Institute of Building Sciences www.nibs.org
FTMS	Federal Test Method Standard (See FS (Federal Specification))
MIL	(See MILSPEC (Military Specification and Standards))
MIL-STD	(See MILSPEC (Military Specification and Standards))
MILSPEC	Military Specification and Standards Available from Department of Defense Single Stock Point www.dsp.dla.mil/Specs-Standards/
UFAS	Uniform Federal Accessibility Standards Available from Access Board www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-aba-standards/ufas *(UFAS is **only** for housing projects per Fair Housing Act. See also the Fair Housing Act Design Manual, www.huduser.gov/portal/publications/destech/fairhousing)*

1.5 ENVIRONMENTAL REFERENCE STANDARDS

A. American Forest and Paper Association:

1. Sustainable Forestry Initiative

B. American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE):
- **ASHRAE 52.2,** *Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size*
- **ASHRAE 55,** *Thermal Environmental Conditions for Human Occupancy*
- **ASHRAE 62.1,** *Ventilation for Acceptable Indoor Air Quality*
- **ASHRAE 62.2,** *Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings*
- **ASHRAE/IESNA 90.1,** *Energy Standard for Buildings, Except Low-Rise Residential Buildings*
- **ASHRAE 90.2,** *Energy Efficient Design of Low-Rise Residential Buildings*

C. American Association of State Highway and Transportation Officials (AASHTO):
- M288 Geotextile Specification for Highway Applications
- MP009-06 Standard Specification for Compost for Erosion/Sediment Control (Filter Berms and Filter Socks)
- MP010-03 Standard Specification for Compost for Erosion/Sediment Control (Compost Blankets)

D. American Society for Testing and Materials International (ASTM):
- A478 Standard Specification for Chromium-Nickel Stainless Steel Weaving and Knitting Wire
- A580/A580M Standard Specification for Stainless Steel Wire
- A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- B813 Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
- C1240 Standard Specification for Silica Fume Used in Cementitious Mixtures
- C128 Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
- C131 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- C1319 Standard Specification for Concrete Grid Paving Units
- C1338 Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings
- C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
- C1371 Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers
- C1386 Standard Specification for Precast Autoclaved AERATED Concrete (PAAC) Wall Construction Units
- C1483 Standard Specification for Exterior Solar Radiation Control Coatings on Buildings
- C1549 Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer
- C1601 Standard Test Method for Field Determination of Water Penetration of Masonry Wall Surfaces
- C289 Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)

- C311 Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete
- C33 Standard Specification for Concrete Aggregates
- C593 Standard Specification for Fly Ash and Other Pozzolans for Use With Lime
- C595 Standard Specification for Blended Hydraulic Cements
- C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
- C67 Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
- C739 Standard Specification for Cellulosic Fiber (Wood-Base) Loose-Fill Thermal Insulation
- C936 Standard Specification for Interlocking Concrete Paver Units
- C989 Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
- D1435 Standard Practice for Outdoor Weathering of Plastics
- D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 foot pound force per cubic foot (ft-lbf/ft3) (2,700 kilonewton meter per cubic meter (kN-m/m3))
- D1972 Standard Practice for Generic Marking of Plastic Products
- D198 Standard Test Methods of Static Tests of Lumber in Structural Sizes
- D2103 Standard Specification for Polyethylene Film and Sheeting
- D217 Standard Test Methods for Cone Penetration of Lubricating Grease
- D2369 Standard Test Method for Volatile Content of Coatings
- D3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
- D3786 Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method
- D3792 Standard Test Method for Water Content of Coatings by Direct Injection Into a Gas Chromatograph
- D3864 Standard Guide for Continual On-Line Monitoring Systems for Water Analysis
- D3960 Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
- D4017 Standard Test Method for Water in Paints and Paint Materials by Karl Fischer Method
- D4263 Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
- D4444 Standard Test Methods for Use and Calibration of Hand-Held Moisture Meters
- D4491 Standard Test Methods for Water Permeability of Geotextiles by Permittivity
- D4552 Standard Practice for Classifying Hot-Mix Recycling Agents
- D4632 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- D4716 Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
- D4833 Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Product
- D4840 Standard Guide for Sampling Chain-of-Custody Procedures
- D4887 Standard Test Method for Preparation of Viscosity Blends for Hot Recycled Bituminous Materials
- D5106 Standard Specification for Steel Slag Aggregates for Bituminous Paving Mixtures
- D5116 Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products

- D5199 Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
- D5261 Standard Test Method for Measuring Mass per Unit Area of Geotextiles
- D5268 Standard Specification for Topsoil Used for Landscaping Purposes
- D5359 Standard Specification for Glass Cullet Recovered from Waste for Use in Manufacture of Glass Fiber
- D5505 Standard Practice for Classifying Emulsified Recycling Agents
- D5509 Standard Practice for Exposing Plastics to a Simulated Compost Environment
- D5512 Standard Practice for Exposing Plastics to a Simulated Compost Environment Using an Externally Heated Reactor
- D5539 Standard Specification for Seed Starter Mix
- D5957 Standard Guide for Flood Testing Horizontal Waterproofing Installations
- D5603 Standard Classification for Rubber Compounding Materials—Recycled Vulcanizate Particulate Rubber
- D5663 Standard Guide for Validating Recycled Content in Packaging Paper and Paperboard
- D5759 Standard Guide for Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
- D5792 Standard Practice for Generation of Environmental Data Related to Waste Management Activities: Development of Data Quality Objectives
- D5834 Standard Guide for Source Reduction Reuse, Recycling, and Disposal of Solid and Corrugated Fiberboard (Cardboard)
- D5851 Standard Guide for Planning and Implementing a Water Monitoring Program
- D5852 Standard Test Method for Erodibility Determination of Soil in the Field or in the Laboratory by the Jet Index Method
- D6002 Standard Guide for Assessing the Compostability of Environmentally Degradable Plastics
- D6006 Standard Guide for Assessing Biodegradability of Hydraulic Fluid
- D6007 Standard Test Method for Determining Formaldehyde Concentration in Air from Wood Products Using a Small Scale Chamber
- D6046 Standard Classification of Hydraulic Fluids for Environmental Impact
- D6081 Standard Practice for Aquatic Toxicity Testing of Lubricants: Sample Preparation and Results Interpretation
- D6108 Standard Test Method for Compressive Properties of Plastic Lumber and Shapes
- D6109 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastic Lumber
- D6112 Standard Test Methods for Compressive and Flexural creep and Creep-Rupture of Plastic Lumber and Shapes
- D6117 Standard Test Methods for Mechanical Fasteners In Plastic Lumber and Shapes
- D6155 Standard Specification for Nontraditional Coarse Aggregates for Bituminous Paving Mixtures
- D6245 Standard Guide for Using Indoor Carbon Dioxide Concentrations to Evaluate Indoor Air Quality and Ventilation
- D6261 Standard Specification for Extruded and Compression Molded Basic Shapes Made from Thermoplastic Polyester (TPES)
- D6262 Standard Specification for Extruded, Compression Molded, and Injection Molded Basic Shapes of Poly(aryl ether ketone) (PAEK)
- D6270 Standard Practice for Use of Scrap Tires in Civil Engineering Applications
- D6329 Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers

- D6330 Standard Practice for Determination of Volatile Organic Compounds (Excluding Formaldehyde) Emissions from Wood-Based Panels Using Small Environmental Chambers Under Defined Test Conditions
- D6345 Standard Guide for Selection of Methods for Active, Integrative Sampling of Volatile Organic Compounds in Air
- D6400 Standard Specification for Compostable Plastics
- D6435 Standard Test Method for Shear Properties of Plastic Lumber and Plastic Lumber Shapes
- D6629 Standard Guide for Selection of Methods for Estimating Soil Loss by Erosion
- D6662 Standard Specification for Polyolefin-Based Plastic Lumber Decking Boards
- D6712 Standard Specification for Ultra-High-Molecular-Weight Polyethylene (UHMW-PE) Solid Plastic Shapes
- D6886 Standard Test Method for Speciation of the Volatile Organic Compounds (VOCs) in Low VOC Content Waterborne Air-Dry Coatings by Gas Chromatography
- D692 Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures
- D696 Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C With a Vitreous Silica Dilatometer
- D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))
- D7186 Standard Practice for Quality Assurance Observation of Roof Construction and Repair
- E1021 Standard Test Methods for Measuring Spectral Response of Photovoltaic Cells
- E1038 Standard Test Method for Determining Resistance of Photovoltaic Modules to Hail by Impact with Propelled Ice Balls
- E1039 Standard Test Method for Calibration of Silicon Non-Concentrator Photovoltaic Primary Reference Cells Under Global Irradiation
- E1040 Standard Specification for Physical Characteristics of Nonconcentrator Terrestrial Photovoltaic Reference Cells
- E1105 Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform or Cyclic Static Air Pressure Difference
- E1171 Standard Test Method for Photovoltaic Modules in Cyclic Temperature and Humidity Environments
- E1333 Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Under Defined Test Conditions Using a Large Chamber
- E1362 Standard Test Method for Calibration of Non-Concentrator Photovoltaic Secondary Reference Cells
- E1433 Standard Guide for Selection of Standards on Environmental Acoustics
- E1462 Standard Test Methods for Insulation Integrity and Ground Path Continuity of Photovoltaic Modules
- E1596 Standard Test Methods for Solar Radiation Weathering of Photovoltaic Modules
- E1597 Standard Test Method for Saltwater Pressure Immersion and Temperature Testing of Photovoltaic Modules for Marine Environments
- E1609 Standard Guide for Development and Implementation of a Pollution Prevention Program
- E1686 Standard Guide for Selection of Environmental Noise Measurements and Criteria
- E1690 Standard Test Method for Determination of Ethanol Extractives in Biomass
- E1721 Standard Test Method for Determination of Acid-Insoluble Residue in Biomass

- E1755 Standard Test Method for Ash in Biomass
- E1758 Standard Test Method for Determination of Carbohydrates in Biomass by High Performance Liquid Chromatography
- E1780 Standard Guide for Measuring Outdoor Sound Received from a Nearby Fixed Source
- E1799 Standard Practice for Visual Inspections of Photovoltaic Modules
- E1802 Standard Test Methods for Wet Insulation Integrity Testing of Photovoltaic Modules
- E1821 Standard Test Method for Determination of Carbohydrates in Biomass by Gas Chromatography
- E1827 Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door
- E1830 Standard Test Methods for Determining Mechanical Integrity of Photovoltaic Modules
- E1861 Standard Guide for Use of Coal Combustion By-Products in Structural Fills
- E1918 Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field
- E1971 Standard Guide for Stewardship for the Cleaning of Commercial and Institutional Buildings
- E1980 Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces
- E1991 Standard Guide for Environmental Life Cycle Assessment of Building Materials/Products
- E2047 Standard Test Method for Wet Insulation Integrity Testing of Photovoltaic Arrays
- E2114 Standard Terminology for Sustainability Relative to the Performance of Buildings
- E2128 Standard Guide for Evaluating Water Leakage of Building Walls
- E2129 Standard Practice for Data Collection for Sustainability Assessment of Building Products
- E2397 Standard Practice for Determination of Dead Loads and Live Loads associated with Green Roof Systems
- E2398 Standard Test Method for Water Capture and Media Retention of Geocomposite Drain Layers for Green Roof Systems
- E2399 Standard Test Method for Maximum Media Density for Dead Load Analysis of Green Roof Systems
- E2400 Standard Guide for Selection, Installation, and Maintenance of Plants for Green Roof Systems
- E241 Standard Guide for Limiting Water-Induced Damage to Buildings
- E2432 Standard Guide for General Principles of Sustainability Relative to Buildings
- E408 Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques
- E413 Standard Classification for Rating Sound Insulation
- E477 Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers
- E648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
- E683 Standard Practice for Installation and Service of Solar Space Heating Systems for One- and Two-Family Dwellings
- E779 Standard Test Method for Determining Air Leakage Rate by Fan Pressurization

- E781 Standard Practice for Evaluating Absorptive Solar Receiver Materials When Exposed to Conditions Simulating Stagnation in Solar Collectors With Cover Plates
- E782 Standard Practice for Exposure of Cover Materials for Solar Collectors to Natural Weathering Under Conditions Simulating Operational Mode
- E823 Standard Practice for Nonoperational Exposure and Inspection of a Solar Collector
- E881 Standard Practice for Exposure of Solar Collector Cover Materials to Natural Weathering Under Conditions Simulating Stagnation Mode
- E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
- E903 Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres
- E948 Standard Test Method for Electrical Performance of Photovoltaic Cells Using Reference Cells Under Simulated Sunlight
- F1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
- F2034 Standard Specification for Sheet Linoleum Floor Covering
- F2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

E. Bat Conservation International:
- Bat Approved Bat Houses

F. Carpet and Rug Institute
- Green Label & Green Label Plus Testing Programs, carpet-rug.org/testing/green-label-plus

G. Center for Resource Solutions
- Green-e program

H. Environmental Protection Agency (EPA):
- Comprehensive Procurement Guidelines
- ENERGY STAR
- Environmentally Preferable Purchasing Program Final Guidance
- GreenScapes program
- Heat Island Initiative
- Indoor Air Quality Building Education and Assessment Model (I-BEAM)
- National Environmental Performance Track
- Pollution Prevention (P2)
- Product Stewardship Program
- Significant New Alternatives Policy (SNAP) Program

I. Federal Trade Commission:
- Guide for the Use of Environmental Marketing Claims

J. Forest Stewardship Council:
- Chain-Of-Custody
- Forest Management

K. Green Building Initiative (GBI):

- Green Globes - US

L. Green Seal:
- GC-03 Anti-Corrosive Paints
- GC-12 Occupancy Sensors
- GC-13 Split-Ductless Air-Source Heat Pumps
- GS-05 Compact Fluorescent Lamps
- GS-11 Paints
- GS-13 Windows
- GS-14 Window Films
- GS-31 Electric Chillers
- GS-32 Photovoltaic Modules
- GS-36 Commercial Adhesives
- GS-37 Industrial & Institutional Cleaners

M. International Iron and Steel Institute:
- CO2 Breakthrough Program

N. International Organization of Standardization:
- Guide 64; Guide for Inclusion of Environmental Aspects in Product Standards
- 9660 Information processing -- Volume and file structure of CD-ROM for information interchange
- 14001 Environmental management systems – Specification with guidance for use
- 14004 Environmental Management Systems – General Guidelines on Principles, Systems and Supporting Techniques
- 14020 Environmental labels and declarations – General principles
- 14024 Environmental labels and declarations – Type I environmental labelling - Principles and procedures
- 14040 Environmental management – Life cycle assessment – Principles and framework

O. National Association of Home Builders:
- Advanced Framing Techniques: Optimum Value Engineering

P. National Institute of Building Sciences:
- MOIST program for transfer of heat and moisture
- Whole Building Design Guide

Q. National Institute of Standards and Technology:
- BEES (Building for Environmental and Economic Sustainability) Lifecycle Decision Support Tool

R. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
- IAQ Guidelines for Occupied Buildings Under Construction

S. Southcoast Air Quality Management District:
- 1168 Adhesive And Sealant Applications

T. US Composting Council:

- Seal of Testing Assurance Program

U. US Department of Agriculture:
- Biobased Products – Definitions and Descriptions

V. US Green Building Council:
- LEED™ 2009 Green Building Rating System
- LEED™ v4 (version 4) Green Building Rating System

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

A. Permanent Enclosure: As determined by Contracting Officer (CO), permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and openings are closed with permanent construction or substantial temporary closures.

1.3 USE CHARGES

A. General: Cost or use charges for temporary facilities shall be included in Contract Sum as required.

B. Water Service: Potable Water from existing water system is available for use with metering and without payment of use charges. Provide connections and extensions of services as required for construction operations with any additional permit costs.

C. Electric Power Service: Electric power from existing system is available for use with metering and without payment of use charges. Provide connections and extensions of services as required for construction operations with any additional permit costs.

1.4 QUALITY ASSURANCE

A. Electric Service: Comply with National Electrical Contractors Association (NECA), National Electrical Manufacturers Association (NEMA), and Underwriter Laboratories (UL) standards and regulations for temporary electric service. Install service to comply with National Fire Protection Association (NFPA) 70.

B. Environmental Protection: Provide environmental protection as required by agency(ies) with jurisdiction and as indicated in Contract Documents. Coordinate with requirements of the following:

1. Regulatory Requirements
2. Indoor Air Quality (IAQ) Management
3. Noise and Acoustics Management
4. Environmental Management

5. Construction Waste Management

1.5 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Temporary materials may be new or used, but must be adequate in capacity for required usage, must not create unsafe conditions, and must not violate requirements of applicable codes and standards.

B. Pavement: Comply with Division 32 [Section "Asphalt Paving."] [Section "Concrete Paving."] [pavement Sections.]

C. Portable Chain-Link Fencing: Minimum 2 inch (50 millimeters), 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet (1.8 millimeters) high with galvanized steel pipe posts; minimum 2-3/8 inch (60 millimeters) OD line posts and 2-7/8 inch (73 millimeters) OD corner and pull posts, with 1-5/8 inch (42 millimeters) OD top and bottom rails. Provide galvanized steel bases for supporting posts.

D. Safety Barrier Fence: Orange plastic fence, minimum height, 4 feet.

E. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10 mil (0.25-millimeter) minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.

F. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches (914 by 1624 millimeters).

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Contracting Officers Field Office: Field office shall be a separate structure from Contractor's office.

1. Prefabricated, job built, or a mobile unit; excellent condition, structurally sound, non-flammable exterior construction, weather tight, minimum 300 square feet.
2. Operable windows and security screens, adjustable ventilation.
3. Restroom (minimum of lavatory and toilet, with exhaust fan if room is windowless) or accessible Contractor facilities if available.
4. Air conditioner and heater.

5. Interior partition with lockable door to divide office
6. Paneling or freshly painted walls, acoustical tile or painted ceilings, and resilient flooring.
7. Two exterior doors with dead bolts keyed from outside,
8. Minimum 20-square-foot landing and steps at each exterior door.

C. Storage and Fabrication Sheds: Temporary weather tight sheds or other covered facilities for storage of materials subject to weather damage. Number and size of structures shall be subject to Contracting Officer's approval.

D. Toilets: Sufficiently lighted and ventilated toilet facilities in weatherproof, sight proof, handicap accessible, sturdy enclosures with privacy locks.

1. Provide separate toilet facilities for men and women.

2.3 EQUIPMENT

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

B. Lighting: Temporary lighting must comply with NPS and park lighting guidelines to reduce impacts to the night sky and wildlife. This will include, but is not limited to, energy efficient light sources in warm color hue such as amber or yellow (2700K or warmer); shielding to direct light downward; lowest lumens possible; and fixtures with adaptive technology controls such as timers, motion detectors, hue adapters, and dimmers.

C. Heating, Ventilation, and Air Conditioning (HVAC) Equipment: Unless Contracting Officer authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to agency(ies) with jurisdiction, and marked for intended use.

D. Contracting Officers Field Office

1. Outlets: Minimum of two, quad outlets with surge protection.
2. Refrigerator: Under counter, 3.2-cubic-foot volume with 0.8-cubic-foot freezer with dedicated power receptacle.
3. Fire Extinguisher: UL listed and FM (Fire Pump Motors) approved, minimum rating of 2-A:10-B:C, dry chemical.
4. First-Aid Kit: General office/light industrial kit.
5. Two desks with five drawers each and two chairs with casters; two drafting tables (minimum 40 inches wide by 5 feet long) and two stools; drawing rack; two 2-drawer and one 4-drawer legal size locking filing cabinets with keys; 8 feet of 12 inch deep shelving; coat rack; two additional guest chairs; two desk lamps; two drafting table lamps; and a maximum/minimum thermometer.
6. Manufactured computer work station, capable of containing CPU (central processing unit), monitor, keyboard, printer; work station chair.
7. Additional tables necessary for FAX machine and copier.

8. Two 5-gallon trash cans and one 30-gallon trash can with lid.
9. Ceiling mounted general lighting fixtures.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance and as directed by the Contracting Officer.

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

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, NPS, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services. Acquire necessary permits.

B. Storm Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system as directed by the agency(ies) with jurisdiction.

C. Non-potable water for construction is available on site. Install piping and connections as required.

D. Potable water is available on site. Make connections to existing facilities as needed. Facilities must be cleaned and maintained in a condition acceptable to NPS. At Substantial Completion, restore these facilities to condition existing before initial use.

E. Sanitary Facilities: Provide temporary toilets, and wash facilities for use by construction personnel.

1. Place in approved locations secluded from public observation and convenient to work stations. Relocate as work progress requires.
2. Maintain and clean toilet facilities at least weekly.
3. Completely remove sanitary facilities on completion of work.

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

1. Use of permanent heating and cooling system will not be allowed without written authorization from Contracting Officer. When the permanent heating and cooling system

is approved for use as temporary heating and cooling, pay costs until final acceptance. Permanent heating and cooling system shall be sufficiently complete, including controls, to permit safe operation

2. Provide and maintain adequate approved facilities, as required for safety and construction requirements, during the work. Provide ample clearance around stoves, heaters, chimney and vent connections to prevent ignition of combustible material
3. Install and maintain temporary filters when air handing equipment is used for temporary heating and cooling. Install new filters before final acceptance in addition to any extra sets of filters required. Clean coils as determined by Contracting Officer.
4. Warranties for equipment used for temporary heating and cooling shall start on date of Final Acceptance.

G. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

H. Electric Power Service: Use of existing electric power service will be permitted, as long as equipment is maintained in a condition acceptable to NPS.

1. When temporary connections are removed, restore existing utility services to original condition.

I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

J. Telephone Service: No telephone service is available on site for Contractor's use. If needed, make arrangements with Telephone Company and pay costs.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 50 feet of building lines. Comply with NFPA 241.
2. Maintain support facilities until near Substantial Completion. Remove structures, equipment, and furnishings, and terminate services after punch list is 100 percent completed or when directed by Contracting Officer. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Contracting Officer.

B. Contracting Officers Field Office:

1. Provide Heat, lights, power, air conditioning, temporary water pressure and sewage holding tanks.

2. Provide office, furnishings, and utility connections no later than 7 days after date of Notice to Proceed. Exact location will be determined by Contracting Officer.
3. Maintain equipment, furnishings, and structures. Provide equipment replacement elements as needed. Provide weekly cleaning services and trash disposal. Maintain and service water and sewer holding tanks as required.

C. Traffic Controls: Erect and maintain barricades, lights, danger signals, and warning signs in accordance with Manual on Uniform Traffic Control Devices (MUTCD), Part 6, latest edition.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.
3. Illuminate barricades and obstructions at night; keep safety lights burning from sunset to sunrise.
4. Adequately barricade and post open cuts in or adjacent to thoroughfares.
5. Protect pedestrian traffic by guardrails or fences.
6. When pedestrian traffic is detoured onto a roadway, provide temporary walkways with protection as required at ends and overhead. For walkways, use lumber running parallel to direction of traffic movement and provide ramps at changes of elevation.
7. Cover pipes, hoses, and power lines crossing sidewalks and walkways with troughs using beveled edge boards.
8. Install Barrier Tape where directed by Contracting Officer. Keep a minimum of two rolls on site.

D. Parking: If additional parking is required outside of the fenced construction site, use designated areas of existing parking areas shown on drawings for construction personnel.

E. Dewatering Facilities and Drains: Comply with requirements of the agency(ies) with jurisdiction. Maintain Project site, excavations, and construction free of water.

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

F. Project Identification and Temporary Signs: Provide Project identification and other signs. Fence, barricade, or otherwise block off the immediate work area to prevent unauthorized entry.

1. Provide temporary, directional signs for construction personnel and visitors.
2. Maintain and touchup signs so they are legible at all times.
3. Erect and maintain sufficient detour signs at road closures and along detour routes.

G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of agency(ies) with jurisdiction.

H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

I. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

J. Existing Stair Usage: Use of existing stairs will be permitted, as long as stairs are cleaned and maintained in a condition acceptable to Contracting Officer. At Substantial Completion, restore stairs to condition existing before initial use.

1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

K. Temporary Use of Permanent Stairs: Cover finished, permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of acceptance.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

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

B. Cleaning of Equipment: Contractor shall ensure prior to moving on to Project Area, equipment, is free of soil, seeds, vegetative matter, or other debris that could contain or hold seeds. Ensure equipment has been pressure washed and is free of exotic species. Equipment shall be considered free of soil, seeds, and other debris when visual inspection does not disclose such material. Disassembly of equipment components or specialized inspection tools are not required.

C. Temporary Erosion and Sedimentation Control: Refer to Section 01 57 23 "Temporary Storm Water Pollution Prevention".

D. Tree and Plant Protection: Refer to Section 01 11 00 "Summary of Work".

E. Pest Control: Follow NPS requirements to minimize attraction and harboring of rodents, roaches, and other pests and perform extermination and control procedures at regular intervals so Project will be free of pests and residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

F. Site Enclosure Fence: Before construction operations begin furnish and install portable chain link fencing with galvanized steel bases to prevent people and animals from easily entering site except by entrance gates.

1. Extent of Fence: As indicated on Drawings.
2. Locate vehicular gates to avoid interference with traffic on public thoroughfares.
3. Locate pedestrian entrance gates as required to provide controlled personnel entry.
4. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide Contracting Officer with one set of keys.

G. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

H. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

I. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

1. Responsible Person: Capable and qualified person shall be placed in charge of fire protection. Responsibilities shall include locating and maintaining fire protective equipment and establishing and maintaining safe torch cutting and welding procedures.
2. Tobacco Use, Smoking, and Vaping: Smoking within buildings or temporary storage sheds is prohibited.
3. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of NPS and Agency(ies) with Jurisdiction. Check with Park; many require "burn permits" for welding.
4. Develop and supervise overall fire-prevention and -protection program for personnel at Project Site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
5. Provide temporary standpipes and hoses for fire protection. Hang hoses with warning sign stating hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.
6. Hazard Control: Take necessary precautions to prevent fire during construction. Do not store flammable or combustible liquids in historic structures or existing buildings. Provide adequate ventilation during use of volatile or noxious substances. Ensure cleanup procedures and storage requirements are followed at close of every work session.
7. Spark Arresters: Equip gasoline or diesel powered equipment used during periods of potential fire hazards or in potential forest and grass fire locations with spark arresters approved by United States Department of Agriculture (USDA) Forest Service.

    a. Written determinations of periods and areas of potential fire hazard will be issued by Contracting Officer.

8. Buildings: Furnish a minimum of one extinguisher for each 1,500 square feet of area or major fraction thereof.

    a. Travel distance from any work station to nearest extinguisher shall not exceed 75 feet.

9. Vehicles and Equipment: Provide one extinguisher on each vehicle or piece of equipment.
10. Service and Refueling Areas: Locate areas a minimum of 50 feet from buildings. Shut down equipment before refueling.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. Minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on 24-hour basis where required to achieve indicated results and avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. NPS reserves right to take possession of Project identification signs.

END OF SECTION 01 50 00

SECTION 01 56 26
CONSTRUCTION FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Exhibits, and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Construction Fencing and Gates.

B. Related Requirements:

   1. None

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Chain-Link Fencing:

   1. Fabric: 11 Ga., galvanized steel wire woven into 2-inch diamond mesh, knuckled at the bottom and barbed at the top.

   2. Line Posts: 2 1/2” inch O.D. galvanized steel, standard weight pipe conforming to F 1083, schedule 40, weighing 3.65 pounds per linear foot.

   3. Terminal, Corner Posts and Gate: 3-inch O.D. galvanized steel, standard weight pipe conforming to ASTM F1083 schedule 40, weighing 5.79 pounds per linear foot.

   4. Braces: 1 5/8” inch O.D. galvanized steel, standard weight pipe conforming to ASTM F 1083, schedule 40, weighing 2.27 pounds per linear foot. Trusses shall be 5/16" diameter adjustable truss rods.

   5. Top Rail: 1 5/8” inch O.D. galvanized steel, standard weight pipe conforming to ASTM F 1083, schedule 40, weighing 2.27 pounds per linear foot.

   6. Bottom Tension Wire: Tension wire shall be No. 6 gauge galvanized wire.

   7. Fabric Tie Wires: 9-gauge galvanized wire.

   8. Post Caps, Rail Clamps, Fittings, and Hardware: Hot Dip Galvanized ductile iron, cast steel or pressed steel.

B. Gates:

1. Fabric: 11 Ga., galvanized steel wire woven into 2-inch diamond mesh, knuckled at the bottom and barbed at the top.

2. Frame: 2” O.D. gate frame with mid rail brace and 5/16” diameter adjustable truss rods.

3. Hinges: Heavy Duty, minimum 2 per leaf.

C. Locks:

1. Provide heavy duty steel chain and padlock at each gate.

2. Provide Construction manager with a set of gate keys, two (2) keys for each lock.

D. Concrete for Fence Foundations: Conform to N.Y.C. Dept. Of Transportation class B- 32, Type II A, air entrained, moderate sulphate resistant. The batch shall contain a minimum of six (6) bags of cement per cubic yard of concrete, maximum of 6 ½ gallons of water per bag, a maximum of three (3") inch slump, and a minimum compressive strength of 3,200 psi. Large aggregate shall be limited to one (1") inch.

E. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain-link fence and sized to height of fence and gate panels.

1. U.V. resistant, high-density polyethylene with fire retardant, such as Debris Netting as manufactured by PowerPak, Congers, NY, or equal.

2. Height of netting shall be eight (8’) feet minimum with a maximum hole size of one-sixteenth (1/16”) inch.

3. Color of netting shall be black, unless otherwise directed by the Engineer.

4. Netting shall meet the following minimum requirements:

Fabric weight	Exceeds	3 oz./SY
Air Permeability ASTM D737		1480 CFM
Bursting Strength		
ASTM D3786-2000 (Mullen Test)	Exceeds	100.0 PSI
Fire retardant standard	Meets	NFPA 701 Method II

5. Cable Ties (Zip Ties): Nylon with a minimum loop tensile strength of 18 lbs.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to installation of construction fencing and temporary construction fencing, mark- out fence and gate locations for review and approval by the Construction Manager. Adjust location as directed.

3.2 INSTALLATION, GENERAL

A. Construction Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.

1. Extent of Fence: As indicated on the Drawings and as required to enclose entire Project site or portion determined sufficient to accommodate construction operations.

2. Relocate fence as directed by the Construction Manager and as required to accommodate construction phasing and construction operations.

3. Maintain security by limiting number of keys and restricting distribution to authorized personnel.

Gates: Place gates at locations as shown on the Drawings or as required by the Contractor and approved by the Engineer.

3.3 OPERATION, TERMINATION, AND REMOVAL

A. Termination and Removal: Remove construction fences and gates as directed by the Construction Manager.

B. If necessary, restore permanent construction that may have been delayed because of interference with temporary facility Manager.

C. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

D. Materials and facilities that constitute temporary facilities are property of Contractor.

END OF SECTION

SECTION 015723
TEMPORARY STORM WATER POLLUTION PREVENTION

PART 1 GENERAL

1.1 SUMMARY

A. Federal Regulations for controlling discharges of pollutants (including chemicals, erodible material, and trash) from municipal separate storm sewer systems, construction sites, and industrial activities, were brought under the National Pollution Discharge Elimination System (NPDES) permit process by amendments to the Clean Water Act (CWA), and promulgation of federal stormwater regulations issued by the United States Environmental Protection Agency (USEPA). The USEPA uses amount of ground disturbance as a measure of a project potential to generate pollution from erosion. NPDES Phase I regulates discharges from construction sites that disturb 5 acres or more. NPDES Phase II regulations expand existing General Permit requirements under Phase I to include/regulated discharges from construction sites that disturb land equal to or greater than one (1) acre and less than 5 acres, known as Small Construction Activity. Construction disturbances 1 acre and above typically require a formal NPDES permit and a formal Stormwater Pollution Prevention Plan (SWPPP) must be submitted to Agency(ies) with Jurisdiction for review and approval.

B. National Park Service (NPS) Standards and Guidelines require water quality be protected to ensure compliance with Organic Act. Contractor shall prepare an Under-An-Acre Pollution Prevention Plan (UPPP) for each project resulting in less than 1 acre of soil disturbance or not otherwise subject to requirements of NPDES program. (UPPP Guideline)

C. The work of this section consists of implementing measures to prevent discharges of pollutants, including temporary storm water pollution during construction activities, either through compliance with NPDES permit program, or in conformance with NPS guidance for UPPPs.

D. Work of this section consists of implementing measures to Temporary Storm Water Pollution during construction activities, either through compliance with NPDES permit program; or in conformance with NPS guidance for UPPPs.

1.2 DEFINITIONS

A. Definitions pertaining to sustainable development: As defined in ASTM E2114.

B. Environmental Pollution and Damage: The presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances; or degrade utility of the environment for aesthetic, cultural, or historical purposes.

C. National Pollution Discharge Elimination System (NPDES) Phase I: Regulates discharges from construction sites that disturb 5 acres or more.

D. NPDES Phase II: Regulations expand existing General Permit requirements under Phase I to include and regulate discharges from construction sites that disturb land equal to or greater than one (1) acre and less than 5 acres, known as Small Construction Activity.

E. Storm Water Pollution Prevention Plan (SWPPP): Developed and implemented stormwater management measures to protect surface water from pollutants during construction activities disturbing an acre or more in compliance with federal, state, and local requirements for permit approval under NPDES program.

F. Under-An-Acre Pollution Prevention Plan (UPPP): Developed and implemented pollution prevention plan (including stormwater management measures, if needed) to protect environment from pollutants on construction projects with less than one acre of disturbance in conformance with NPS guidelines.

1.3 INFORMATIONAL SUBMITTALS

A. After contract award and before pre-construction conference, prepare and submit:

1. A SWPPP in conformance with NPS guidelines and adherence to applicable construction storm water management practices.

B. Inspection Schedule: Submit schedule for inspection and monitoring of pollution prevention measures.

C. Inspection Schedule: Submit schedule for inspection and monitoring of storm water pollution prevention measures.

D. Erosion Control Products: Submit manufacturer's product information and installation recommendations for silt fence, filter fabric, erosion control blanket, straw bales, and other materials proposed for use on this project.

1.4 QUALITY ASSURANCE

A. Contractor shall prepare and submit a plan to Contracting Officer (CO) for review and concurrence.

B. Orientation Meeting: Contractor shall be responsible for arranging and conducting Pollution Prevention meeting/briefing to inform parties scheduled to be on-site during project of measures to be implemented for proper pollution prevention and control (may be included as part of Pre-Construction Meeting).

1. Installation of silt fences, storm drain protection, and other forms of pollution prevention controls shall not begin until after this meeting has occurred.

C. Pollution Prevention Manager: Contractor shall designate Pollution Prevention Manager who will be responsible for implementation, inspection, maintenance, and amendments to approved plan.

1. Pollution Prevention Manager shall be familiar with SWPPP procedures and Best Management Practices (BMPs) and shall ensure emergency procedures and plans are updated as needed and available for inspection.

2. When changes in approved plan are required, Pollution Prevention Manager shall prepare and certify an amendment and submit to Contracting Officer for review and concurrence.

PART 2 PRODUCTS

2.1 STORM WATER POLLUTION PREVENTION PLAN

A. Provide SWPPP which conforms to NPDES requirements and include:

1. Responsible Parties
2. General Information: Project Scope, Project Details, Site Information, and Spill Prevention
3. Standards and Constraints
4. Project Scheduling
5. Known Data on Soil and Fill
6. Activities with Potential to Generate Sediment
7. Activities and Materials with Potential to Pollute Storm Water
8. Management and Reporting BMPs
9. Waste Management BMPs
10. Non-Storm Water Pollution Control BMPs
11. Soil Stabilization BMPs
12. Sediment Control BMPs
13. Other Pollution Control BMPs
14. References
15. Preparer's Certification
16. Appendices: Contact Information, Pollution Prevention Control Map or Sheet(s), Standard Installation Specifications for each BMP, and Blank forms.

PART 3 EXECUTION

3.1 ENVIRONMENTAL PROTECTION

A. Protection of Natural Resources: Comply with applicable regulations and these specifications. Preserve natural resources within project boundaries and outside limits of work performed under this Contract in their existing condition or restore to an equivalent or improved condition as approved by Contracting Officer.

B. Construction Zone: Arrange construction activities to minimize pollution (i.e., erosion, trash, etc.) to maximum practical extent.

1. Clearing, excavation, and grading shall be limited to those areas of project site necessary for construction. Minimize area exposed and unprotected.

2. Clearly mark and delineate limits of work activities.

3. Equipment shall not be allowed to operate outside limits of work or to disturb existing vegetation.

4. Excavation and grading shall be completed during dry season to maximum extent possible.

5. Material shall be stored away from locations where water is present to greatest extent practicable.

3.2 STORM WATER POLLUTION PREVENTION PLAN

A. Review and Acceptance: Contractor and Contracting Officer will jointly review draft Plan and agree to needed revisions. Contractor shall incorporate revisions, sign, and submit final Plan to Contracting Officer. Final Plan will be the document enforced on the project.

1. Accepted Plan will describe and ensure implementation of practices to be used to reduce pollutants in storm water discharges.

2. Contractor shall maintain current copy of Plan and associated records and forms at jobsite throughout duration of project.

3. Plan shall be available for public inspection and inspection and use of Contracting Officer.

4. Approval of Contractor's Plan will not relieve Contractor of responsibility for compliance with applicable environmental regulations.

B. Implementation: Implement Plan as required throughout construction period and maintain erosion control elements in proper working order.

1. Do not perform clearing and grubbing or earthwork until Plan has been implemented.

3.3 SITE INSPECTIONS AND PLAN REVISIONS

A. Inspections: Contractor and Contracting Officer will perform a weekly inspection onsite.

1. Inspection shall include disturbed areas not completely stabilized, areas used for storage of materials, locations where vehicles enter or exit site, and other erosion and sediment controls included in the Plan.

2. Inspections shall be documented.

3. Inspection forms shall be retained onsite in Plan notebook throughout construction period.

B. Plan Revisions: It may be necessary to revise Plan during construction to make necessary improvements, revisions, or to respond to unforeseen conditions noted during construction or site inspections.

1. Plan shall specify mechanism whereby revisions may be proposed by Contractor or Contracting Officer.

2. Contractor and Contracting Officer will jointly review each revision to Plan before changes incorporated and implemented. Contractor will then provide revised copy of Plan to Contracting Officer.

3. Accepted modifications will be implemented within 7 calendar days following date of inspection when deficiencies or necessary corrections are first noted.

C. Negligence: Provide additional temporary erosion and pollution controls made necessary by Contractor's errors or negligence at no additional cost to Government.

3.4 HOUSEKEEPING AND SITE MANAGEMENT

A. Store materials onsite in conformance to Federal, state, local, and manufacturer's regulations and specifications. Use Best Management Practices to minimize risk of materials coming into contact with environmental conditions (i.e. water and wind) that could disperse them.

B. Manage solid waste in conformance to Federal, state, and local regulations. Best Management Practices should be used to minimize risk of materials coming into contact with environmental conditions (i.e. water and wind) that could disperse them.

C. Manage hazardous waste (including contaminated soil) in conformance to Federal, state, local and NPS regulations and guidelines.

3.5 EROSION CONTROL MEASURES

A. Erosion control measures shall consist of Best Management Practices for storm water discharges, including silt fencing, barrier protectors, straw bales, temporary soil retention blankets, excelsior drainage filters, sediment traps and berms.

B. Berms and excelsior drainage filters shall be used to form sediment traps and control run-on and run-off into other areas, including creeks, streams, marshes, access roads, well areas, and staging areas.

C. Erosion control measures shall be used to contain only direct precipitation in construction zone. Contained water shall be allowed to percolate into ground or drain slowly through drainage filter sediment traps.

D. Earthen sediment traps or holding ponds shall not be used unless accepted by Contracting Officer.

E. Reduce runoff velocity and direct surface runoff around and away from fuel containment, storage, and borrow areas.

F. Divert surface runoff around and away from cut and fill slopes.

G. Place drainage filters around catch basins to create sediment traps to control run-off from construction area.

H. Excess water used for dust control shall be contained within demolition areas by erosion control measures.

I. Contractor shall prevent deposition of materials onto paved areas. Contractor shall inspect paved areas for deposited materials weekly and remove materials immediately.

J. Furnish, install, maintain, and operate necessary control measures and other equipment necessary to prevent erosion as described in approved SWPPP.

K. Before work begins, sufficient equipment shall be available on site to assure operation and adequacy of erosion control system can be maintained.

3.6 MAINTENANCE OF TEMPORARY FACILITIES

A. Ensure erosion and sediment control structures remain effective throughout excavation and grading operations. Relocate structures as necessary.

B. Inspect control structures after each significant rainfall. Promptly repair breaches which occur.

C. Contractor shall remove entrapped sediment from behind excelsior drainage filter after each storm.

3.7 REPORTING

A. If a discharge occurs or if project receives written notice or order from regulatory agency, Contractor shall immediately notify Contracting Officer and shall file written report to Agency(ies) with Jurisdiction within 7 days of discharge event, notice, or order. Corrective measures shall be implemented immediately following discharge, notice, or order. The report to the Agency(ies) with Jurisdiction shall contain:

1. Date, time, location, nature of operation, and type of discharge, including cause or nature of notice or order.

2. Best Management Practices deployed before discharge event, or prior to receiving notice or order.

3. Date of deployment and type of Best Management Practices deployed after discharge event, or after receiving notice or order, including additional Best Management Practices installed or planned to reduce or prevent re-occurrence.

4. An implementation and maintenance schedule for affected Best Management Practices.

3.8 SEDIMENT DISPOSAL

A. Sediment excavated from temporary sediment control structures shall be disposed on site with general fill, or with topsoil. Sediment shall be allowed to dry out as required before reuse.

B. Contractor shall place sediment removed from traps and other structures where it will not enter a storm drain or watercourse and where it will not immediately reenter the basin.

3.9 REMOVAL OF TEMPORARY STORM WATER POLLUTION CONTROL MEASURES

A. Temporary control measures shall be removed with permission of Contracting Officer within 20 working days after final acceptance of project, and/or once grading is complete and slopes have stabilized.

END OF SECTION

SECTION 01 67 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

A. Products: Items purchased for incorporating into Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number and other designation shown or listed in manufacturer's published product literature, current as of date of Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
3. Approved Equals: Product demonstrated and approved through submittal process, or where indicated as a product substitution, to have indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Definitions pertaining to sustainable development: As defined in ASTM E2114.

C. Biobased Materials: As defined in Farm Security and Rural Investment Act, for purposes of Federal procurement of biobased products, "biobased" means a "commercial or industrial product (other than food or feed) composed, in whole or in significant part, of biological products or renewable domestic agricultural materials (including plant, animal, and marine materials) or forestry materials." Biobased materials also include fuels, chemicals, building materials, or electric power or heat produced from biomass as defined by The Biomass Research and Development Act of 2000.

1. Biobased content: Amount of biobased carbon in material or product as a percentage of weight (mass) of total organic carbon in material or product.

D. Chain-of-Custody: Process whereby a product or material is maintained under physical possession or control during its entire life cycle.

E. Environmentally preferable products: Products and services with lesser or reduced effect on the environment in comparison to conventional products and services. Refer to Environmental Protection Agency's (EPA) Final Guidance on Environmentally Preferable Purchasing for more information.

F. Stewardship: Responsible use and management of resources in support of sustainability.

G. Sustainability: Maintenance of ecosystem components and functions for future generations.

1. Recycled Content Materials: Products containing pre-consumer or post-consumer materials as all or part of their feedstock. Recycled content claim shall be consistent with International Organization for Standardization (ISO) 140001 Standard for the Use of Environmental Marketing Claims.
2. Rapidly Renewable Material: Material made from plants typically harvested within a ten-year cycle.
3. Regional Materials: Materials manufactured and extracted, harvested, or recovered within a radius of 500 miles from Project location.

1.3 SUBMITTALS

A. Record Submittals as specified in – Sustainable Design Close-Out Documentation, submit:

1. Affirmative Procurement Reporting Form. Submit on form in Appendix A of this Section, or similar form as approved by Contracting Officer (CO).
2. Submit environmental data in accordance with Table 1 of ASTM E2129 for these products:

a. Masonry
b. Finish Carpentry
c. Building Insulation
d. Roofing
e. Joint Sealers
f. Wood & Plastic Doors
g. Windows
h. Skylights
i. Gypsum Board
j. Tile
k. Resilient Flooring
l. Paints & Coatings
m. Toilet Compartments
n. Furnishings & Accessories
o. Renewable Energy Equipment
p. Plumbing fixtures and equipment.
q. HVAC equipment
r. Lighting equipment

.Material Safety Data Sheets (MSDS): For each product required by OSHA to have a MSDS, submit an MSDS. MSDS shall be prepared within the previous five years. Include information for MSDS Sections 1 to 16 in accordance with ANSI Z400.1 and as follows:

a. Section 1: Chemical Product and Company Identification
b. Section 2: Composition/Information on Ingredients
c. Section 3: Hazards Identification
d. Section 4: First Aid Measures
e. Section 5: Fire Fighting Measures
f. Section 6: Accidental Release Measures
g. Section 7: Handling and Storage
h. Section 8: Exposure Controls/Person Protection
i. Section 9: Physical and Chemical Properties
j. Section 10: Stability and Reactivity Data
k. Section 11: Toxicological Information. Include data used to determine the hazards cited in Section 3. Identify acute data, carcinogenicity, reproductive effects, and target organ effects. Provide written description of the process used in evaluating chemical hazards relative to preparation of the MSDS.
l. Section 12: Ecological Information. Include data regarding environmental impacts during raw materials acquisition, manufacture, and use. Include data regarding environmental impacts in event of accidental release.
m. Section 13: Disposal Considerations. Include data regarding proper disposal of the chemical. Include information regarding recycling and reuse. Indicate whether or not product is considered to be "hazardous waste" according to United States EPA Hazardous Waste Regulations 40 CFR 261 (Code of Federal Regulations).
n. Section 14: Transportation Information. Identify hazard class for shipping.
o. Section 15: Regulatory Information. Identify federal, state, and local regulations applicable to the material.
p. Section 16: Other Information. Include additional information relative to recycled content, biobased content, and other information regarding environmental and health impacts. Identify the date MSDS was prepared.

4. Chain of Custody: Submit chain-of-custody documentation for sustainable forestry for these products:

a. Rough Carpentry
b. Finish Carpentry
c. Wood Doors
d. Windows
e. Wood Flooring
f. Furnishings & Accessories

1.4 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:

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

C. Storage:

1. Allow for inspection and measurement of quantity or counting of units.
2. Store materials in manner to not endanger Project structure.
3. Store products subject to damage by the elements, under cover in weather tight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store cementitious products and materials on elevated platforms.
5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Store loose granular materials in well-drained area on solid surfaces to prevent mixing with foreign matter.

1.6 PACKAGING

A. Where Contractor has option to provide one of listed products or equal, preference shall be given to products with minimal packaging and easily recyclable packaging as defined in ASTM D5834.

B. Maximize use of source reduction and recycling procedures outlined in ASTM D5834.

C. Provide minimum 45 percent post-consumer recycled content and minimum 100 percent recovered fiber content of industrial paperboard in accordance with EPA's Comprehensive Procurement Guidelines and ASTM D5663.

D. Provide minimum 15 percent post-consumer recycled content and minimum 100 percent recovered fiber content of carrier board in accordance with EPA's Comprehensive Procurement Guidelines and ASTM D5663.

E. Provide minimum 20 percent post-consumer recycled content and minimum 40 percent recovered fiber content of brown papers (e.g., wrapping papers and bags) in accordance with EPA's Comprehensive Procurement Guidelines and ASTM D5663.

1.7 ENVIRONMENTALLY PREFERABLE PRODUCTS

A. Provide environmentally preferable products to greatest extent possible.

1. To greatest extent possible, provide products and materials with a lesser or reduced effect on the environment considering raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, and/or disposal of the product.
2. Eliminate use of ozone depleting compounds during and after construction where alternative environmentally preferable products are available, consistent with either Montreal Protocol and Title VI or Clean Air Act Amendments of 1990, or equivalent overall air quality benefits that take into account life cycle impacts.
3. Use products meeting or exceeding EPA's recycled content recommendations for EPA-designated products. Use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the pre-consumer content constitutes at least 10% (based on cost) of total value of the materials in project.

1.8 PRODUCT WARRANTIES

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

1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for product specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by or incorporated into Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. Special Warranties: Prepare written document containing appropriate terms and identification, ready for execution. Submit draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with Specifications, prepare written document using appropriate form properly executed.
3. Refer to Divisions 2 through 49 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 01 77 00 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products to comply with Contract Documents, undamaged and, unless otherwise indicated, new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types produced and used successfully in similar situations on other projects.
3. Government reserves right to limit selection to products with warranties not in conflict with requirements of Contract Documents.
4. Where products are accompanied by term "as selected," Contracting Officer will make selection.
5. Where products are accompanied by term "match sample," sample to be matched is Governments.
6. Descriptive, performance, and reference standard requirements in Specifications establish "salient characteristics" of products.

B. Product Selection Procedures:

1. Product: Where Specifications name single product and manufacturer, provide named product that complies with requirements or approved equal.
2. Manufacturer/Source: Where Specifications name single manufacturer or source, provide product by named manufacturer or source that complies with requirements or approved equal.
3. Products: Where Specifications include list of names of both products and manufacturers, provide one of the products listed that complies with requirements or approved equal.
4. Manufacturers: Where Specifications include list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements or approved equal.
5. Available Products: Where Specifications include list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Products" Articles for consideration of an unnamed product.
6. Available Manufacturers: Where Specifications include list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Products" Articles for consideration of an unnamed product.
7. Product Options: Where Specifications indicate sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide specified product, system, or approved equal.
8. Visual Matching Specification: Where Specifications require matching an established Sample, select product that complies with requirements and matches Architect's sample. Contracting Officers decision will be final on whether a proposed product matches.

    a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.

9. Visual Selection Specification: Where Specifications include phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.

a. Standard Range: Where Specifications include phrase "standard range of colors, patterns, textures" or similar phrase, Contracting Officer will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
b. Full Range: Where Specifications include phrase "full range of colors, patterns, textures" or similar phrase, Contracting Officer will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 APPROVED EQUAL PRODUCTS

A. Conditions: Contracting Officer will consider Contractor's request when the following conditions are satisfied. If following conditions are not satisfied, Contracting Officer will return requests without action, except to record noncompliance with these requirements:

1. Evidence proposed product does not require revisions to Contract Documents, that it is consistent with Contract Documents and will produce indicated results and is compatible with other portions of Work.
2. Detailed comparison of significant qualities of proposed product with those named in Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION

3.1 PROTECTION AFTER INSTALLATION

A. Provide adequate coverings as necessary to protect installed materials from damage resulting from natural elements, traffic, and subsequent construction. Remove when no longer needed.

END OF SECTION 01 67 00

AFFIRMATIVE PROCUREMENT REPORTING FORM
Recycled Content Materials & Biobased Content Materials

Project Name: _____ Project Number: _____

Contractor Name: _____ License Number: _____

Contractor Address: _____

Product	Total $ value provided	Total $ value with recycled content Pre-consumer	Total $ value with recycled content Post-consumer	Total $ value with biobased content	Exempted indicate 1,2,3,4	Comments
Hydraulic Mulch (paper based)						
Hydraulic Mulch (wood based)						
Compost						
Parking Stops (Concrete w/ fly ash, slag cement or low cement content)						
Parking Stops (Plastic/Rubber)						
Patio Blocks/Rubber						
Patio Blocks/Plastic						
Playground Surfaces						
Concrete with fly ash						
Concrete with slag cement						
Concrete with low cement content						
Plastic lumber						
Building Insulation						
Rock Wool						
Fiber glass						
Cellulose						
Perlite Comp Board						
Plastic Rigid Foam						
Glass Fiber Reinforced Foam						
Phenolic Rigid Foam						
Ceramic tile						
Resilient flooring						
Floor Tiles/Rubber						
Floor Tiles/Plastic						
Running Tracks						
Carpet (PET)						
Paint						

Reprocessed Latex Paint White & Light Colors						
Reprocessed Latex Dark Colors						
Consolidated Latex Paint						
Toilet/Shower partitions (plastic or steel)						
Other						

CERTIFICATION

I hereby certify the information provided herein is accurate and that the requisition/procurement of all materials listed on this form comply with current EPA standards for recycled/recovered materials content. The following exemptions may apply to the non-procurement of recycled/recovered content materials:

1. The product does not meet appropriate performance standards.
2. The product is not available within a reasonable time frame.
3. The product is not available competitively (from two or more sources).
4. The product is only available at an unreasonable price (compared with a comparable non-recycled content product.)

Signature: _____ Date: _____

END OF
AFFIRMATIVE PROCUREMENT REPORTING FORM
Recycled Content Materials & Biobased Content Materials

SECTION 01 73 40 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general procedural requirements governing execution of Work including:

1. Coordination with utility service providers
2. Construction layout
3. Field engineering and surveying
4. General installation of products
5. Progress cleaning
6. Starting and adjusting
7. Protection of installed construction
8. Correction of the Work

1.2 SUBMITTALS

A. Certificates: Submit certificate signed by land surveyor and professional engineer certifying location and elevation of improvements comply with requirements.

B. Landfill Receipts: Submit copy of receipts issued by landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

C. Certified Surveys: Submit two copies signed by land surveyor and professional engineer.

D. Quantity Surveys: Submit 2 copies showing quantities of work performed and actual construction completed in place.

1.3 QUALITY ASSURANCE

A. Land Surveyor Qualifications: Professional engineer legally qualified to practice in jurisdiction where Project is located and–is experienced in providing land-surveying services of kind indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: Existence and location of site improvements and other construction indicated as existing are not guaranteed.

1. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

2. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: Existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify existence and location of underground utilities and other construction affecting Work.

1. Before construction, verify location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 COORDINATION WITH UTILITY SERVICE PROVIDERS

A. Coordination with Utility Service Providers: Contact following Utility Service providers, sufficiently in advance to avoid delaying the work, to coordinate Contractor's portion of Work, testing requirements, and inspections.

1. Electrical: Service Contact: ConEdison. Contact Contracting Officer coordinate Electrical service requirements.

a. Construction Contractor Responsibilities: Contractor is responsible for temporary hookups, maintenance and dismantling at project close-out as well as hookup and permit fees as required. Contractor is required to coordinate all work for temporary service.

2. Water Service Contact: NYDEP. Contact Contracting Officer to coordinate Water service requirements.

   a. Construction Contractor Responsibilities: Contractor is responsible for temporary hookups, maintenance and dismantling at project close-out as well as hookup and permit fees as required. Contractor is required to coordinate all work for temporary service.

3. Wastewater Service Contact: NYDEP. Contact Contracting Officer to coordinate Wastewater service requirements.

   a. Construction Contractor Responsibilities: Contractor is responsible for temporary hookups, maintenance and dismantling at project close-out as well as hookup and permit fees as required. Contractor is required to coordinate all work for temporary service.

4. Telephone Service Contact: If needed, contact Contracting to coordinate Telephone service requirements.

   a. Construction Contractor Responsibilities: Contractor is responsible for temporary hookups, maintenance and dismantling at project close-out as well as hookup and permit fees as required. Contractor is required to coordinate all work for temporary service.

3.3 PREPARATION

A. Field Measurements: Take field measurements as required to fit Work properly. Recheck measurements before installing each product. Where portions of Work are indicated fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying Work.

B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

C. Review of Contract Documents and Field Conditions: Immediately on discovery of need for clarification of the Contract Documents caused by differing field conditions outside control of Contractor, submit request for information to Contracting Officer in accordance with Section 01 31 00 "Project Management and Coordination."

3.4 CONSTRUCTION LAYOUT

A. Verification: Verify layout information shown on Drawings, in relation to the existing benchmarks before proceeding to lay out Work. Notify Contracting Officer promptly if discrepancies are discovered.

B. General: Engage a land surveyor to lay out Work using accepted surveying practices.

   1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.

2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
3. Inform installers of lines and levels to which they must comply.
4. Check location, level and plumb, of every major element as Work progresses.
5. Notify Contracting Officer when deviations from required lines and levels exceed allowable tolerances.
6. Close site surveys with an error of closure equal to or less than the established standard.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make log available for review by National Park Service (NPS).

3.5 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning Work. Preserve and protect permanent benchmarks and control points during construction operations. Controls destroyed by Contractor will be replaced by Contractor at their expense.

1. Existing Monuments: All benchmarks, land corners, and triangulation points, established by other surveys, existing within construction area shall be preserved. If existing monuments interfere with Work, secure written permission before removing them.

B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with NPS requirements for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

3.6 INSTALLATION

A. General: Locate Work and components of Work accurately in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.

2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions for best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Templates: Obtain and distribute to parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of Work.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Contracting Officer.
2. Allow for building movement, thermal expansion, and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors to be embedded in concrete or masonry. Deliver to Project site in time for installation.

H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for best visual effect. Fit exposed connections together to form hairline joints.

I. Hazardous Materials: Use products, cleaners, and installation materials not considered hazardous.

J. Quantity surveys: Shall be conducted, and data derived from these surveys shall be used in computing quantities of work performed and actual construction completed and in place.

1. Contractor shall conduct original and final surveys and surveys for any periods for which progress payments are requested. These surveys shall be conducted under direction of a representative of the Contracting Officer, unless Contracting Officer waives requirement in a specific instance. Government shall make such computations as are necessary to determine quantities of work performed or finally in place. Contractor shall make computations based on surveys for any periods for which progress payments are requested.
2. Promptly upon completing a survey, Contractor shall furnish originals of field notes and other records relating to survey or layout of Work to Contracting Officer. Contractor shall retain copies of all such material furnished to Contracting Officer.

3.7 PROGRESS CLEANING

A. General: Clean Project site, work areas, and common areas daily. Coordinate progress cleaning for joint-use areas where more than one Installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in National Fire Protection Association (NFPA) 241 for removal of combustible waste materials and debris at the end of every work session.
2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 degrees Fahrenheit (27 degrees Celsius).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to level of cleanliness necessary for proper execution of Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of Work, broom-clean or vacuum entire work area, as appropriate.
3. Contractor shall provide progress cleaning that minimizes sources of food, water, and harborage available to pests.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials not hazardous to health or property and will not damage exposed surfaces.

1. Utilize non-toxic cleaning materials and methods.

a. Comply with Green Seal Standard (GS) 37 for general purpose cleaning and bathroom cleaning.
b. Use natural cleaning materials where feasible. Natural cleaning materials include:

1) Abrasive cleaners: substitute 1/2 lemon dipped in borax.
2) Ammonia: substitute vinegar, salt and water mixture, or baking soda and water.
3) Disinfectants: substitute 1/2 cup borax in gallon water.
4) Drain cleaners: substitute 1/4 cup baking soda and 1/4 cup vinegar in boiling water.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

H. Clean and protect construction in progress and adjoining materials already in place during handling and installation. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations so that no part of construction completed or in progress, is subject to harmful, dangerous, damaging, or deleterious exposure during construction period.

K. Final Cleaning: At completion of Work, remove remaining waste materials, rubbish, tools, equipment, machinery and surplus materials. Clean exposed surfaces and leave Project clean and ready for occupancy.

1. Provide final cleaning in accordance with ASTM E1971.

3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Section 01 40 00 "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Section 01 73 29 "Cutting and Patching."

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to specified condition.

C. Remove and replace damaged surfaces exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 73 40

SECTION 017419
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

1.2 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Solid Waste: Garbage, debris, sludge, or other discharged material (except hazardous waste) including solid, liquid, semisolid, or contained gaseous materials resulting from domestic, industrial, commercial, mining, or agricultural operations.

D. Debris: Non-hazardous solid waste generated during construction, demolition, or renovation of a structure which exceeds 2.5 inch (60 millimeter) particle size that is: a manufactured object; plant or animal matter; or natural geologic material (e.g. cobbles and boulders). A mixture of debris and other material such as soil or sludge is also subject to regulation as debris if mixture is comprised primarily of debris by volume, based on visual inspection.

E. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

F. Environmental Pollution and Damage: Presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances; or degrade utility of environment for aesthetic, cultural, or historical purposes.

G. Garbage: Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

H. Hazardous Materials: Material regulated as a hazardous material in accordance with 49 CFR 173 (Code of Federal Regulations), requires a Material Safety Data Sheet (MSDS) in accordance with 29 CFR 1910.1200, or which during end use, treatment, handling, storage, transportation or disposal meets or has components which meet or have potential to meet the definition of Hazardous Waste in accordance with 40 CFR 261.

I. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

J. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

K. Single-use plastic products: Plastic items intended to be disposed of immediately after use, including plastic and polystyrene food and beverage containers, bottles, straws, cups, cutlery, and disposable plastic bags.

1.3 PERFORMANCE REQUIREMENTS

A. General: Project shall minimize creation of construction, deconstruction, and demolition waste to protect and restore natural habitat and resources. Minimize factors contributing to waste such as over packaging, improper storage, ordering error, poor planning, breakage, mishandling, single- use plastic products, and contamination. A Waste Management Plan shall be developed to ensure that existing site and building materials are reused, salvaged, or recycled. Minimize waste disposal in landfills.

B. Salvage /Recycle Requirements: Develop waste management plan resulting in end-of-Project rates for salvage/recycling of 75 percent by weight of total waste generated by the Work. The following waste categories, at a minimum, shall be diverted from a landfill:

1. Land clearing debris (chipped debris can be used on site for mulch or erosion control)
2. Clean dimensional wood, palettes
3. Plywood, OSB (oriented strand board), and particle board
4. Concrete (can be ground and used for fill on site)
5. Asphaltic concrete (can be ground and used for fill on site)
6. Cardboard, paper, packaging, newsprint
7. Metals (from banding, stud trim, piping, rebar, roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze)
8. Gypsum drywall - unpainted
9. Non-hazardous paint and paint cans
10. Beverage containers: Aluminum, glass, and plastic containers
11. Insulation
12. Ceiling grid and tiles
13. Ductwork
14. Wiring
15. Other mixed construction and demolition waste as appropriate.

C. If waste materials encountered during deconstruction/demolition or construction phase are found to contain lead, asbestos, polychlorinated biphenyls (PCBs), (such as fluorescent lamp ballasts), or other harmful substances, they are to be handled and removed in accordance with local, state, and federal laws and requirements concerning hazardous waste.

D. Existing items and material to be removed during deconstruction/demolition phase shall be reused in construction phase of the Project. Items that cannot be reused shall be recycled. Items considered for reuse must be in refurbishable condition and must meet quality standards set forth in these specifications. Contractor shall ensure quality of the item(s) in question will meet or exceed accepted industry or trade standards for first quality commercial grade application. During construction, deconstruction, or demolition Contracting Officer (CO) may designate other objects or materials for reuse.

E. Salvage/Recycle Requirements: Government goal is to salvage and recycle as much nonhazardous demolition and construction waste as possible including the following materials:

F. Salvage/Recycle Requirements: Government goal is to salvage and recycle as much nonhazardous demolition and construction waste as possible. Government has established minimum goals for the following materials:

1.4 INFORMATIONAL SUBMITTALS

A. Waste Management Plan: After award of contract and prior to scheduled Pre-Construction Conference, Contractor shall submit a draft Waste Management Plan to Contracting Officer for approval. Submit 3 copies of plan. Revise and resubmit Plan as required by Contracting Officer. Approval of Contractor's Plan will not relieve Contractor of responsibility for compliance with applicable environmental regulations.

B. Qualification Data: For Waste Management Coordinator and refrigerant recovery technician.

C. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating refrigerant that was present was recovered and recovery was performed according to Environmental Protection Agency (EPA) regulations. Include name and address of technician and date refrigerant was recovered.

D. Progress payment requirements:

1. With each Application for payment, submit an updated Project Waste Management Plan worksheet for solid waste disposal and diversion.

2. With each Application for Payment, submit manifests, weight tickets, receipts, and invoices specifically identifying the Project and waste material.

E. Closeout Submittals

1. With Closeout Submittals, submit a summary of a Project Waste Management Plan worksheet for solid waste disposal and diversion.

1.5 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, with record of successful waste management coordination of projects with similar requirements, that employs a LEED™- Accredited Professional, certified by USGBC, as waste management coordinator. [Waste management coordinator may also serve as LEED™ coordinator].

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

C. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Waste Management Meeting: Conduct separate meeting or cover in Pre-Construction Conference and comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to waste management including:

1. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review procedures for reduction of single-use plastic products on site.
6. Review waste management requirements for each trade.

PART 2 PRODUCTS

2.1 WASTE MANAGEMENT PLAN

A. General: Develop plan consisting of waste identification and waste reduction work plan. Include separate sections in plan for demolition and construction waste. Indicate quantities by weight or volume but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials salvaged and reused in Project, describe methods for preparing salvaged materials before incorporation into the Work.

2. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.

3. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.

4. Handling and Transportation Procedures: Include method used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

5. Reduction of single-use plastic products: Include methods for water distribution to include bottle refilling stations if available for personnel.

D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include:

1. Landfill tip fees per ton.

2. If diverted, tip fee savings from landfill diversion.

3. Costs of recycling, salvage, or reuse.

4. Revenue from recycling, salvage, or reuse.

5. Total cost or savings from diversion. (Calculate by using tip fee savings and subtracting costs of recycling or adding revenue from recycling.)

PART 3 EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement waste management plan as approved by Contracting Officer. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during entire duration of Contract.

B. Waste Management Coordinator: Engage waste management coordinator responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.

C. Contractor shall establish contacts with local recycling and reuse companies to set up lines of responsibility. Contractor shall be responsible for coordination in terms of identifying materials, pickup schedules, and standard quality for recycled materials.

D. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

1. Distribute waste management plan to everyone concerned within three days of submittal return.

2. Distribute waste management plan to entities when they begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

E. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

F. Separation facilities:

1. Contractor shall designate and Contracting Officer shall approve specific area or areas to facilitate separation of materials for potential reuse, salvage, recycling, and return.

2. Place waste and recycling bins near each other, and close to point of waste generation but out of traffic pattern.

3. Keep recycling and waste bin areas neat, clean, and clearly marked in order to avoid co-mingling of materials.

4. Protect bins during non-working hours from off-site contamination.

5. Check garbage dumpsters periodically for recyclables being thrown away and undocumented materials that could be recycled.

G. Materials handling procedures: Material to be recycled shall be protected from contamination and shall be handled, stored, and transported in a manner that meets requirements set by designated facilities for acceptance. Establish defined area for operations of each trade, especially woodcutting so off-cuts are kept in one area and can be sorted by dimension for future reuse.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work:

1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers.

3. Store items in secure area until installation.

4. Protect items from damage during transport and storage.

5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Governments Use:

1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers.

3. Allow for inspection if necessary.

4. Store items in secure area until delivery to Government.

5. Transport items to storage area off-site designated by Government.

6. Protect items from damage during transport and storage.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Receivers and Processors: List below is provided for information only; available recycling receivers and processors include:

C. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to maximum extent practical.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.

4. Store components off ground and protect from weather.

5. Remove recyclable waste off Government property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Pulverize concrete to maximum 1-1/2 inch (38 millimeter).

B. Metals: Separate metals by type.

1. Remove and dispose of bolts, nuts, washers, and other rough hardware.

C. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

D. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in dry location.

1. Separate suspension system, trim, and other metals from panels and tile and sort with other metals.

E. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.

1. Store clean, dry carpet and pad in closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.

F. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

G. Conduit: Reduce conduit to straight lengths and store by type and size.

H. Electronic Products: Ensure non-usable electronic products are reused, donated, sold, or recycled using environmentally sound management practices at end of life.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in dry location.

2. Polystyrene Packaging: Separate and bag materials.

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

4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Gypsum Board: Stack large clean pieces on wood pallets and store in dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose in landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials to accumulate on-site.

2. Remove and transport debris in manner preventing spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Transport waste materials off Government property and legally dispose of them.

D. Excess material excavated must be legally disposed of as part of the bid price of this item. All excess material shall be removed in compliance with current New York State Department of Environmental Conservation (NYSDEC) regulations. Where quantities of excess material exceed ten (10) cubic yards, or as directed by the Contracting Officer, a material disposal plan shall be submitted. Any testing required by the disposal facility to accept the excess material shall be included under the bid price of this item, unless otherwise specified.

END OF SECTION

DIVISION 02 -- EXISTING CONDITIONS

SECTION 02 41 00
SELECTIVE DEMOLITION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of building elements for alteration purposes.

1.02 DEFINITIONS

A. Existing to Remain: Designation for existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

B. Demolition: Dismantle, raze, destroy or wreck any building or structure or any part thereof.

C. Dismantle: to disassemble or detach a historic item from a surface, or a nonhistoric item from a historic surface, using gentle methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

D. Remove: to take down or detach a non-historic item located within a historic space, area, or room, using methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged and returned to the park or reinstalled.

E. Remove and Salvage: Detach or dismantle items from existing construction in a manner to prevent damage. Clean, package, label and deliver salvaged items to Park in ready-for-reuse condition.

F. Remove and Reinstall: Detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall where indicated.

G. Retain: to keep existing items that are not to be demolished, removed or dismantled.

1.03 REFERENCE STANDARDS

A. 29 CFR 1926 - Safety and Health Regulations for Construction Current Edition.

B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations 2022, with Errata (2021).

1.04 SUBMITTALS

A. Site Plan: Indicate:
   1. Areas for temporary construction and field offices.
   2. Areas for temporary and permanent placement of removed materials.
   3. Areas for salvaged materials to be used in future construction work.

B. Demolition Plan: Submit demolition plan as required by OSHA and local AHJs.

C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Company specializing in the type of work required.

1. Minimum of 5 years of documented experience working on selective demolition within Historic buildings.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 DEMOLITION

A. Remove portions of existing buildings as indicated in the Construction Documents.

B. Remove other items indicated, for salvage, relocation, and recycling.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Comply with applicable requirements of NFPA 241.
   3. Use of explosives is not permitted.
   4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   5. Provide, erect, and maintain temporary barriers and security devices.
   6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   8. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
   9. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
   10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.

B. Do not begin removal until receipt of notification to proceed from CO.

C. Do not begin removal until built elements to be salvaged or relocated have been removed.

D. Protect existing structures and other elements to remain in place and not removed.
   1. Provide bracing and shoring.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately and notify CO if adjacent structures appear to be in danger.

E. Minimize production of dust due to demolition operations. Do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

F. Hazardous Materials:
   1. Hazardous materials are known to be in this building. See Sections 02 82 13 Asbestos Removal and 02 83 33 Lead-Containing Paint.

3.03 EXISTING UTILITIES

A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to CO.

E. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

F. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

G. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone. Identify and mark, in same manner as other utilities to remain, utilities to be reconnected.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.
   1. Verify construction and utility arrangements are as indicated.
   2. Report discrepancies to CO before disturbing existing installation.
   3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Services including, but not limited to, HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications: Remove existing systems and equipment as indicated in Construction Documents.
   1. Maintain existing historic systems to remain in the building as indicated on the Construction Documents.

C. Protect existing work to remain.
   1. Prevent movement of structure. Provide shoring and bracing as required.
   2. Perform cutting to accomplish removal work neatly and as specified for cutting new work.

3.05 DEBRIS AND WASTE REMOVAL

A. Properly remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 02 82 13 - ASBESTOS REMOVAL

PART 1 - GENERAL REQUIREMENTS

1.1 GENERAL INFORMATION

A. Hangars 3 and 4 at Floyd Bennett Field will undergo renovations. An asbestos containing building material inspection was completed and analysis of the 121 samples collected identified eight (8) materials containing greater than 1.0% asbestos. The asbestos containing material (ACM) are classified as Category I non-friable. The locations and descriptions of the samples collected is presented in the Environmental Hazardous Materials Survey provided as **Appendix A**. The following plan outlines work practices required for this work. This work will be contracted under a single contract and other specifications, drawings, and general provisions of the contract referenced under other specifications provided shall apply.

B. The Owner for this project is the National Park Services. The Architect for this project is Quinn Evans Architects and is referred to throughout this section as "Architect." The Owner's authorized representative for the purposes of asbestos abatement is referred to as COR throughout this section.

C. The Contractor is the person or entity identified as such in the Owner-Contractor Agreement and is referred to throughout this section as "Contractor." The term Contractor means the Asbestos Abatement Contractor for the purposes of this section. The COR will contract with a qualified abatement Contractor.

1.2 SCOPE OF WORK

A. The scope of work includes the removal and disposal of the identified ACM located in the Hangars by a Contractor property licensed in the state of New York.

1.3 OTHER REQUIREMENTS

A. The Contractor shall stage work in a clear and organized manner.

B. The Contractor is required to provide all necessary air monitoring services in order to meet NY State and OSHA standards.

C. The Contractor shall be prepared to provide temporary power and water. Temporary power and water piping shall be secured so that it does not present a hazard to onsite workers and authorized visitors. The Contractor shall also be responsible for providing electrical power to the air monitoring firm for air sample collection.

D. Authorized workers: All workers performing the asbestos work at this site must be licensed by New York with appropriate asbestos credential.

E. Discovery of other hazardous materials. If hazardous materials, such as chemicals, or other hazardous materials are discovered during the work other than asbestos debris, the Contractor shall cease work in affected area and immediately assess the area. The Owner shall be notified within the work shift of discovery.

F. The Contractor shall assume full responsibility and liability for the compliance with all applicable federal, state and local regulations pertaining to work practices, hauling, disposal, and protection of workers, visitors to the site, and persons occupying areas adjacent to the site.

G. The Contractor is responsible for providing medical examinations and maintaining medical records of personnel as required by the applicable federal, state, and local regulations. The Contractor shall hold the Owner, COR, Architect, and Engineer/Air Monitoring Firm harmless for failure to comply with any applicable work, hauling, disposal, safety, health or other regulation on the part of himself, his employees, or his subcontractors.

H. Contractor must furnish all permits, labor, material, services, insurance, tools, equipment (including, but not limited to, power and water), and notifications in accordance with EPA, OSHA, State, and all other applicable agencies to complete removal of asbestos containing materials from the structures. It is the Contractors' responsibility to be aware of and obtain all permits necessary to complete the scope of work.

I. The Contractor shall prepare a work plan to address means and methods for removal and disposal of the ACM. Include in the plan location detailed description of the work methods, and methods to endure safety of building occupants and visitors to the site. The Plan shall be presented to the COR at least 10 days prior to the planned removal and disposal of the ACM for review and comment.

J. Where in the performance of the Work, workers, supervisory personnel, subcontractors, or consultants may encounter, disturb, or otherwise function in the immediate vicinity of any identified asbestos-containing materials, take appropriate continuous measures as necessary to protect all building occupants from the potential hazard of exposure to airborne asbestos. Such measures will include the procedures and methods described herein, and compliance with regulations of applicable federal, state and local agencies.

K. The Contractor is responsible for all costs, including additional visits, should the Air Monitoring Firm determine that additional monitoring is required.

L. In event of any apparent conflict among codes, standards, or this Plan, the Contractor shall refer the conflict to the COR for written resolution.

1.4 CONTRACTOR USE OF PREMISES

A. The Contractor shall limit their use of the premises to the work indicated. The Contractor is responsible for securing all points of ingress/egress to the Hangar during the removal/disposal work.

B. The Contractor shall notify the COR at least seven (7) days in advance of a proposed time for shutting down or interrupting any utilities, services or facilities which may affect the operation of other portions of the building or of other buildings, services or facilities of the COR. In no case may any shutdown or interruption of any utilities, services or facilities be made without the approval and authorization of the COR.

C. Driveways and Entrances: Keep driveways and entrances adjacent to the premises clear and available to the other contractors and the public. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site. All vehicles must be parked in areas approved by the COR.

D. Partial Owner Occupancy: The COR reserves the right to occupy and to place and install equipment in completed areas prior to Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placing of equipment and partial occupancy shall not constitute acceptance of the total Work.

E. Smoking: Smoking or open fires will not be permitted within the building enclosure or on the premises.

F. Temporary Toilet Rooms: If necessary, the Contractor must provide self-contained, single-occupant toilet units of the chemical, aerated recirculation, or combustion type. Provide units properly vented and fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material. Comply with regulations and health codes for the type, number, location, operation, and maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs. Provide temporary hand washing facilities maintained with soap and disposable towels in an area adjacent to the toilet rooms.

G. The Contractor at all times shall keep the premises free from accumulation of waste materials or rubbish caused by his operations. At the completion of the work the Contractor shall leave the Project in a clean and orderly condition, including removing all his waste materials and rubbish from and about the Project as well as all his tools, construction equipment, machinery, and surplus materials.

H. The Contractor is responsible for the behavior of workers within his employment. If at any time during the contracted work, any of his employees are judged to exhibit behavior unfitting for the area or judged to be a nuisance by the COR, the Contractor shall remove them immediately from the project.

I. Under no circumstances are alcohol, firearms, drugs, or any other type of controlled substances permitted on the work site property.

J. All workers must conform to the following basic dress code when in public areas of the project confines: long pants, shirts, no tank tops, no shorts, no bare backs.

1.5 COORDINATION

A. Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly completion of each part of the Work. Coordinate construction operations included under different Sections that depend on each other for proper installation, connection, and operation.

B. Develop a directory of all entities involved in the project. Include the Contractor's principal staff assignments, including the Superintendent and other personnel in attendance at the site. Identify individuals, their duties and responsibilities. List business name, contact person, normal business and emergency telephone, pager and fax numbers and addresses.
   1. Supervisor. All supervisors on the project shall have a minimum of two years' experience in the administration and supervision of asbestos abatement projects including work practices, protective measures for building and personnel, disposal procedures, etc. One supervisor shall be provided for every 10 workers inside each containment. A minimum of one supervisor shall be provided per asbestos work area.
   2. The Contractor shall have at least one employee on the jobsite in either a foreman, supervisor, and/or competent person position that is fluent in English and also fluent in

any necessary languages to effectively communicate with abatement personnel who do not fluently speak English. That person must be on site at all times as long as non-English speaking personnel are working on site.

3. A competent person, as defined in the OSHA asbestos standard 29 CFR 1926.1101, employed by the Contractor must be outside each asbestos work area at all times to monitor activity, ensure security, provide information to visitors, and provide access to the work area. The competent person, employed by the Contractor, shall be bilingual in the appropriate languages when employing workers who do not speak fluent English.

C. Notify other entities at the job site of the nature of the asbestos abatement activities, location of asbestos-containing materials (ACM), requirements relative to asbestos set forth in these specifications and applicable regulations. Advance notification will be made to the COR; employees who will perform asbestos abatement work or related activities or who will be in the work area during the course of the work of this contract; and, employers of employees who work and/or will be working in adjacent areas during the course of the work of this contract.

D. Notify emergency service agencies (not less than 10 days prior to start) including fire, ambulance, police or other agency that may service the abatement work site in case of an emergency. Notification is to include methods of entering work area, emergency entry and exit locations, modifications to fire notification or fire-fighting equipment, and other information needed by agencies providing emergency services.

E. Contingency Plan: Prepare a contingency plan for emergencies or any other event that may require breaching of work area containment or modification or abridgement of decontamination or work area isolation procedures. Include in this plan procedures for performing electrical and mechanical repairs inside containment after abatement work has begun. Include in plan specific procedures for decontamination or work area isolation. Note that nothing in this specification should impede safe exiting or providing of adequate medical attention in the event of an emergency. Items to be addressed in the plan include, but are not limited to the following:

1. Fire
2. Accident
3. Life threatening injury
4. Non-life threatening injury
5. Rescue
6. Power Failure
7. Pressure differential system failure
8. Breach of containment
9. Electrical faults or shock
10. Excessive heat / cold (if/when such limits are specified)
11. Supplied air system failure
12. Water leaks
13. Waste spills
14. Unauthorized entry into work area
15. Elevated air samples outside of containment
16. Repairs inside containment
17. Toxic releases

1.6 PRE-CONSTRUCTION CONFERENCE

A. An initial progress meeting recognized as "Pre-Construction Conference" will be conducted prior to start of any work. The preconstruction conference will be scheduled before start of

construction, at a time convenient to the COR, but no later than 15 days after execution of the Agreement. Meet at the project site, or as otherwise directed, with General Superintendent, COR, and other entities concerned with the asbestos work. 72 hours advance notice will be provided to all participants prior to convening Pre-Construction Conference.

B. Attendees: Authorized representatives of the COR and their consultants will be in attendance. An authorized representative of the Contractor and its superintendent; major subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.

C. Agenda: This is an organizational meeting, to review responsibilities and personnel assignments, to locate regulated areas and temporary facilities including power, light, water, etc. Items of significance that could affect progress will be discussed, including the following:
   1. Tentative construction schedule.
   2. Critical work sequencing.
   3. Designation of responsible personnel.
   4. Procedures for processing field decisions and Change Orders.
   5. Procedures for processing Applications for Payment.
   6. Distribution of Contract Documents.
   7. Submittal of Shop Drawings, Product Data, and Samples.
   8. Preparation of record documents.
   9. Use of the premises.
   10. Parking availability.
   11. Office, work, and storage areas.
   12. Equipment deliveries and priorities.
   13. Safety procedures.
   14. First aid.
   15. Security.
   16. Working hours.

1.7 REFERENCES

A. Except to the extent that more explicit or more stringent requirements are written directly into the contract documents, all applicable codes, regulations, and standards have the same force and effect (and are made a part of the central documents by reference) as if copied directly into the contract documents, or as if published copies are bound herewith.

B. The current issue of each regulation, code and standard shall govern. Where conflict among requirements or with these specifications exists, the more stringent requirements shall apply.

C. U.S. Department of Labor, Occupational Safety and Health Administration, (OSHA), including but not limited to:
   1. Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite: Final Rules Title 29, Part 1910, Section 1001 and Part 1926, Section 1101, of the Code of Federal Regulations.
   2. Respiratory Protection: Title 29, Part 1910, Section 134 and Title 29, Part 1926, Section 103 of the Code of Federal Regulations.
   3. Construction Industry: Title 29, Part 1926, of the Code of Federal Regulations.
   4. Access of Employee Exposure and Medical Records: Title 29, Part 1910, Section 20 and Title 29, Part 1926, Section 33 of the Code of Federal Regulations.

5. Specifications for Accident Prevention Signs and Tags: Title 29, Part 1910, Section 145 of the Code of Federal Regulations.
6. Personal Protective Equipment: Title 29, Part 1910, Section 132 and Title 29, Part 1926, Sections 95 through 107 of the Code of Federal Regulations.
7. Hazard Communication: Title 29, Part 1910, Section 1200 and Title 29, Part 1926, Section 59 of the Code of Federal Regulations.
8. Lead in Construction; Title 29, Part 1926, Section 62.

D. U.S. Environmental Protection Agency (EPA) including but not limited to:
1. Asbestos Abatement Project Rule: 40 CFR Part 763 Subpart G; as of July 1, 1991.
2. Regulations for Asbestos: Title 40, Part 61, Subpart A of the Code of Federal Regulations.
3. National Emissions Standard for Asbestos: Title 40, Part 61, Subpart M (Revised Subpart B); Code of Federal Regulations.
4. Hazardous Wastes: Title 40, Part 260-265.

E. American National Standards Institute (ANSI):
1. ASTM D1331 - 1989: Surface and Interfacial Tension of Solution of Surface-Active Agents.
2. American National Standard for Respiratory Protection - Respirator Use-Physical Qualifications for Personnel, Publication Z88.6-1984
3. Practices for Respiratory Protection - Publication Z88.2-1992

F. American Society for Testing and Materials (ASTM):
1. ASTM D-1331 - 1989: Surface and Interfacial Tension of Solution of Surface Active Agents.

G. Underwriters Laboratories, Inc. (UL):
1. UL 586 - 1985 (Rev 1988): High-Efficiency Particulate, Air Filter Units.
2. E1368-90: Standard Practice for Visual Inspection of Asbestos Abatement Projects

H. N.Y. Department of Public Health (NDPH)
1. 10 NYCRR Part 73
2. 12 NYCRR Part 56
3. 6 NYCRR Part 360
4. 6 NYCRR Part 364

1.8 DEFINITIONS

A. Amended Water: Water to which a surfactant (wetting agent) has been added to increase the ability of the liquid to penetrate asbestos-containing materials (ACM).

B. Area Monitoring: Sampling of asbestos fiber concentrations within the asbestos control area and outside the asbestos control area which is representative of the airborne concentrations of asbestos fibers that may reach the breathing zone of personnel potentially exposed to asbestos.

C. Asbestos: A group of naturally occurring minerals that separate into fibers. There are six asbestos minerals used commercially: chrysotile; amosite; crocidolite; tremolite; anthophyllite; and actinolite.

D. Asbestos Control Area: An area where asbestos removal operations are performed which is isolated by physical boundaries to prevent unauthorized entry of personnel and to prevent the spread of asbestos dust, fibers, or debris.

E. Asbestos-Containing Material (ACM): Any material containing more than 1% asbestos by volume of any type or mixture of types.

F. Asbestos Fibers: Asbestos fibers having a length to diameter ratio of at least 3:1 and is 5 micrometers long or longer, as analyzed by Phase Contrast Microscopy utilizing NIOSH Method 7400.

G. Asbestos Permissible Exposure Limit: The limit is 0.1 fibers per cubic centimeter of air as an 8-hour time weighted average as determined by 29 CFR 1926.1101.

H. Competent Person: One who is capable of identifying existing asbestos, tremolite, anthophyllite, or actinolite hazards in the work place and who has the authority to take prompt corrective measures to eliminate them.

I. COR: Contracting Officer Representative

J. Critical Barrier: Those portions of the containment barrier which represent the minimum structural components necessary to maintain the asbestos removal area in airtight isolation from the surrounding areas. Critical barriers shall be placed at floors, windows, ventilation louvers and other openings as necessary to achieve abatement work area isolation before putting up the double-layer plastic sheeting containment enclosure within which abatement work is performed. If a temporary plastic sheeting/stud wall must be erected, it shall be treated as a critical barrier. The double-layer plastic sheeting containment enclosure shall then be erected on that wall. Wrappings on lights, control boxes, etc., do not constitute part of the critical barrier.

K. Encapsulant: A material applied after the removal of ACM or to the ACM-edges of partially abated substrates which surrounds or embeds residual asbestos fibers in an adhesive matrix to prevent their release into the atmosphere.

L. Friable Asbestos Material: Material that contains more than one percent asbestos as determined using the method specified in Appendix A, Subpart F, 40 CFR Part 763 Section 1, Polarized Light Microscopy, that when dry can be crumbled, pulverized, or reduced to powder by hand pressure.

M. GFCI (Ground Fault Circuit Interrupter): A type of ground fault protection in areas where personnel are at high risk of receiving electrical shocks (for example, in damp locations); makes use of a device designed to trip at a ground current in the milliampere range, i.e., very much below currents that are normally harmful.

N. HEPA Vacuum Equipment: High efficiency particulate air (HEPA) filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining asbestos fibers. Filters shall be of 99.97 percent efficiency for retaining fibers of 0.3 micrometers or larger.

O. Impermeable Waste-Disposal Containers: Suitable to receive and retain any asbestos-containing or contaminated material until disposal at an approved site. The containers shall be labeled in accordance with OSHA Regulation 29 CFR 1910.1001 and 29 CFR 1926.1101. Containers must be both water-tight and air-tight.

P. Lockdown: Lockdown is the procedure of applying a protective coating or sealant to a surface from which asbestos-containing material has been removed. Its primary function is to control and minimize airborne asbestos fiber generation that might result from any asbestos-containing residue on the substrate.

Q. Non-friable Asbestos Material: Material that contains more than one percent asbestos as determined by the method specified in Appendix A, Subpart F, 40 CFR Part 763 Section 1, in which the fibers have been locked in by a bonding agent, coating, binder, or other material so that the asbestos is well bound and may not release fibers in excess of the asbestos permissible exposure limit during any appropriate use, handling, storing, transporting, or processing. Non-friable asbestos material may be hazardous and rendered friable during removal and disposal procedures. Cutting, crushing, grinding and sanding will render non-friable materials into a friable state.

R. Personal Monitoring: Sampling of asbestos fiber concentrations within the breathing zone of an employee to determine the Excursion Level (i.e., short-term) 30 minute exposure and/or 8-hour time weighted average in accordance with Appendix A of 29 CFR 1926.1101. The samples shall be representative of the employee's work tasks. The breathing zone shall be considered an area within 12 inches of the nose or mouth of an employee.

S. Regulated Area: An area established to demarcate areas where airborne concentrations of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals exceed or can be expected to exceed the permissible exposure limits. The regulated area may take the form of an enclosed control area or an area demarcated to prohibit occupants from the vicinity of the area and prevent potential exposure to asbestos, tremolite, anthophyllite, or actinolite.

T. Surfactant (Wetting Agent): A chemical wetting agent added to water to improve penetration. The surfactant shall be a 50/50 mixture of polyoxyethylene ether and polyoxyethylene ester, or equivalent, mixed in a proportion of one fluid ounce to 5 gallons of water or as specified by the manufacturer. An equivalent surfactant shall be understood to mean a material with a surface tension of 29 dynes/cm as tested in accordance with ASTM D 1331.

U. Time Weighted Average (TWA): The TWA is an 8-hour time weighted average of airborne concentration of fibers (5 micrometers or longer) per cubic centimeter of air which represents the employee's 8-hour workday exposure as determined by Appendix A of 29 CFR 1926.1101.

1.9 SUBMITTALS

A. The Contractor shall be responsible for obtaining and maintaining all permits and certifications for the work. All permits and certifications shall be maintained onsite. The Contractor shall submit permits and certifications to the COR for recordkeeping prior to final payment. Final payment will not be made until all requested submittals have been reviewed and approved by the COR.

B. Affidavits: Contractor’s affidavit of payment of debts and claims, affidavit of release of liens, and consent of surety company to final payment.

C. Notification: If required, notify the appropriate regulatory body for asbestos removal. If necessary, obtain and post the asbestos removal permit onsite. Submit notification and permit copies to the COR not less than 10 days prior to commencing any work. Contractor is responsible for obtaining any work practice variances.

D. All work practice variances must be approved in writing by the COR. Contractor shall submit written variances for review. Allow one week for initial review.

E. Hazard Communication Program: The Contractor will submit evidence, if requested, of a written Hazard Communication Program as required by 29 CFR 1910.1200.

F. Respirator Program: Establish and implement a respirator program as required by ANSI Z88.2, 29 CFR 1910.134, and 29 CFR 1926.1101. Submit evidence of program, if requested.

G. Training: Submit to the COR not less than 10 days prior to commencing any work documentation that the required EPA, OSHA and State training has been conducted. Prior to or at time of initial assignment to asbestos work, and at least annually thereafter, each employee shall be instructed with regard to the hazards of asbestos, safety and health precautions, the use and requirements for protective clothing, equipment, and respirators, and the association of cigarette smoking and asbestos-related disease, and the additional requirements of 29 CFR 1926.1101. Training shall fully cover engineering and other hazard control techniques and procedures.

H. Logs: Submit to the COR a daily sign in sheet, a record of all employees and visitors who enter the asbestos control area, daily reports of the abatement activity compiled by the onsite abatement supervisor, reports of unusual events, and accident reports.

I. Landfill Receipts: Submit to the COR receipts from the approved landfill and transport waste manifest recording the transportation and disposal of the asbestos and demolition waste. Submit detailed delivery tickets, prepared signed, and dated by an agent of the landfill, certifying the amount of asbestos materials delivered to the landfill. All asbestos waste shall be disposed of in accordance with federal, state, and local regulations.

J. Air Monitoring Firm Submittals

1. Submit the license of the of the air monitoring professional 10 days prior to the start of monitoring for review by the COR and A/E.

2. Submittal of firms Quality Assurance program to meet the requirements of NIOSH Method 7400, Asbestos and Other Fibers by PCM 10 days prior to the start of monitoring for review by the COR and A/E.

3. Submit current calibration certificates for air calibration devices used onsite. 10 days prior to the start of monitoring for review by the COR and A/E.

4. On a weekly basis submit air monitoring data and quality assurance data via email to the COR and A/E.

1.10 DAILY REPORTS

A. The Contractor shall maintain daily logs and reports of job-site activities and personnel exposure monitoring at the site and shall provide copies to the COR prior to final payment.

B. Reporting Unusual Events: When an event of unusual and significant nature occurs at site (examples: failure equipment or power failure, high airborne fiber reading, etc.), prepare and

submit a special report listing chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information.

C. Accident Reporting: Report all accidents immediately to onsite safety representative and COR. Prepare reports of significant accidents, at site and anywhere else work is in progress. Record and document data and actions; comply with industry standards. For this purpose, a significant accident is defined to include events where personal injury is sustained, property loss of substance is sustained, or where the event posed a significant threat of loss or personal injury. Contractor shall be responsible for the investigation of accidents, the generation of documentation, and the resolution of issues within its control.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Impermeable Waste-Disposal Containers: Suitable to receive and retain any asbestos-containing or contaminated material until disposal at an approved site. The containers shall be labeled in accordance with OSHA Regulation 29 CFR 1910.1001 and 29 CFR 1926.1101. Containers must be both water-tight and air-tight.

B. Plastic Sheeting: Polyethylene plastic sheeting material typically 6-mil thickness for covering floors and walls, providing air locks, and sealing doors and windows; supply in appropriate widths to minimize seams.

C. Surfactant (Wetting Agent): 50% polyoxyethylene ester and 50% polyoxyethylene ether, or approved equal, shall be mixed with water to provide a concentration of 2 ml surfactant to 1 liters of water, or manufacturer's recommended concentration.

D. Tape: Glass fiber or other tape capable of sealing joints of adjacent sheets of plastic sheeting and for attachment of plastic sheets to finished or unfinished surfaces of dissimilar materials under both dry and wet conditions, including use of amended water.

E. Warning Signs and Labels: Provide caution signs printed in English at approaches to asbestos control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Provide caution labels printed in English. Affix labels to asbestos materials, scrap, waste, debris, sealed impermeable bags, asbestos waste drums, and other asbestos-contaminated products.

1. Warning Signs: The warning signs required by 29 CFR 1926.1101, paragraph (k)(7), shall bear the following information:

DANGER

ASBESTOS

MAY CAUSE CANCER

CAUSES DAMAGE TO LUNGS

AUTHORIZED PERSONNEL ONLY

In addition, where the use of respirators and protective clothing is required in the regulated areas, the warning signs shall include the following:

WEAR RESPIRATORY PROTECTION AND PROTECTIVE CLOTHING IN THIS AREA

2. Warning Labels: Provide label with sufficient print size to be clearly legible with bold print on a contrasting background, displaying the following legend:

DANGER

CONTAINS ASBESTOS FIBERS

MAY CAUSE CANCER

CAUSES DAMAGE TO LUNGS

DO NOT BREATHE DUST

AVOID CREATING DUST

2.2 EQUIPMENT

A. The Contractor shall make available three complete sets of personal protective equipment daily, as required herein, for entry to and inspection of the asbestos regulated area by the COR or other appointed authorized safety or health personnel. The items furnished by the Contractor shall include disposable protective whole body covering, head covering, gloves, foot coverings, eye protection, and use of the Contractor's staging/decontamination area. The personal protective equipment shall remain the property of the Contractor.

B. Respirators: Select respirators approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services, for use in atmospheres containing asbestos fibers. Respirator selection shall be in accordance with OSHA Regulation 29 CRF 1910.134.

C. Eye Protection: Furnish eye protection for personnel engaged in asbestos operations when the use of a full-face respirator is not required.

D. Protective Clothing: Personnel exposed to airborne concentrations of asbestos fibers shall wear disposable protective whole-body clothing, head coverings, gloves, and foot coverings. Cloth gloves may be worn for comfort, but shall not be used alone. Secure sleeves at the wrists and secure foot coverings at the ankles with duct tape.

E. Work Clothing: Cloth or nylon undergarments may be worn under the disposable protective coveralls.

F. Temporary Water Service Connection: Connections to any Owner or municipal water system shall include backflow protection, as required. Valves shall be temperature and pressure rated for operation of the temperatures and pressures encountered. After completion of use, connections and fittings shall be removed without damage or alteration to existing water piping and equipment. Leaking or dripping valves shall be piped to the nearest drain or located over an

existing sink or grade where water will not damage existing finishes or equipment. Provide separate hoses and/or/ pumps for shower water and amended water, without the possibility of cross connection.

G. Electrical Power Cords: Provide grounded extension cords. Use hard-service cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.

H. Lamps and Light Fixtures: Provide general service lamps of wattage indicated or required for adequate illumination as required by the work or this section. Protect lamps with guard cages or tempered glass enclosures, where fixtures are exposed to breakage by construction operations. Provide exterior fixtures where fixtures are exposed to the weather or moisture.

I. First Aid Supplies: Comply with governing regulations and recognized recommendations within the construction industry.

J. Fire Extinguishers: Provide hand-carried, portable, UL-rated, Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, UL-rated, Class ABC, dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for the exposures. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

PART 3 - EXECUTION

3.1 ASBESTOS WORK AREA PREPARATION (GENERAL)

A. During the abatement completely isolate the Regulated Area from the outside to prevent asbestos containing dust or debris from passing beyond the isolated area. Should the area beyond the Regulated Area(s) become contaminated with asbestos containing dust or debris as a consequence of the Work, immediately stop all abatement work and clean those areas. Perform all such required cleaning or decontamination at no additional cost to Owner.

3.2 ASBESTOS WORK AREA PREPARATION (NON-FRIABLE MATERIALS)

A. Post Warning signs and barrier tape in and around work area as required by all applicable regulatory

B. For interior work, seal off all openings with critical barriers. Critical barriers must be placed on penetrations that include but are not limited to; heating and ventilation ducts, doorways, corridors, and windows, with plastic sheeting taped securely in place.

C. All building ventilation air systems connected to the work area shall remain off and sealed during preparation and until the area has passed final visual inspection and final air sampling when required.

D. The floor of the immediate work area, the area where the ACM will be moved, will be covered with a single layer of 6-mil poly sheeting. The sheeting will be secured to the floor with duct tape to prevent movement and potential trip hazards.

E. The Contractor shall implement an electrical practice protocol that includes, but is not limited to, lockout and GFCI shutdown as described in OSHA Construction Standard 29 CFR 1926.417. All electrical powered equipment utilized during the project shall have ground-fault protection as described in OSHA Construction Standards. All equipment and wiring shall be in compliance with National Fire Protection Association Standard 70, and the National Electrical Code.

F. Workers disposing of the ACM will wear appropriate personal protective equipment when handling and disposing of the fixtures.

G. The stored ACM will be removed intact placed into suitable containers for transport. Bags and containers shall be marked with labels prescribed by the OSHA and NESHAP regulations referenced in these specifications. All material shall be double bagged and the outside bag and container shall be clean before leaving the regulated area.

H. If necessary, wet non-friable material with amended water to minimize asbestos fiber dispersion. The asbestos material shall be removed by means which do not render the material friable or prevent dust from being released during the removal and bagging. Do not subject the material to grinding, sanding, chipping or abrading. If the material should become friable, stop work and notify the COR.

I. All plastic sheeting, tape, cleaning material, clothing, and all other disposable material or items used in the work area shall be packed into sealable plastic bags (6-mil minimum). Each bag shall be individually sealed and placed in containers, at a minimum, a second bag, suitable for transport to the landfill.

3.3 DECONTAMINATION OF WORK AREAS

A. Any surface or area potential contaminated during removal of the ACM, shall be cleaned. The cleaning shall including ducts, electrical conduits, steel beams, roof deck, etc. as needed, with amended water and/or HEPA filtered vacuum. After cleaning the work area, the Contractor shall allow the area to thoroughly dry. At the completion of the cleaning operation, the Contractor's supervisor shall perform a complete visual inspection of the work area to insure that the work area is dust and fiber free. Final air sampling shall not commence until the visual inspection by the COR is completed and passed.

B. If the COR finds that the work area has not been adequately decontaminated, cleaning and/or air monitoring shall be repeated until the work area is in compliance. All repeat visual inspections and air monitoring will be conducted only after all surfaces are dry. Visual inspections shall be in accordance with E1368: Standard Practice for Visual Inspection of Asbestos Abatement Projects.

C. After the work area is found to be in compliance from final air monitoring results, all entrances and exits shall be unsealed and the plastic sheeting, tape, and any other trash and debris shall be disposed of in sealable plastic bags (6-mil minimum) and buried in the approved waste disposal site.

3.4 DISPOSAL OF ASBESTOS MATERIAL AND CONTAMINATED DEBRIS

A. The stored ACM and project waste shall be transported directly to the landfill following completion of the project in accordance with 40 CFR 61.150, DOT 49 CFR Parts 100-399, and 6 NYCRR Parts 360 and 364.

B. The Contractor shall transport the containers and bags of waste material to the approved waste disposal site. The sealed plastic bags and containers shall be placed into the burial site unless the bags or containers have been broken or damaged.

C. Workers unloading the asbestos will wear appropriate personal protective equipment when handling material at the disposal site. Asbestos warning signs shall be posted during loading and unloading of asbestos waste.

D. The Contractor shall use the Waste Shipment Record for disposal records as per 40 CFR 61.150 and distribute a copy of all waste shipment records to the COR after the completion of the project.

3.5 OSHA REQUIRED AIR MONITORING

A. The Contractor is responsible for OSHA required monitoring and shall be conducted in accordance with OSHA sampling requirements.

B. The Contractor shall conduct air sampling that is representative of both the full shift (8-hour time weighted average) and excursion level (30-minute short-term exposures) to indicate compliance with the permissible exposure and excursion limits.

C. Samples shall be analyzed by a laboratory proficient in the American Industrial Hygiene Association's (AIHA) Proficiency Analytical Testing Program.

D. Results of personnel air sample analyses shall be available, verbally, within twenty-four (24) hours of sampling and shall be posted upon receipt.

3.6 AREA AIR MONITORING

A. The COR will provide an air monitoring professional to perform area monitoring during ACM abatement work. The Contractor is responsible for OSHA required employee air monitoring.

B. Air Monitoring Professional Qualifications.
   1. The air monitor performing air monitoring shall have a current New York license.
   2. If air samples are analyzed onsite, the analyst shall be proficient in AIHA's Asbestos Analysts Registry (AAR) program and submit evidence to the COR and A/E.
   3. If samples are not analyzed onsite the Air Monitoring Firm's laboratory shall be proficient in AIHA's PAT program. Alternatively, the samples may be sent to a third-party AIHA accredited laboratory for analysis.
   4. Submittal of firms Quality Assurance program to meet the requirements of NIOSH Method 7400, Asbestos and Other Fibers by PCM 10 days prior to the start of monitoring for review by the COR and A/E.
   5. Submit current calibration certificates for air calibration devices used onsite. 10 days prior to the start of monitoring for review by the COR and A/E.
   6. Have at least 90 days of onsite experience monitoring asbestos abatement projects.

C. Prior to any work, background air sampling will be conducted in a minimum of 4 locations. A minimum of two samples will be collected inside the oil house and two will be collected outside the work area.

D. During ACM removal activities, area air monitoring will be conducted both inside and outside the work areas. The samples will be collected at a sufficient volume to yield a minimum detection limit of 0.01 fibers per cubic meter (F/cc). A minimum of two samples will be collected in each area (two inside the building and two outside).

E. Analytical Methods: Background and daily air samples during asbestos work will be analyzed by Phase Contrast Microscopy (PCM) using the NIOSH 7400 Method.

F. Clearance Monitoring After Clean-up of Non-Regulated (Non-Friable) Materials.

1. The COR shall perform a visual observation of the work area in accordance with E1368: Standard Practice for Visual Inspection of Asbestos Abatement Projects. If an area fails visual (materials remaining on the substrate or debris in the work area) the Contractor shall re-clean work area.

2. The samples upper confidence limit (UCL) shall be calculated to compare to the criterion of 0.01 F/cc. A minimum of two air samples shall be collected inside the work area.

3. If the air results UCL exceeds the clearance criteria, cleaning shall be repeated until the work area is in compliance. Additional observations will be at the expense of the Contractor.

G. Air Monitoring Results

1. All testing and analysis will be performed promptly and results issued expeditiously in order to minimize any possible delay in the progress of the Work.
2. Air sample results by Phase Contrast Microscopy: 24 hours from sample extraction time.
3. Air sample clearance results by Transmission Electron Microscopy: 24 hours from sample receipt at the laboratory.
4. Results of other tests deemed necessary by the COR/A/E: as quickly as possible but not later than three days following completion of test(s) and receipt of results.
5. If any air samples collected outside of the Work Area exceeds the 0.01 F/cc when analyzed by PCM, the COR and A/E shall be notified. This will be considered an action level.
6. If any air samples collected outside of the Work Area exceeds the 0.01 F/cc when analyzed by PCM, then Contractor will be required to immediately and automatically stop all Work and take remedial action. The COR shall be notified immediately.

H. Reporting: At the completion of the project, the air monitoring firm shall prepare a report describing the assessment of the project, all air monitoring data, acceptance letters, calibration records, quality assurance documentation referenced in NIOSH 7400, and a description of the project as it proceeded to completion and submit an electronic copy of the report to the COR for review. Final payment will not be made until all requested submittals have been reviewed and approved by the COR and A/E.

END OF SECTION 02 82 13

SECTION 02 83 33 – REMOVAL AND DISPOSAL OF LEAD-CONTAINING PAINT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This section identifies the precautions and procedures required for lead contaminant control and lead waste disposal during the life of the contract. All painted surfaces found in facilities constructed prior to 1978 shall be considered lead-containing unless proven otherwise by testing. This specification applies to the identification, disturbance, containment, removal and disposal of lead-containing paint, adhesives, residue and dust, sludges, chips, scrap, and where applicable, soil. A copy of the Environmental Hazardous Materials Survey is provided as **Appendix A**.

B. Remove paint on the in the Hangars scheduled for removal as identified in these project specifications and drawings. Use of abrasive, thermal, or chemical methods shall be the least destructive to the substrate. Ensure the removal methods do not further mortar.

C. The Contractor shall set-up a paint removal test location to verify methods prior to any paint removal. The test location shall be a minimum of 3’ x 3’. The purpose of this test is to determine effectiveness, review methods, review any damage to the substrate from removal methodology, and provide a test location to judge quality of work for the remainder of the project. The Contractor shall schedule a site visit to observe the removal process. Notify the COR 72 hours prior to the scheduled site visit to observe the removal methods.

1.2 RELATED WORK

A. Section 01 74 19: Construction Waste Management and Disposal

B. Section 02 41 00: Selective Demolition

1.3 DEFINITIONS

A. Action Level: Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter (µg/m3) of air averaged over an 8-hour period. As used in this section, “30 micrograms per cubic meter of air" refers to the action level.

B. Area Monitoring: Sampling of lead concentrations within the lead control area and inside the physical boundaries which is representative of the airborne lead concentrations which may reach the breathing zone of personnel potentially exposed to lead.

C. Breathing Zone: Area within hemisphere, forward of shoulders, with 6 to 9 inches radius and center at nose or mouth of employee.

D. Certified Industrial Hygienist (CIH): As used in this section, refers to an Industrial Hygienist Certified in the Comprehensive Practice of Industrial Hygiene by the American Board of Industrial Hygiene and Board for Global EHS Credentialing.

E. Change Rooms and Shower Facilities: Rooms within the designated physical boundary around the lead control area equipped with separate storage facilities for clean protective work clothing and equipment and for street clothes which prevent cross-contamination.

F. Competent Person (CP): A person employed by the Contractor who is trained in the recognition and control of lead hazards in accordance with current federal, State, and local regulations and has the authority to take prompt corrective actions to control the lead hazard. The Contractor may provide more than one CP as required to supervise and monitor the work. The competent person(s) shall also have no less than 2 years' experience in removing lead containing paint from historic structures.

G. Contracting Officer's Representative (COR): means an individual designated and authorized in writing by the contracting officer to perform specific technical or administrative functions.

H. Decontamination Room: Room for removal of contaminated personal protective equipment (PPE).

I. Delaminated Paint: A peeling or otherwise structurally compromised paint system that is subject under normal conditions to potentially release paint and primer particles, as well as those systems that are in such condition that they will likely release particles from the forces that are expected to act upon it.

J. Eight-Hour Time Weighted Average (TWA): Airborne concentration of lead averaged over an 8-hour workday to which an employee is exposed.

K. High Efficiency Particulate Air (HEPA) Filter Equipment: HEPA filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead-containing paint dust. A high efficiency particulate filter means 99.97 percent efficient against 0.3 micron size particles.

L. Lead: Metallic lead, inorganic lead compounds, and organic lead soaps. Excluded from this definition are other organic lead compounds.

M. Lead-Based Paint (LBP): Paint or other surface coating that contains lead in excess of 0.7 milligrams per centimeter squared utilizing X-ray Fluorescence techniques or 0.5% lead by weight by laboratory analysis. Paints or coatings meeting this definition are considered to be LBP by regulation and are subject to disposal standards.

N. Lead-Containing Paint (LCP): Lead-based paint or other similar surfaces or coatings containing lead or lead compounds which contain detectable levels of lead and are regulated under the OSHA standard (29 CFR 1926.62). Any condition that causes exposure to lead from lead-contaminated dust, lead-contaminated soil, lead-based paint that is deteriorated or present in accessible surfaces, friction surfaces, or impact surfaces that would result in adverse human health effects.

O. Lead Control Area: An enclosed area or structure with full containment to prevent the spread of lead dust, paint chips, or debris of lead-containing paint removal operations. The lead control area is isolated by physical boundaries to prevent unauthorized entry of personnel.

P. Paint: Means paint and primer systems

Q. PEL: Permissible Exposure Limit. The PEL for lead is 50 ug/m3 (0.05 mg/m3) for an 8-hour exposure. If an employee is exposed for more than 8-hours in a work day, determine the PEL by

the following formula: PEL (micrograms/cubic meter of air) = 400/Number of hrs. worked per day.

R. Personal Sampling: Sampling of airborne lead concentrations within the breathing zone of an employee to determine the 8-hour time weighted average concentration in accordance with 29 CFR 1926.62. Samples shall be representative of the employee's work tasks. Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of 6 to 9 inches and centered at the nose or mouth of an employee.

S. Physical Boundary: Area physically roped or partitioned off around an enclosed lead control area to limit unauthorized entry of personnel. As used in this section, "inside boundary" shall mean the same as "outside lead control area."

T. State Historic Preservation Officers (SHPO) or New York State Historic Preservation Officers (NYSHPO): A person or group that assists private citizens, private institutions, local governments, and agencies of state and federal government in the identification, evaluation, protection, and enhancement of properties significant in New York history and archaeology. Documents submitted to the COR will also undergo review by SHPO/NYSHPO as necessary.

1.4 REFERENCES

A. The Contractor is responsible for ensuring compliance with all applicable Federal, State, and local regulations and referenced industry guidelines including:

B. U.S. Department of Labor, Occupational Safety and Health Administration, (OSHA), including but not limited to:

1. Occupational Exposure to Lead in Construction, Title 29, Part 1926, Section 62, of the Code of Federal Regulations.
2. Respiratory Protection: Title 29, Part 1910, Section 134 and Title 29, Part 1926, Section 103 of the Code of Federal Regulations.
3. Construction Industry: Title 29, Part 1926, of the Code of Federal Regulations.
4. Access of Employee Exposure and Medical Records: Title 29, Part 1910, Section 20 and Title 29, Part 1926, Section 33 of the Code of Federal Regulations.
5. Specifications for Accident Prevention Signs and Tags: Title 29, Part 1910, Section 145 of the Code of Federal Regulations.
6. Personal Protective Equipment: Title 29, Part 1910, Section 132 and Title 29, Part 1926, Sections 95 through 107 of the Code of Federal Regulations.
7. Hazard Communication: Title 29, Part 1910, Section 1200 and Title 29, Part 1926, Section 59 of the Code of Federal Regulations.

C. U.S. Environmental Protection Agency (EPA) including but not limited to:

1. Hazardous Wastes: CFR 40, Part 260-265.
2. SW-846, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods"

D. U.S. Department of Transportation (DOT):

1. Specifications for Packaging: CFR 49, Part 178

E. American National Standards Institute (ANSI):

1. American National Standard for Respiratory Protection - Respirator Use-Physical Qualifications for Personnel, Publication Z88.6-1984
2. Practices for Respiratory Protection - Publication Z88.2-1992
3. Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems - Publication Z9.2

F. American Society for Testing and Materials (ASTM)

1. ASTM Standard Practice E 1728: Standard Practice of Collecting Settled Dust Samples

G. Underwriters Laboratories, Inc. (UL):

1. UL 586 - 1985 (Rev 1988): High-Efficiency Particulate, Air Filter Units.

H. State Historic Preservation Office (SHPO)

I. National Park Service, Technical Preservation Services, including but not limited to:

1. Technical Preservation Briefs
2. The Secretary of the Interior's Standards for Rehabilitation

J. U.S. General Services Administration (GSA) Historic Preservations Technical Documents https://www.gsa.gov/real-estate/historic-preservation/historic-preservation-policy-tools/preservation-tools-resources/technical-documents , including but not limited to:

1. General Project Guidelines – 110007S
2. Chemically Removing Paint from and Repainting Brick Masonry – 421114S
3. Chemically Removing Paint from Wood Features – 640007S
4. Removing Paint from Wood Features Using Thermal Methods – 640009S
5. Supplemental Guidelines for removing Paint form Interior and Exterior Wood Surfaces - 640002G
6. Removing Paint from Wrought Iron, Cast Iron, and Steel Using Abrasive, Chemical, or Thermal Methods (501015S, 501017S, and 501016S, respectively)– 570003S

K. State of New York:

1. NYCRR Title 10 Part 67 – Lead Poisoning Prevention and Control.

L. The Society for Protective Coatings (SSPC)

1. SSPC Guide 6: Guide for Containing Debris Generated During Paint Removal Operations.
2. SSPC-TU-7: Conducting Ambient Air, Soil, and Water Sampling of Surface Preparation and Paint Disturbance Activities.

1.5 SUBMITTALS:

A. Submittal Procedures: Section 01 33 23, Shop Drawings, Product Data, And Samples.

B. The following submittals are required to be submitted to the CO or designated representative prior to work initiation for approval:

1. Manufacturer's Literature and Data:
   a. Description of each product.
      1) Paint removal products.
      2) Vacuum filters.
      3) Respirators.

2. Safety Data Sheet for each paint removal product.

3. Installation instructions of paint removal products.

4. Certificates: Certify completed lead training.
   a. Submit certificate for each employee stating employee was trained.
   b. Names and qualifications (experience and training) of supervisor and personnel who will be working on-site.
   c. Certification of medical examinations for each employee.
   d. Medical Opinion that employee is qualified to wear a respirator, that employees has been trained and fit tested for the respirator.

5. Qualifications: Substantiate qualifications comply with specifications.
   a. Paint removal contractor.
      1) Testing laboratory.
      2) Name and qualification of analytical laboratory to be used to analyze personal exposure samples and/or profile wastes.
      3) Current evidence of participation in American Industrial Hygiene Association (AIHA) Laboratory Accreditation Program (LAP), LLC, Environmental Lead Laboratory Accreditation Program (ELLAP). Copy of current AIHA accreditation certificate.

6. Paint disposal facility.
   a. Name, address, and telephone number.
   b. Names and qualifications of each contractor that will be transporting, storing, treating, recycling, and/or disposing of the wastes. Include the facility location, phone number, and a 24-hour point of contact. Furnish two copies of State (in accordance with New York) hazardous waste permit applications / permits / manifests and USEPA Identification numbers.
   c. Current license or authorization to receive and dispose lead contaminated waste.

7. Plans referenced in Section 1.6

C. The following submittals are required to be submitted to the CO or designated representative at the during the progress of work:

1. Test Reports: Submit testing laboratory reports.
   a. Submit air monitoring results within three working days, signed by testing laboratory employee performing air monitoring, employee analyzing sample, and CIH.

2. Daily Reports
   a. The Contractor shall maintain daily logs and reports of job-site activities and personnel exposure monitoring at the site and shall provide copies for review upon request. A complete copy of all logs shall be submitted at the conclusion for the project.

b. Daily sign in sheet, a record of all employees and visitors who enter the lead control area, daily reports of the abatement activity compiled by the on-site supervisor, reports of unusual events, and accident reports.

c. Reporting Unusual Events: When an event of unusual and significant nature occurs at site (examples: failure of pressure differential system, rupture of temporary enclosures, equipment or power failure, high airborne readings), prepare and submit a special report listing chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information.

d. Accident Reporting: Report all accidents to the COR immediately. Prepare reports of significant accidents, at site and anywhere else work is in progress. Record and document data and actions; comply with industry standards. For this purpose, a significant accident is defined to include events where personal injury is sustained, property loss of substance is sustained, or where the event posed a significant threat of loss or personal injury. Contractor shall be responsible for the investigation of accidents, the generation of documentation, and the resolution of issues within its control.

D. The following submittals are required to be submitted to the CO or designated representative at the completion of work:

1. Completed and signed hazardous waste manifest from waste transporter.

2. Toxicity Characteristic Leaching Procedure (TCLP) test results to determine if waste is hazardous.

3. Paint disposal facility receipts and disposition reports.

4. Landfill Receipts/Waste Manifests: Submit weight tickets, receipts, bills of lading, and/or waste manifests from the approved recycling/disposal facility. Submittals must be detailed, signed or stamped and dated by an agent of the recycling or disposal facility, and be legible.

5. All personal exposure and environmental sample results.

1.6 QUALITY ASSURANCE

A. Contractor Qualifications: Experienced contractor shall be registered and licensed by applicable state agency regulating lead-based paint removal and certified by the Society for Protective Coatings (SSPC) or equivalent. The Contractor shall have experience and knowledgeable in regulations and guidelines pertaining to removal of LCP in historic structures.

B. Contractor must furnish all permits, labor, material, services, insurance, tools, equipment (including, but not limited to, power and water), and notifications in accordance with EPA, OSHA, state, and all other applicable agencies to complete the work scoped. It is the Contractor's responsibility to be aware of and obtain all permits necessary to complete the scope of work.

C. The Contractor shall assume full responsibility and liability for the compliance with all applicable federal, state and local regulations pertaining to work practices, hauling, disposal, and protection of workers, visitors to the site, and persons occupying areas adjacent to the site. The Contractor is responsible for providing medical examinations and maintaining medical records of personnel as required by the applicable federal, state, and local regulations.

D. The Contractor shall prepare a removal Work Plan, Safety Plan, and Waste Management Plan to address the work specified herein. These can be one complete plan or separate. Contractors Work Plan shall include, but not be limited to, the following: worker protection, environmental/site impact, encompassing NPS, GSA, SHPO/NYSHPO, and SSPC technical guidelines, Safety Plan and disposal.

1. Detailed site-specific work plan to indicate the means for demarcating the work area and providing for decontamination by workers, protecting the occupants, general public and other trades, and adjacent building surfaces and furnishings from contamination. Sketch showing location, size, and details of lead control areas, decontamination rooms, change rooms, shower facilities, and mechanical ventilation system.

2. Methods and materials for LBP abatement and/or the engineering controls to be used when disturbing LBP surfaces (engineering controls i.e. enclosures, dust control and collection mechanisms, etc.). A safety data sheet (SDS) shall be provided for all chemical removers proposed for use.

3. Detailed job-specific Lead Waste Management Plan. The Lead Waste Management Plan must comply with applicable requirements of federal, state, and local hazardous waste regulations and address:

   a. Identification and classification of wastes associated with the work.
   b. Estimated quantities of wastes to be generated and disposed of.
   c. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.
   d. Spill prevention, containment, and cleanup contingency measures including a health and safety plan to be implemented in accordance with 29 CFR 1926.65.
   e. Work plan and schedule for waste containment, removal and disposal. Proper containment of the waste includes using acceptable waste containers (e.g., 55-gallon drums) as well as proper marking/labeling of the containers. Clean up and containerize wastes daily.
   f. Include any process that may alter or treat waste rendering a hazardous waste non-hazardous.

4. Safety Plan: Prepare a Safety Plan for emergencies. Note that nothing in this specification should impede safe exiting or providing of adequate medical attention in the event of an emergency. Items to be addressed in the plan include, but are not limited to the following:

   a. Fire
   b. Accident
   c. Life threatening injury
   d. Non-life threatening injury
   e. Rescue
   f. Power Failure
   g. Pressure differential system failure
   h. Breach of containment
   i. Electrical faults or shock
   j. Excessive heat / cold (if/when such limits are specified)
   k. Waste spills
   l. Unauthorized entry into work area
   m. Elevated air samples outside of containment

n. Toxic releases
o. Covid-19 Policies
p. Severe weather (hurricane)
q. Include in this plan procedures for performing electrical and mechanical repairs by others inside containment/work area after abatement work has begun.

5. Hazard Communication Program: The Contractor will submit evidence, if requested, of a written Hazard Communication Program as required by 29 CFR 1910.1200.

6. Respirator Program: Establish and implement a respirator program as required by ANSI Z88.2, 29 CFR 1910.134, and 29 CFR 1926.62. Provide each employee required to wear a respirator a respirator fit test at the time of initial fitting and at least annually thereafter as required. Submit evidence of program, if requested.

7. Pre-work blood lead levels for all workers performing lead activities during the execution of the work (upon request). Initial medical surveillance as required by 29 CFR 1926.62 must be made available to all employees exposed to lead at any time (one day) above the action level. Full medical surveillance must be made available to all employees on an annual basis who are or may be exposed to lead in excess of the action level for more than 30 days a year or as required by 29 CFR 1926.62. Adequate records must show that employees meet the medical surveillance requirements of 29 CFR 1926.33 and 29 CFR 1926.103. Provide medical surveillance to all personnel exposed to lead as indicated in 29 CFR 1926.62. Maintain complete and accurate medical records of employees for the duration of employment plus 30 years.

1.7 WARRANTY

A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

PART 2 - PRODUCTS

2.1 PAINT REMOVAL PRODUCTS

A. Submit applicable Safety Data Sheets (SDS) for paint removal products and neutralizers used in paint removal work. Use the least toxic product suitable for the job and acceptable to the COR.

B. Chemical paint strippers must not contain methylene chloride and be formulated to prevent stain, discoloration, or raising of the substrate materials. Products are listed in the US GSA document Chemically Removing Paint from and Repainting Brick Masonry – 421114S.

C. Neutralizers for paint strippers must be compatible with the substrate and suitable for use with the chemical stripper that has been applied to the surface.

D. Detergents or cleaning agents must not contain trisodium phosphate and have demonstrated effectiveness in lead control work using cleaning techniques specified by SHPO/US GSA guidelines.

2.2 EQUIPMENT

A. The Contractor shall make available three complete sets of personal protective equipment daily, as required herein, for entry to and inspection of the lead control area by Authorized Representative(s) or other appointed authorized safety or health personnel. The personal protective equipment furnished shall include disposable protective whole body covering, head covering, gloves, foot coverings, eye protection, and use of the Contractor's staging/decontamination area. The personal protective equipment shall remain the property of the Contractor.

B. Respirators: Select respirators approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services, for use in atmospheres containing lead particulate. Respirator selection shall be in accordance with OSHA Regulation 29 CFR 1910.134.

C. Eye Protection: Furnish eye protection for personnel engaged in lead disturbance operations when the use of a full-face respirator is not required.

D. Protective Clothing: Personnel exposed to airborne concentrations of lead or lead compounds shall wear disposable protective whole-body clothing, head coverings, gloves, and foot coverings. Cloth gloves may be worn for comfort but shall not be used alone. Secure sleeves at the wrists and secure foot coverings at the ankles with duct tape.

E. Work Clothing: Cloth or nylon undergarments may be worn under the disposable protective coveralls.

F. Decontamination Systems: Provide a personnel decontamination staging area and an equipment decontamination staging area as described herein. Personnel entry/exit procedures shall be located adjacent to the regulated area as described in 29 CFR 1926.1101. Wastewater shall be captured, properly containerized, and a hazardous waste determination performed to address the Toxicity Characteristic (see Section 3.3); the material will then be managed properly, consistent with the waste determination. Leakage of contaminated or potentially contaminated decontamination wastewater shall require immediate cessation of work activities until properly addressed and waste residue from the clean-up shall be properly managed (see Section 3.3).

G. Containers: Containers must be leak-tight and be labeled in accordance with EPA, DOT and OSHA standards.

H. Heat guns must be flameless, electrical, paint-softener type with controls to limit temperature to 1,100 degrees F. Heat blower must be (grounded) 120 volts ac, and must be equipped with cone, fan, glass protector and spoon reflector nozzles.

I. Tools and Exhaust Systems: Provide the local exhaust in accordance with ANSI Z9.2 and as specified herein. Filters on vacuums and exhaust equipment shall be absolute HEPA filters and UL 586 labeled. Replace filters as required to maintain the efficiency of the system. Discarded filters shall be managed as discussed elsewhere.

J. Scaffolding: Provide scaffolding, ladders and/or staging, etc. as necessary to accomplish the work of this contract. Scaffolding may be of suspension type or standing type such as metal tube and coupler, tubular welded frame, pole or outrigger type or cantilever type. The type, erection and use of scaffolding shall comply with applicable OSHA provisions and be designed and erected under the supervision of a Competent Person. Scaffolding shall not be anchored directly into the Hangar masonry.

K. First Aid Supplies: Comply with governing regulations and recognized recommendations within the construction industry. Where the eyes of employees may be exposed to injurious corrosive materials, suitable facilities for flushing of the eyes shall be provided within the work area for immediate emergency use.

L. Fire Extinguishers: Provide hand-carried, portable, UL-rated, Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, UL-rated, Class ABC, dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for the exposures. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

M. Rental Equipment. If rental equipment is to be used during LBP/LCP handling and disposal where potential contamination exists, notify the rental agency in writing concerning the intended use of the equipment.

PART 3 - EXECUTION

3.1 LEAD CONTROL AREA PREPARATION

A. Prior to the start of work, photograph or collect video evidence of any current damage. Submit prior to the start of work. Where existing work is damaged discuss removal actions which could further damage building materials with the COR.

B. Establish a lead control area in accordance with 29 CFR 1926.62. Provide physical boundaries around the lead control area by roping off the area.

C. Prepare a containment system or use engineering controls to prevent lead dust from extending beyond the work area including into the interior of the structure. Any containment system used must not be anchored directly into the Hangar masonry. Any connection points shall be approved by the COR. The contractor should reference SSPC Guide 6 for selecting containment systems for removal options or use effective engineering controls to collect lead dust. During any time, dust (or track out) should not extend beyond the work area.

D. Warning Signs: Provide warning signs at approaches to lead control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Signs shall comply with the requirements of 29 CFR 1926.62.

E. Protection of Existing Work to Remain: Perform work without damage or contamination of adjacent areas.

F. Change Room and Shower Facilities: Provide clean change rooms and shower facilities within the physical boundary around the designated lead control area in accordance with requirements of 29 CFR 1926.62.

1. Whenever personnel exit the lead-controlled area, they shall perform the following procedures and shall not leave the workplace wearing any clothing or equipment worn during the work day:
2. Vacuum themselves off.

3. Remove protective clothing in the decontamination room and place them in an approved impermeable disposal bag.
4. Wash hands and face and move to an appropriate shower facility, shower.
5. Change to clean clothes prior to leaving the physical boundary designated around the lead-contaminated job site.

G. To the extent feasible, use fixed local exhaust ventilation connected to HEPA filters or other collection systems. Local exhaust ventilation systems shall be designed, constructed, installed, and maintained in accordance with ANSI Z9.2.

H. Lockout all existing power to lighting circuits in work area. Unless specifically noted otherwise existing lighting circuits to the work area are not to be used. All lighting to the Work Area is to be provided from temporary electrical panel installed by a qualified electrician. Provide sufficient temporary lighting to ensure proper workmanship everywhere; by combined use of daylight, general lighting, and portable plug-in task lighting.

I. The Contractor shall implement an electrical practice protocol that includes, but is not limited to, lockout and GFCI shutdown as described in OSHA Construction Standard 29 CFR 1926.417. All electrically powered equipment utilized during the project shall have ground-fault protection as described in OSHA Construction Standards. All equipment and wiring shall be in compliance with National Fire Protection Association Standard 70, and the National Electrical Code.

J. The Contractor shall thoroughly seal the work area for the duration of the work by completely sealing off all openings and fixtures in the work area, including, but not limited to, heating and ventilation ducts, doorways, corridors, windows, skylights, and lighting, with plastic sheeting taped securely in place. Entrances and exits from the work area will have air locks and triple barriers of plastic sheeting so that the work area is always closed off by one barrier when workers enter or exit. The beacon area should be temporary isolated during the removal of paint in the stairwell.

K. Provide scaffolding or other safe access means to remove paint. Any system used must not be anchored directly into the Hangar masonry.

L. Personnel Protection: Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been given appropriate training and protective equipment.

3.2 WORK PROCEDURES

A. Use procedures and equipment required to limit occupational and environmental exposure to lead when lead-containing paint is removed in place in accordance with 29 CFR 1926.62, except as specified herein. No open flame burning, chemical stripping with methylene chloride-based products, dry sanding or scraping, and use of power tools without HEPA attachments.

B. The Contractor shall schedule a site visit to observe the removal process in a test panel at least 3’x3’ location prior to large scale removal. Notify the COR 72 hours prior to the scheduled site visit to observe removal methods.

C. Protect all surfaces not scheduled for paint removal from damage from work methods and chemicals used for paint removal in the work area. Damages to non-protected areas or from lack of care shall be repaired or replaced at the Contractor's expense.

D. Conduct lead-based paint removal using materials and methods that require the gentlest means possible, which is defined as the least-aggressive approach to obtain acceptable results without causing surface damage, deterioration, or other deleterious effects to substrate materials, as determined by preparation of test panels or mockups and their approval by COR. Adjust dwell times and number of applications of chemical agents to achieve these results. Abrasive or mechanical methods of paint removal are not generally permitted for paint removal of masonry. For metals to receive paint or primer coatings, limit abrasive or mechanical methods to the minimum required to adequately prepare the surface to receive specified coatings.

E. Removal of Paint from Masonry Surfaces should be in accordance with the US GSA document Chemically Removing Paint from and Repainting Brick Masonry (421114S). All visible paint shall be removed from surfaces as determined by comparison to the accepted test panel.

F. Removal of Paint from Metal Surfaces shall be in accordance with US GSA document Removing Paint from Wrought Iron, Cast Iron and Steel Using Abrasive, Chemical, or Thermal Methods (501015S, 501017S, and 501016S, respectively). Remove only as much paint on metal surfaces each day as can be primed that same day. Bare iron and steel will begin to rust again within a few hours, it should not be allowed to sit unprotected overnight. After complete drying, prepare the substrate and seal all metal surfaces where lead-containing paint was removed with a primer or encapsulant which is compatible with the substrate. Take representative photographs of the metal surfaces prior to priming.

G. Removal of paint from Wood Surfaces shall be in accordance with US GSA Documents Chemically removing Paint from Wood Features (640007S) or Removing Paint from Wood Features using Thermal Methods (640009S) and Supplemental Guidelines for Removing Paint from Interior and Exterior Wood Surfaces (640002G).

H. Maintain surfaces of the lead control area free of accumulations of dust and debris and use lead-safe work practices. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use pressurized air to clean up the area. At the end of each shift and when the lead operation has been completed, clean the controlled area of all visible contamination by vacuuming with a HEPA filtered vacuum cleaner, wet mopping the area and wet wiping the area. No paint chips or chemical striper residue shall be left on the floor or any substrate at the end of the work shift.

I. Protect substrates from deterioration and contamination until refinished.

J. At the conclusion of paint removal, clean the exterior sidewalk.

K. During removal the COR may elect to have a representative present to observe work practices for adherence to this Plan and written plan submitted as part of Section 1.6.

L. Employee Monitoring: Monitoring of airborne concentrations of lead shall be in accordance with 29 CFR 1926.62. Until the employer performs an employee exposure assessment as required in paragraph (d) of 29 CFR 1926.62 and documents that the employee performing any of the listed tasks is not exposed above the PEL, the employer shall treat the employee as if the employee were exposed above the PEL. The contractor is responsible for OSHA compliance monitoring. Collect

personal air monitoring samples on employees who are anticipated to have the greatest risk of exposure. In addition, collect air monitoring samples on at least 25 percent of the work crew or a minimum of two employees, whichever is greater, during each work shift. Results shall be made available to within 48 hours after air samples are collected. The COR reserves the right to have an Industrial Hygiene Firm to conduct third-party monitoring of the contractor's employees to verify lead exposure results.

M. Area Monitoring: Sufficient area monitoring shall be conducted at the physical boundary to ensure unprotected personnel (general public) are not exposed the National Ambient Air Quality Standards (NAAQS) for lead. The contractor shall provide any necessary monitoring to ensure this is met. If the outside boundary lead levels exceed NAAQS work shall be stopped and the Contractor shall immediately correct the condition(s) causing the increased levels. If adjacent areas are contaminated, the contractor shall clean contaminated areas. Perform all such required cleaning or decontamination at no additional cost. The COR reserves the right to have an Industrial Hygiene Firm conduct area monitoring to verify airborne lead levels. See Section 3.4 for additional details.

3.3 DISPOSAL OF LEAD WASTES AND CONTAMINATED DEBRIS

A. All waste removal from the work area/containment shall be transported in sealed containers. Monitor the path for any debris or broken bags. Fully clean area if accidental spill occurs and engage work practices in the Waste Management Plan.

B. Contractor shall notify the COR of disposal location for approval prior to any material leaving site.

C. Project related items which cannot be cleaned (lead-contaminated waste, scrap, debris, bags, containers, equipment, and lead contaminated clothing, which may produce airborne concentrations of lead particles) shall be tested using a New York-certified laboratory by Toxicity Characteristic Leaching Procedure (TCLP, also referred to as EPA Method 1311 within SW-846), managed in accordance with the associated regulatory requirements, and transported and disposed at an approved facility based upon the results. TCLP testing should include all eight heavy metals listed in RCRA (commonly referred to as the "RCRA-8") due to the potential presence of other metals such as barium, cadmium, and chromium in paint and/or primer systems. Label the containers appropriately, in accordance with 29 CFR 1926.62 and 40 CFR 261. The contractor is responsible for this testing.

D. All waste samples must be collected in a manner that will ensure that they are representative of the waste undergoing the hazardous waste determination. Sampling methodology shall conform to the applicable requirements of EPA's SW-846, entitled "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods."

E. Lead paint waste shall be stored in U.S Department of Transportation (49 CFR 178) approved containers/drums. Properly label the container/drum to identify the type of waste (49 CFR 172) and the date the container/drum was filled. The Contractor will assign a secured area for interim storage of waste-containing drums. Do not store hazardous waste drums in temporary storage location longer than 90 calendar days from drum label date. The Contractor shall test lead paint waste by TCLP (also referred to as EPA Method 1311 within SW-846) using a New York-certified laboratory in order to properly profile the waste material into an appropriate approved disposal facility. The Contractor is responsible for the proper characterization, handling,

management, transportation and disposal of the waste, consistent with the waste determination. Copies of all waste characterization analyses must be provided to the COR within 48 hours of receipt by the Contractor.

F. All waste samples must be collected in a manner that will ensure that they are representative of the waste undergoing the hazardous waste determination. Sampling methodology shall conform to the applicable requirements of EPA's SW-846, entitled "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods."

G. Handle, store, transport, and dispose lead or lead-contaminated waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, and 40 CFR 265. Comply with land disposal restriction notification requirements as required by 40 CFR 268, as applicable. Contractor shall adhere to the more stringent hazardous waste management regulations, whether state or federally required.

H. Upon receipt, Contractor will submit one copy of each completed manifest, signed and dated by the generator, transporter, and disposal facility representatives in accordance with 40 CFR 262 to the COR. Contractor shall ensure that all waste shipment manifests are accurate and complete in accordance with the applicable regulation(s).

I. Contractor shall ensure transportation of hazardous waste is performed by a New York licensed hazardous waste transporter.

J. Contractor shall ensure that all waste, whether hazardous or non-hazardous, is properly containerized, labeled, and protected from tampering and accidents. All waste containers shall be neatly maintained, with no residue on the container exteriors and securely closed at all times except when emptying and filling.

K. Contractor shall ensure that hazardous waste is properly containerized, labeled, etc. by an individual or individuals trained and qualified under the respective US Department of Transportation requirements. Records of the responsible individual's training shall be provided for file retention.

L. Contractor shall provide to the COR the total weight of hazardous material/waste generated during this project on a weekly basis.

3.4 ENVIRONMENTAL MONITORING

A. Environmental monitoring shall be conducted under the direction of a CIH. The CIH shall certify in writing all monitoring results and final observations.

B. Monitoring shall be conducted as described in applicable sections of the referenced document SSPC-TU 7. The guidelines presented in this document provide methods for assessing the effectiveness of work site engineering controls implemented to protect the public and surrounding environment and to asses the impact of hazardous and toxic substances, as well as; dust emissions from project operations, materials, and equipment.

C. Monitoring shall be conducted at project initiation and periodically thereafter at locations refenced in the guidance document SSPC-TU 7. Results must meet acceptance criterion and monitoring will include.

1. Dust particles for PM-10 particulate size
2. Total lead
3. Visible emissions

D. Soil Sampling: Baseline and project completion soil sampling for lead shall be conducted as outlined in the SSPC-TU 7 guidance document. Acceptance criteria must be below 1,200 ppm. If initial baseline soils sample are above this criterion contact the COR for resolution.

E. Final surface dust sampling shall be conducted on exterior walkways, floors, and window sills

1. Dust samples must be collected using wet wipes. The recommended protocol for sample collection is ASTM Standard Practice E 1728.
2. Clearance wipe samples must be analyzed for lead by a laboratory recognized by the EPA under the National Lead Laboratory Accreditation Program (NLLAP) for analysis of lead in dust.
3. The following clearance criterion must be met are as follows:
   a. Floors must meet a criterion not to exceed 10 ug/ft^2
   b. Exterior walkways must meet a criterion not to exceed 40 ug/ft^2
   c. Window sills must meet a criterion not to exceed 100 ug/ft^2

F. If an area fails any of the aforementioned parameters, the Contractor shall stop work, correct actions causing the exceedance, and clean the affected area. Additional testing will be at the expense of the Contractor.

END OF SECTION 02 83 33

DIVISION 03 -- CONCRETE

SECTION 03 01 00 - MAINTENANCE OF CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cleaning of existing concrete surfaces.

B. Repair of exposed structural, shrinkage, and settlement cracks.

C. Resurfacing of concrete surfaces having spalled areas and other damage.

D. Repair of deteriorated concrete.

E. Repair of internal concrete reinforcement.

F. Scope of Work: As indicated on drawings.

1.2 RELATED REQUIREMENTS

A. Section 03 30 53 Miscellaneous Cast-In-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.

1.3 DEFINITIONS

A. Pressure Spray Levels:
   1. Very Low-Pressure Spray: Less than 100 psi (0.69 Mpa).
   2. Low-Pressure Spray:
      a. Pressure: 100 to 400 psi. (0.69 to 2.76 Mpa).
      b. Flow Rate: 4 to 6 gpm. (0.25 to 0.4 L/s)
   3. Medium-Pressure Spray:
      a. Pressure: 400 to 800 psi. (2.76 to 5.52 Mpa).
      b. Flow Rate: 4 to 6 gpm. (0.25 to 0.4 L/s).
   4. High-Pressure Spray:
      a. Pressure: 800 to 1200 psi. (5.52 to 8.7 Mpa).
      b. Flow Rate: 4 to 6 gpm. (0.25 to 0.4 L/s).

B. Carbon Fiber Reinforced Polymer (CFRP): Composite material comprising a polymer matrix reinforced with carbon fiber cloth, mat, or strands.

1.4 REFERENCE STANDARDS

A. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.

B. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.

C. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.

D. ASTM D3039/D3039M - Standard Test Method for Tensile Properties of Polymer Matrix Composite Materials; 2017.

E. ICC-ES AC178 - Acceptance Criteria for Inspection and Verification of Concrete and Reinforced and Unreinforced Masonry Strengthening Using Fiber-Reinforced Polymer (FRP) or Steel-Reinforced Polymer (SRP) Composite Systems; 2017, with Editorial Revision (2020).

1.5 ADMINISTRATIVE REQUIREMENTS

A. Scheduling: If blast cleaning is needed, perform blast cleaning only between the hours of 7 am to 10 pm.

1.6 SUBMITTALS

A. See Section 01 33 23 Submittal Procedures, for submittal procedures.

B. Product Data: Indicate product standards, physical and chemical characteristics, technical specifications, limitations, maintenance instructions, and general recommendations regarding each material.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Cleaner Qualifications: Company specializing in, and with minimum of 3 years of experience in, the type of cleaning specified.

C. Installer Qualifications: Company specializing in performing work of the type specified and with minimum of 3 years of documented experience.

1.8 MOCK-UPS

A. Test each type of maintenance procedure, including cleaning, required on each type of existing construction, to determine the most appropriate procedures to use and as a record of expected results.

B. Crack Injection: Prepare one sample of each type of injection.

C. Horizontal Surface Repair: Total of 4 foot square area, demonstrating each type of repair.

D. Vertical Surface Repair: Total of 4 foot square area, demonstrating each type of repair.

E. Where color or texture matching is required, first prepare a small size sample on cementitious board.

F. Locate mock-up(s) where directed by Contracting Officer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturers' instructions for storage, shelf-life limitations, and handling of products.

B. Deliver polymer resin materials in original factory-sealed containers with manufacturer's labels intact and legible. Verify product nomenclature, manufacturer's name, product identification, batch number, date of manufacture, and shelf life or expiration date. Do not use polymer resin materials that have exceeded shelf life.

C. Store materials in covered, well-ventilated area and according to manufacturer's written storage instructions. Store polymer resins and hardeners separate from construction materials that can absorb odors.

PART 2 PRODUCTS

2.1 CLEANING MATERIALS

A. Water: Potable.

B. Detergent: Mild, Non-ionic detergent.

2.2 CEMENTITIOUS PATCHING AND REPAIR MATERIALS

A. Cementitious Repair Mortar, Trowel Grade: One- or two-component, factory-mixed, polymer-modified cementitious mortar.

2.3 ACCESSORIES

A. Anchoring Adhesive: Self-leveling or non-sag as applicable.

B. Portland Cement: ASTM C150/C150M, Type I, grey.

C. Sand: ASTM C33/C33M or ASTM C404; uniformly graded, clean.

D. Water: Clean and potable.

E. Concrete patch ties: Stainless Steel Type 304.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Beginning of installation means acceptance of substrate.

3.2 CLEANING EXISTING CONCRETE

A. Provide enclosures, barricades, and other temporary construction as required to protect adjacent work from damage.

B. Clean concrete surfaces of dirt or other contamination using the gentlest method that is effective.
   1. Test areas as determined by the Contracting Officer should be mocked up to determine the appropriate, most effective, least damaging cleaning method.
   2. Try the gentlest method first, then, if not clean enough, use a less gentle method taking care to watch for impending damage.
   3. Clean out cracks and voids using same methods.

C. The following are acceptable cleaning methods, in order from gentlest to less gentle:
   1. Water washing using low-pressure, maximum of 100 psi, and, if necessary, brushes with natural or synthetic bristles.

2. Increasing the water washing pressure to maximum of 200 psi.
3. Steam-generated low-pressure (under 200 psi) hot-water washing.
4. Adding detergent to washing water; with final water rinse to remove residual detergent.
5. If the above methods are not effective, the following may be tested for use at the discretion of the Contracting Officer:
    a. Alkaline cleaning agent applied for the least amount of time that is effective, followed by slight acid rinse and water rinse.
    b. Acidic cleaning agent applied for the least amount of time that is effective, followed by water rinse. Test acidic cleaning agents on mock-up surfaces prior to use.
    c. Abrasive blasting: Low pressure - 35 psi to 75 psi. Use only abrasive media that have been proven not to damage concrete by testing on mock-up.

D. Do not use any of the following cleaning methods, unless otherwise indicated:
1. Brushes with wire bristles, grinding with abrasives, solvents, hydrochloric or muriatic acid, sodium hydroxide, caustic soda, or lye.
2. Soap or detergent that is not non-ionic.

3.3 CONCRETE STRUCTURAL MEMBER REPAIR

3.4 CRACK REPAIR USING GROUT INJECTION

A. Repair exposed cracks.

B. Provide temporary entry ports spaced to accomplish movement of fluids between ports; no deeper than the depth of the crack to be filled or port size diameter no greater than the thickness of the crack. Provide temporary seal at concrete surface to prevent leakage of adhesive.

C. Inject grout into ports under pressure using equipment appropriate for particular application.

D. Begin injection at lower entry port and continue until adhesive appears in adjacent entry port. Continue from port to port until entire crack is filled.

E. Remove temporary seal and excess adhesive.

F. Clean surfaces adjacent to repair and blend finish.

3.5 CONCRETE SURFACE REPAIR USING CEMENTITIOUS MATERIALS

A. Clean concrete surfaces, cracks, and joints of dirt, laitance, corrosion, and other contamination using method(s) specified above and allow to dry.

B. Apply coating of bonding agent to entire concrete surface to be repaired.

C. Fill voids with cementitious mortar flush with surface.

D. Apply repair mortar by steel trowel to a minimum thickness of 1/4 inch (6 mm) over entire surface, terminating at a vertical change in plane on all sides.

E. Trowel finish to match adjacent concrete surfaces.

3.6 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. An independent testing agency, as specified in Section 01 40 00, will perform field inspection and testing.

1. Field Quality Control for CFRP:
   a. Inspect installation and test for compliance with ICC-ES AC178.
   b. Inspect for voids, bubbles, and delaminations by performing a visual and acoustic tap test of layered surface after 24 hours of initial resin saturant cure.
   c. Test for material properties of CFRP in accordance with ASTM D3039/D3039M.
   d. Nonconforming Work: Repair defective work after minimum cure time for CFRP laminates.

END OF SECTION

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

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete, including reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Sections:

1. Section 31 23 00 “Earthwork, Unclassified Excavation” for drainage fill under slabs-on-grade.
2. Section 31 23 33 “Excavation, Backfilling, and Compaction for Pipes and Trenches."

1.2 ACTION SUBMITTALS

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

B. Other Action Submittal:

1. Design Mixtures: For each concrete mixture.

1.3 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. Comply with the following sections of ACI 301 (ACI 301M), unless modified by requirements in the Contract Documents:

1. "General Requirements."
2. "Formwork and Formwork Accessories."
3. "Reinforcement and Reinforcement Supports."
4. "Concrete Mixtures."
5. "Handling, Placing, and Constructing."

C. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

PART 2 - PRODUCTS

2.1 FORMWORK

A. Furnish formwork and formwork accessories according to ACI 301 (ACI 301M).

2.2 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **60** percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

C. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

D. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.

E. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout Project:

1. Portland Cement: ASTM C 150, Type I/II. Supplement with the following:

   a. Fly Ash: ASTM C 618, Class C or F.
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregate: ASTM C 33, graded.

C. Water: ASTM C 94/C 94M.

2.4 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.

6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.5 RELATED MATERIALS

A. Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick; or plastic sheet, ASTM E 1745, Class C.

B. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

2.6 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth or cotton mats.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.7 RELATED MATERIALS

A. Floor Slab Protective Covering: Eight-feet- (2438-mm-) wide cellulose fabric, for floor surfaces scheduled to be polished.

2.8 CONCRETE MIXTURES

A. Comply with ACI 301 (ACI 301M) requirements for concrete mixtures.

B. Normal-Weight Concrete: Prepare design mixes, proportioned according to ACI 301 (ACI 301M), as follows:

1. Minimum Compressive Strength: as indicated on drawings.
2. Maximum Water-Cementitious Materials Ratio: as indicated on drawings.
3. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent. Limit fly ash content to 25% maximum.
4. Slump Limit: as indicated on drawings, before adding high-range water-reducing admixture or plasticizing admixture.
5. Air Content: Maintain within range permitted by ACI 301 (ACI 301M). Do not allow air content of trowel-finished floor slabs to exceed 3 percent.

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, construct, erect, brace, and maintain formwork according to ACI 301 (ACI 301M).

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR RETARDERS

A. Install, protect, and repair vapor retarders according to ASTM E 1643; place sheets in position with longest dimension parallel with direction of pour.

1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended adhesive or joint tape.

3.4 STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.5 JOINTS

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

B. Construction Joints: Locate and install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Contracting Officer.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:
   1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints: Install joint-filler strips at junctions with slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

   1. Extend joint fillers full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

3.6 CONCRETE PLACEMENT

A. Comply with ACI 301 (ACI 301M)for placing concrete.

B. Do not add water to concrete during delivery, at Project site, or during placement.

C. Consolidate concrete with mechanical vibrating equipment.

D. Equipment Bases and Foundations:

   1. Coordinate sizes and locations of concrete bases with actual equipment provided.
   2. Construct concrete bases as indicated on drawings; and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
   3. Minimum Compressive Strength: **4000 psi (27.6 MPa)** at 28 days.
   4. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding 1/2 inch (13 mm).

   1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch (3 mm).

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following rubbed finish, defined in ACI 301 (ACI 301M), to smooth-formed finished as-cast concrete where indicated:

1. Smooth-rubbed finish.
2. Grout-cleaned finish.
3. Cork-floated finish.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.8 FINISHING UNFORMED SURFACES

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

B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on surface.

1. Do not further disturb surfaces before starting finishing operations.

C. Trowel Finish: Apply a hard trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system.

1. Finish surfaces to the following tolerances, in accordance with ASTM E1155 (ASTM E1155M), for a randomly trafficked floor surface: At polished concrete floors: Specified Overall Value (SOV): FF 50 and FL 25 with minimum local value (MLV): FF 40 and FL 17.

3.9 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 (ACI 301M) for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure formed and unformed concrete for at least seven days by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.
5. Floors to Receive Polished Finish: Contractor has option of the following:
   a. Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor. Lap edges and ends of absorptive cover not less than 12 inches (300 mm). Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
   b. Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following: Water or Continuous water-fog spray.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.

B. Inspections:
1. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.
5. Steel-reinforcement placement.

C. Concrete Tests: Perform according to ACI 301 (ACI 301M). Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:

1. Testing Frequency: One composite sample shall be obtained for each day's pour of each concrete mix exceeding 5 cu. yd. (4 cu. m) but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.

2. Slump: ASTM C143/C143M.

3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete.

4. Concrete Temperature: ASTM C1064/C1064M.

5. Compression Test Specimens: ASTM C31/C31M. Cast and laboratory cure two sets of three 6-inch (150 mm) by 12-inch (300 mm) cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C39/C39M. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.

7. Measure floor and slab flatness and levelness in accordance with ASTM E1155 (ASTM E1155M) within 48 hours of completion of floor finishing and promptly report test results to Contracting Officer.

3.11 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

3.12 REPAIRS

A. Remove and replace concrete that does not comply with requirements in this Section.

END OF SECTION 03 30 53

DIVISION 04 -- MASONRY

SECTION 04 03 00
TREATMENT FOR EXISTING MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Masonry Types: Brick, Cast Stone.

B. Cleaning of existing masonry surfaces.

C. Replacement of existing masonry units.

D. Repair of damaged existing masonry units.

E. Raking and repointing of existing mortar joints.

1.02 RELATED REQUIREMENTS

A. Section 01 35 91 Historic Preservation Treatment Procedures for general historic preservation project requirements.

B. Section 07 92 00 - Joint Sealants and Seals.

1.03 ABBREVIATIONS AND ACRONYMS

A. NPS: National Park Service, part of U.S. Department of the Interior.

B. TPS: Technical Preservation Services, part of National Park Service.

1.04 DEFINITIONS

A. Aggregates: Sand component of mortar.

B. Biocide: Chemical treatment that inhibits, deters, or controls organic growth typically removed by cleaning following biocide treatment.

C. Binder: Component of mortar that binds aggregate particles into a cohesive material.

D. Dispersed Lime Crack Injection: Repair method in which dispersed lime material is injected using a needle or syringe into small cracks ranging in width from hairline to 1/8 inch (3.2 mm).

E. Consolidant: Chemical product to strengthen loose or deteriorated stone.

F. Dutchman: Repair method to partially remove deteriorated portion of stone and replace with salvaged or new stone.

G. In situ: Masonry units and mortar remain in place and are restored without removal.

H. Lime Wash: Protective surface treatment comprised of calcium hydroxide particles in suspension in water, along with small amounts of calcium carbonate, silica particles, and other minerals.

I. New Elements: New, nonhistoric materials added to masonry structures to aid in resistance to structural loads or water infiltration.

J. Patching: Use of substitute repair materials to treat damaged or deteriorated masonry units in situ.

K. Pressure Spray Levels:
   1. Very Low-Pressure Spray: Less than 100 psi (0.69 Mpa).
   2. Low-Pressure Spray:
      a. Pressure: 100 to 400 psi. (0.69 to 2.76 Mpa).
      b. Flow Rate: 4 to 6 gpm. (0.25 to 0.4 L/s)
   3. Medium-Pressure Spray:
      a. Pressure: 400 to 800 psi. (2.76 to 5.52 Mpa).
      b. Flow Rate: 4 to 6 gpm. (0.25 to 0.4 L/s).
   4. High-Pressure Spray:

a. Pressure: 800 to 1200 psi. (5.52 to 8.7 Mpa).
b. Flow Rate: 4 to 6 gpm. (0.25 to 0.4 L/s).

L. Repointing: Removal of existing mortar joints to specified depth and replacement with mortar matching color, texture, and performance of original mortar, and with water vapor transmission, bond, hardness, and flexibility compatible with original mortar, tested in accordance with ASTM C1713.

M. Retooling: Chisel is used to recreate surrounding stone texture finish.

N. Surface Treatment: Application of traditional materials or contemporary chemical products to surface of masonry to provide protection to the masonry and mortar or reduce water infiltration.

O. Wall System: Masonry structures comprised of different materials but functioning holistically; restoration and cleaning processes should take into account effects on the adjacent materials and the building as a whole.

P. Saturated Surface Dry (SSD): Condition of masonry after application of water to soak into the capillary pores of the masonry, saturating an area of the masonry, reducing further suction, and allowing surface water to evaporate, leaving the substrate damp but without a surface film of water.

1.05 REFERENCE STANDARDS

A. ACI CODE-318 - Design-Build Manual of Practice; Current Edition.

B. ASTM C34 - Standard Specification for Structural Clay Loadbearing Wall Tile; 2023.

C. ASTM C56 - Standard Specification for Structural Clay Nonloadbearing Tile; 2022.

D. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale); 2023.

E. ASTM C67/C67M - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile; 2023.

F. ASTM C97/C97M - Standard Test Methods for Absorption and Bulk specific Gravity of Dimension Stone; Jun 15, 2018.

G. ASTM C99/C99M - Standard Test Method for Modulus of Dimension Stone; Oct 15, 2018.

H. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens);2021.

I. ASTM C119 - Standard Terminology Relating to Dimension Stone; 2022.

J. ASTM C126 - Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units; 2022.

K. ASTM C141/C141M - Standard Specification for Hydrated Hydraulic Lime for Structural Purposes; 2014.

L. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.

M. ASTM C170/C170M - Standard Test Method for Compressive Strength of Dimension Stone; 2017 .

N. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.

O. ASTM C212 - Standard Specification for Structural Clay Facing Tile; 2022.

P. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale); 2023.

Q. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.

R. ASTM C503/C503M - Standard Specification for Marble Dimension Stone; 2023.

S. ASTM C530 - Standard Specification for Structural Clay Nonloadbearing Screen Tile; 2023.

T. ASTM C568/C568M - Standard Specification for Limestone Dimension Stone; 2022.

U. ASTM C615/C615M - Standard Specification for Granite Dimension Stone; 2023.

V. ASTM C616/C616M - Standard Specification for Quartz-Based Dimension Stone; 2022.

W. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete;2015.

X. ASTM C1324 - Standard Test Method for Examination and Analysis of Hardened Masonry Mortar; 20a.

Y. ASTM C1364 - Standard Specification for Architectural Cast Stone; 2023.

Z. ASTM C1489 - Standard Form of Agreement Between Owner and Contractor where the basis of Payment is a Stipulated Sum; 2017.

AA. ASTM C1528/C1528M - Standard Guide for Selection of Dimension Stone; 2020.

BB. ASTM C1713 - Standard Specification for Mortars for the Repair of Historic Masonry; 2023.

CC. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

DD. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 2022.

EE. ASTM D638 - Standard Test Method for Tensile Properties of Plastics;2014.

FF. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics;2015.

GG. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials;2016.

HH. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

II. ILI (HB) - Indiana Limestone Handbook; 2007.

JJ. NPS (THP) - The Secretary of The Interior's Standards For the Treatment of Historic Properties with Guidelines For Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings; 2017.

KK. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

1.06 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work of this section.
   1. Require attendance of parties directly affecting work of this section.
   2. Review installation conditions, procedures, and coordination with related work.

B. Scheduling of Period Treatments: Perform cleaning and washing of masonry between the hours of 7 a.m. and 7 p.m. only.

1.07 SUBMITTALS

A. See Section 01 33 23 Submittal Procedures for submittal procedures.

B. Product Data: For each type of product indicated. Provide test data substantiating products comply with requirements.
   1. Include recommendations for product application and use.

C. Product Data: Provide data on cleaning compounds and cleaning solutions.

D. Shop Drawings: Indicate setting details of stone, details of special masonry shapes, and special supports for the work. Detail shoring and temporary or permanent support.

E. Repointing Schedule: Detailed schedule of areas to be repointed, including assessment of the problem areas and detailed description of repointing procedures. Include the following:
   1. Description of existing general masonry failures that contribute to mortar losses and scheduling for repairs prior to repointing.
   2. Results of analysis of existing and repair mortar types and colors.
   3. 'Before' photos of areas to be repointed.

F. Samples: Submit 8 samples of face brick and 2 samples of cast stone units to show matching color, texture, and extremes of color range.

G. Samples: Each type of pointing mortar in the form of sample mortar strips, 6 inches long by 1/2 inch wide, set in aluminum or plastic channels.
   1. Include with each sample a list of ingredients with proportions of each. Identify sources, both supplier and quarry, of each type of sand and brand names of cementitious materials and pigments if any.

H. Samples: Each type of masonry patching compound in the form of briquettes, at least 3 inches long by 1-1/2 inches wide. Document each sample with manufacturer and stock number or other information necessary to order additional material.

I. Manufacturer's Instructions: For cleaning materials, indicate special procedures, conditions requiring special attention.

J. Conservation treatment quality control plan.

K. Restorer's qualification statement.

L. Mortar testing agency qualification statement.

1.08 QUALITY ASSURANCE

A. Conservation Treatment Quality Control Plan: Prior to commencing work of this section, receive written approval of plan of proposed masonry restoration and cleaning work. Include the following:
   1. Description of dust containment methods.
   2. Description of protection of surrounding construction and landscaping.
   3. Description of sequencing, work procedures, materials, and tools proposed for each conservation treatment.
      a. Effects of weather variations on sequencing of treatments, construction schedule, and protection of completed work.
   4. Survey of original wall layout and datum points and plumb lines for rebuilding masonry.
   5. Description of shoring and providing safe working environment.
   6. Description of selection methods for deconstruction of individual masonry units and tools and methods for cleaning the masonry for reuse.
   7. Description of removal of deteriorated mortar joints.
   8. Description of matching of repair material and compatibility with historic materials.
   9. Description of cleaning process in detail, including materials, methods, and equipment to be used, protection of surrounding materials on building and Project site, and control of runoff during operations. Include schedule for periodic and final cleaning of masonry surfaces.
   10. Description of masonry removal and matching procedures including, but not limited to, equipment, approach, length of time the masonry will be out of the wall, mapping removal locations, and location where masonry units will be repaired, on-site or off-site.
   11. Description of use of reclaimed masonry units including, but not limited to, setting masonry in its original position and maintaining original bond patterns and joint widths.

B. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
   1. Maintain one copy of each document on project site.

C. Mortar Testing Agency Qualifications: Independent firm specializing in performing analysis of historic masonry mortar.

D. Restorer Qualifications: Company specializing in period masonry restoration with minimum five years of documented experience.
   1. Use experienced masons who have demonstrated proficiency with tools on historic structures.

1.09 MOCK-UPS

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. Restore and repoint existing masonry wall defined below. Include mortar, accessories, wall openings, and flashings as required for each type of masonry material indicated.

1. Repointing Mortar Joints:
    a. Minimum Dimensions: 12 feet (4 m) long; 2/3 of length for horizontal joints and 1/3 of length for vertical joints.
    b. Demonstrate cutting out mortar joints, preparation for repointing, and mixing, installing, and curing mortar.
    c. Prepare and place repointing mortar in accordance with guidance provided in NPS (THP) Preservation Brief 2.
2. Retooling Stone Masonry In-Situ: Demonstrate retooling of three deteriorated stone faces in-situ in historic profile textures indicated.
3. Masonry Removal and Replacement: Remove masonry and replace to match existing dimensions and texture, unless indicated otherwise. Size shall represent typical conditions.
    a. Set one masonry unit in same location; match joint width and bond pattern, using mortar specified.
    b. Dry set one unit in opening, set on wood shims for evaluation and approval of preparation conditions.
    c. Confirm with COR that replacement masonry units meet specified requirements, and that quantity required for the work has been identified.
4. Application of Repair Materials:
    a. Patching: Apply repair material on minimum two masonry units of type scheduled for repair.
        1) Demonstrate removal of previous patching and application of new patching on one masonry unit.
        2) Remove metal anchors at two locations and fill in the holes with repair material on minimum one masonry unit.
5. Crack Repair: Repair one crack, 24 inches (610 mm) long, for each indicated method.
    a. Repair with mortar.
    b. Repair with dispersed hydrated lime injection with appropriate repair material.
6. New Masonry Elements: Install one of each type of new component, demonstrating final installation method and finished appearance.
    a. Where masonry materials must match a range of colors, textures, and/or other appearance characteristics, include in mock-up a representative sample of that range.

C. Clean a 10-foot (3 m) by 10-foot (3 m) panel of wall of each type of period masonry.
    1. Repeat, using different cleaning methods for up to three different panels.

D. Locate mock-up areas where directed by COR.

E. Approved restoration mock-up areas, including results of procedures employed, will remain and become the quality standard for work of this section.

1.10 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Contractor will engage a qualified independent testing agency to test the following:
    1. Replacement Brick: For each proposed type of replacement brick, according to sampling and testing methods in ASTM C67/C67M for compressive strength, 24-hour cold-water absorption, 5-hour boil absorption, saturation coefficient, and initial rate of absorption (suction).
    2. Existing Brick: For each type of existing brick indicated for replacement, according to testing methods in ASTM C67/C67M for compressive strength, 24-hour cold-water absorption, 5-hour boil absorption, saturation coefficient, and initial rate of absorption (suction). Carefully remove existing brick units from locations designated by COR.
    3. Existing Mortar: Test according to ASTM C1324, modified as agreed by testing service and COR for Project requirements, to determine proportional composition of original ingredients, sizes and colors of aggregates, and approximate strength. Use X-ray diffraction, infrared spectroscopy, and differential thermal analysis to supplement microscopical methods. Carefully remove existing mortar for testing from within joints at five locations designated by COR.

1) Test three pre-construction mixes for potential use on the project plus an additional test for final approval.

4. Existing Cast Stone: Test according to ASTM C1364, modified as agreed by testing service and COR for Project requirements, to determine proportional composition of original ingredients, sizes and colors of aggregates, and approximate strength. Test cast stone units as selected by COR.
5. Existing Cementitious Parge Coating (located within the WPA infill): Test according to ASTM C1860, modified as agreed by testing service and COR for Project requirements, to determine proportional composition of original ingredients, sizes and colors of aggregates, and approximate strength. Carefully remove existing material for testing at five locations designated by COR. Additionally, contractor to determine if wire mesh and/or metal reinforcing is present.
6. Temporary Patch: Patch areas from which samples were taken that may be exposed to weather. Patch can be temporary in nature unless directed otherwise by COR.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver masonry neatly stacked and tied on pallets. Store clear of ground with adequate waterproof covering.

1.12 FIELD CONDITIONS

A. Cold and Hot Weather Requirements for Masonry Work: Comply with requirements of TMS 402/602.

PART 2 PRODUCTS

2.01 CLEANING MATERIALS

A. Cleaning Agent: Detergent type.

B. Cleaning Agent: 0.5 lb (227 g) of sodium hydrosulfite mixture to one gallon (3.8 L) of water.

C. Poultice Materials: Commercially available or custom-prepared materials that adhere to and peel off paint or other coatings without damaging underlying masonry,
   1. Products:
      a. ABR Products, Inc.: ABR Waterless Cleaning Poultice, or equal.
      b. Waterless Type: Proprietary latex-based coating, direct-applied without on-site mixing.
      c. Substitutions: See Section 01 67 00 - Product Requirements.
   2. Products:
      a. PROSOCO: Sure Klean Marble Poultice, or equal.
      b. Water-Based Type: Proprietary, odorless, nonacidic blend of dry absorbent natural or artificial clays and biodegradable detergents, mixed on-site with potable water.
         1) Form: Light-colored gray or white powder.
         2) Specific Gravity: Approximately 2.0.
         3) Total Solids Content: N/A.
         4) pH, Wet: 9 to 10.
      c. Substitutions: See Section 01 67 00 - Product Requirements.

2.02 MORTAR MATERIALS

A. Mortar to match existing in color, makeup and appearance according to mortar testing as noted in 1.10.A.1 above. Hardness to be less and water absorption rate to be higher than that of the adjacent brick and cast stone materials. Mortar to be in accordance with ASTM C1713.

B. Based upon the mortar testing results above, one or more of the following materials shall be used:
   1. Lime:
      a. Portland Cement - Lime (PCL): ASTM C150/C150M, Type I or Type II; white or gray or both, where required for color matching of mortar.
      b. Natural Hydraulic Lime (NHL): ASTM C141.

c. Pozzolonic Hydraulic Lime (PHL): ASTM C1707.

2. Mortar Sand: ASTM C144 unless otherwise indicated.
   a. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
   b. Color: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
   c. Provide sand with rounded edges.
3. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.
4. Water: Potable, ASTM C260; Clean and free of oils, acids, alkalies, salts, organic materials, or other substances that are deleterious to mortar or metal it comes in contact with.

2.03 MORTAR MIXING:

A. General Requirements:
   1. Do not use modern additives unless permitted in writing by COR.
   2. Preconstruction Testing: Provide mortar mix consistent with test results.
   3. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer. Follow manufacturer's recommendations if mortar prehydration is required.
   4. NHL Mortar: Mix in accordance with manufacturer's instructions.
   5. Match the historic mortar in color, texture, and tooling for each identified mortar type .
   6. Match sand used in the historic mortar for each identified mortar type.
   7. Provide mortar that has same vapor permeability and same or slightly lower compressive strength than the historic mortar.
   8. Do not use portland cement mortars.

B. Mortar for Brick:
   1. Use lime and sand mortars.
   2. Do not use portland cement mortars.
   3. Rebuilding (Setting) and Pointing Mortar by Type: ASTM C270, Proportion Specification, Type N unless otherwise indicated; with cementitious material limited to portland cement and lime. Match mortar mix from construction testing.
   4. Rebuilding (Setting) and Pointing Mortar by Volume: ASTM C270, Proportion Specification, match existing proportions based on mortar testing.
   5. Rebuilding (Setting) and Pointing Mortar by ASTM C1713 Proportion: ASTM C1713 with binder material limited to hydraulic hydrated lime and with a volume ratio of lime and sand matching ratio determined in preconstruction testing
      a. Provide mortar with the following additional tested properties at 28-day cure time:
         1) F_c equal to 750 psi and F_{cmx} equal to 1100 psi.

C. Mortar for Cast Stone Units:
   1. Use lime and sand mortars.
   2. Use portland cement mortars only upon approval by COR.

2.04 MASONRY MATERIALS - GENERAL

A. Owner Furnished Material:
   1. Coordinate with Owner use of existing stock of brick. Evaluate condition of each type of masonry and confirm quantities suitable for use.

B. Salvaged Brick and cast stone: Obtain from location indicated on Drawings. Clean off residual mortar in manner minimizing damage to masonry.

C. Backup Brick: For brick used as backup to face materials, provide brick having same vertical dimension as existing backup brick, according to ASTM C62, Grade SW, MW, or NW.

D. Masonry Matching Existing: Provide brick and cast stone with colors, textures, and other appearance characteristics that match existing materials as closely as possible.
   1. Physical Properties: Provide materials with physical properties within 10 percent of those determined by preconstruction testing.
   2. For existing materials that exhibit a range of colors, textures, and/or other appearance characteristics, provide materials that proportionally match that range.

E. Date Identification: Stamp replacement brick and cast stone with permanent ink on a concealed, interior surface which can be read after installation: "MADE Insert year" in 3/8 inch high letters.

2.05 MASONRY MATERIALS

A. Replacement Facing Brick: Match existing historic brick color, shape, size, texture, and general appearance with physical properties as listed below:
   1. Comply with ASTM C216, Type FBA, Grade SW.
   2. Color and texture: Match existing brick as approved by COR. For brickwork exhibiting a range of colors within each unit, provide brick that proportionally matches color variation rather than matching an individual color within that range.
   3. Actual size: Match existing; Contractor to verify in field.
   4. Special shapes: Molded units as required, unless standard units can be sawn to produce equivalent effect with no exposed sawn edges, core holes, or frogs. Do not use broken bricks or adhesives in producing special shapes.
      a. Provide specially ground units shaped for arches and where indicated.
   5. Compressive strength: As indicated in schedule, measured in accordance with ASTM C67/C67M.

B. Replacement Cast Stone Units:
   1. Architectural concrete product manufactured to simulate appearance of historic cast stones' type, color, shape, size, texture, finish profile, and general appearance. Refer to preconstruction testing results as noted in 1.10.A.2 above. Comply with ASTM C1364.
      a. Compressive Strength: Complying with ASTM C1364; calculate strength of pieces to be field cut at 80 percent of uncut piece.
      b. Freeze-Thaw Resistance: Demonstrated by laboratory testing in accordance with ASTM C1364.
      c. Remove cement film from exposed surfaces before packaging for shipment.
   2. Reinforcement: Provide reinforcement as required to withstand handling and structural stresses; comply with ACI CODE-318.
      a. Stainless steel Pieces More than 24 inches (610 mm) in Any Dimension: Provide full length two-way reinforcement of cross-sectional area not less than 0.25 percent of unit cross-sectional area.

2.06 MASONRY PATCHING AND REPAIR MATERIALS

A. Mortar Mixes - Sandstone Patching: Field-prepared mixes intended for patching various types of sandstone, with slurries applied in multiple coats.
   1. Slurry Coat Proportions: 1 part white Portland cement, 2 parts type S lime, 6 parts sand.
   2. Scratch Coat Proportions: 1 part white Portland cement, 1 part type S lime, 6 parts sand.
   3. Finish Coat Proportions: 1 part white Portland cement, 1 part type S lime, 2 to 3 parts sand, 3 to 4 parts crushed stone, dry pigments. Formulate to match existing stone texture and color.
   4. Water: In sufficient quantity to provide desired workability of the mix and satisfy initial rate of absorption of stone.

B. Cast Stone Patching:
   1. Patching Compound: Factory-mixed cementitious repair material formulated to match color and texture of each type of existing masonry or stone (contractor to test existng cast stone). Patch compound to be free from acrylic, latex, or other synthetic polymer additives.

a. Formulation: Compound to have equal or better vapor and water permeability than masonry, with low shrinkage, lower modulus of elasticity than masonry being repaired, and high developed bond strength to all masonry types.

C. Cementitious Crack filler: Ultrafine superplasticized grout that can be injected into cracks, is suitable for application to wet or dry cracks, with low shrinkage and high bond strength to all stone types.

2.07 BONDING ADHESIVES

A. General: Products designed specifically for repairing and bonding masonry.

B. Cementitious Anchor Grout: Vapor permeable, hydraulic, cement-based grout; no latex, acrylic, or epoxy constituents.
   1. Products:
      a. US Heritage Group: Heritage Masonry Repair Mortar IG10 Injection Grout, or equal.
      b. Substitutions: See Section 01 67 00 - Product Requirements.
   2. Application: For bonding anchors to masonry.
   3. Cured Properties:
      a. Compressive Strength: 4,000 psi (27.58 MPa) to 5,000 psi (34.47 MPa) minimum at 7 days, tested in accordance with ASTM C1019.

C. Epoxy Anchor Grout: 100 percent solids, moisture-insensitive, low-creep structural adhesive complying with ASTM E1512, Type IV; grade and class selected to comply with manufacturer's recommendations for the application.
   1. Products:
      a. Euclid Chemical: Dural 452 LV, or equal.
      b. Substitutions: See Section 01 67 00 - Product Requirements.
   2. Application: For bonding anchors to masonry.
   3. Cured Properties:
      a. Tensile Strength: 3,550 psi (24.48 MPa) minimum at 7 days, tested in accordance with ASTM E1512.
      b. Compressive Strength: 9,210 psi (63.50 MPa) minimum at 7 days, tested in accordance with {RS#1054}.
      c. Flexural Strength: 7,947 psi (54.79 MPa) minimum at 7 days, tested in accordance with {RS#1062}.
      d. 24 Hour Water Absorption: 0.04 percent maximum, tested in accordance with ASTM D570.

D. Epoxy Adhesive: Two-component, exterior grade, clear, tintable adhesive with gel viscosity, recommended by adhesive manufacturer for type of stone repair indicated, matching stone color.
   1. Products:
   2. Sika: Sikadur 52, or equal.
   3. Cured Properties:
      a. Tensile Strength: 2,044 psi (14.09 MPa) minimum at 7 days, tested in accordance with {RS#1043}.
      b. Compressive Strength: 8,182 psi (56.41 MPa) minimum at 7 days, tested in accordance with {RS#1054}.
      c. Flexural Strength: 9,896 psi (68.23 MPa) minimum at 7 days, tested in accordance with {RS#1062}.
   4. Substitutions: See Section 01 67 00 - Product Requirements.

2.08 PAINT REMOVERS

A. Products:
   1. General Paint: PROSOCO, Inc: SafStrip, or equal.
      a. Water-Based: Formulated without methylene chloride or methanol and used for removal of multiple coats of oil-based, water-based, acrylic-based, epoxy-based, urethane-based, elastomeric, and lead-based paints.

1) Formulation: Thixotropic paste or gel.
2) Acidic Type: 2.1 pH.
3) Surface Neutralization After Use: Not required.
4) Restrictions: Not intended by the manufacturer for use on furniture, polished surfaces, or for removal of cementitious coatings.

2. Graffiti Removal: PROSOCO, Inc: Sure Klean Graffiti Remover, or equal.
   a. Water-Based: Formulated without methylene chloride or methanol and used for removal of graffiti.
      1) Acidic Type: not applicable.
      2) Surface Neutralization After Use: Not required.
3. Substitutions: See Section 01 67 00 - Product Requirements.

2.09 ACCESSORY MATERIALS

A. Stone Anchors and Pins: Fabricated from Type 304 stainless steel.

B. Molds for Replication of Masonry Elements: Provide accurate molds of existing elements in situ, for replication by casting.
   1. Digital Capture and Modeling: Use optical 3D coordinate measuring equipment to capture detail of elements as composite mesh scans and proprietary software to build digital models.
      a. Molds and Models: Manufacturer's recommended materials and methods.
   2. Directly-Applied, Custom Molds: Brush-applied rubber materials applied directly onto existing elements.
      a. Sealer for Porous Materials: In accordance with molding compound manufacturer's recommendation.
      b. Rubber Molding Compound: Urethane two-component rubber compound for brush application.
         1) Hardness: 35, measured in accordance with ASTM D2240, using Type A durometer.
         2) Tensile Strength: 335 psi (2.31 MPa), measured in accordance with ASTM D412.
         3) Elongation at Break: 1,000 percent, minimum, measured in accordance with ASTM D412.
         4) Color Tints: In accordance with molding compound manufacturer's recommendation.
      c. Release Agents: In accordance with molding compound manufacturer's recommendation.
      d. Mold Shell Compound: Two-component, fiber resin, trowelable compound to encase and hold in place the inner mold.
         1) Hardness: 70, measured in accordance with ASTM D2240, using Type D durometer.
         2) Ultimate Tensile Strength: 1,600 psi (11.03 MPa), measured in accordance with {RS#1043}.
         3) Compressive Strength: 3,420 psi (23.58 MPa), measured in accordance with {RS#1054}.
         4) Elongation at Break: 1,000 percent, minimum, measured in accordance with ASTM D412.

C. Mortar Additives: Matching project's existing historic mortars including components to enhance color and texture.
   1. Crushed oyster shells.
   2. Animal hair.
   3. Brick dust.
   4. Lamp black.

D. Colorants, When Required for Exact Color Match: Nonfading, mineral oxide masonry pigment as approved by the COR.
   1. Pigments: Maximum 10 percent by weight of binder in the mix.
   2. Carbon Black: Maximum 2 percent of binder in the mix.

E. Lead Covers for Sealant Joints: T-shaped lead profile for embedment into freshly-applied joint sealant.
   1. Manufacturers: Subject to requirements, provide products by:

a. Weathercap, Inc: Joint Protective System, or equal.
b. Substitutions: See Section 01 67 00 - Product Requirements.

2. Sealant: See Section 07 92 00.

PART 3 EXECUTION

3.01 PERIOD TREATMENT, GENERAL

A. See Section 01 35 91 for special procedure requirements related to elements and features of historical significance and value.

3.02 EXAMINATION

A. Verify that surfaces to be cleaned and restored are ready for work of this section.

3.03 EVALUATION AND ASSESSMENT

A. Begin masonry work after evaluation and analysis of areas to be repaired are completed including, but not limited to, sampling and testing of the existing mortar to determine its composition and qualities.

B. Do not start repairs until conditions causing masonry deterioration have been identified.

C. To forestall recurrence of masonry deterioration, correct deterioration-causing conditions prior to start of the restoration work.

D. Analyze composition of existing historic bedding mortar to provide basis for matching with new mortar.

3.04 PREPARATION

A. Protect other elements from damage that may result from restoration procedures.

B. Carefully remove and store identified items located in areas to be restored including, but not limited to, fixtures, fittings, finish hardware, and accessories; reinstall upon completion of restoration work.

C. Protect nonrestoration areas from restoration areas to prevent damage.

D. Mask or cover adjacent surfaces and permanent equipment. Secure coverings without using nails and without tape that leaves residue. Do not use impervious sheeting which produces condensation.

1. Use materials that will withstand cleaning and restoration procedures.

E. Cover existing landscaping within work areas with tarpaulins or similar covers during work periods.

1. Provide coverings that allow plants to breathe.
2. Remove coverings at the end of each workday. Do not cover plants with waterproof membranes for more than eight hours at a time.
3. Set scaffolding and ladder legs away from plants. Request and receive approval from Owner for plant pruning necessary to conduct conservation treatment operations.

F. Separate adjacent occupied areas with dust proof and weatherproof partitions.

G. Protect roof membrane and flashings from damage with 1/2-inch (13 mm) plywood laid on roof surfaces over entire work area and traffic route.

H. When using liquid cleaning methods, provide drainage devices to prevent runoff over adjacent surfaces, unless those surfaces are impervious to damage from runoff.

I. Do not allow cleaning runoff to drain into sanitary or storm sewers.

J. Do not attach scaffolding, ladders, or working platforms to the building without written authorization and instructions from COR.

3.05 PAINT REMOVAL

A. Remove existing coatings to bare substrate as indicated.

B. Removal with Chemical Products: Use products in accordance with manufacturer's instructions.
   1. Vertical Surfaces: Work from the bottom up; apply undiluted removal product to dry surfaces in thickness recommended by manufacturer.
   2. Allow product to dwell on existing surface as recommended by manufacturer or until existing coating shows signs of dissolving. Periodically agitate applied remover product with a stiff bristle brush to improve penetration into existing coating.
   3. Exterior Elements: Unless otherwise noted or recommended by paint remover manufacturer, use the following procedures:
      a. Work from the bottom up, rinse off remover and coating residue using a pressure washer as recommended by remover manufacturer.
   4. Interior Elements: Unless otherwise indicated or recommended by paint remover manufacturer, use the following procedures:
      a. Using low-pressure tank or pump-up sprayer, mist treated surface with clean water to emulsify old sealer and dilute the remover.
      b. Floors: Scrub surfaces until remover and coating residue no longer adhere to substrate. Use power scrubber or buffer with abrasive, nonmetallic scrubbing pad. Add clean water as necessary to aid scrubbing. Dispose of remover and coating residues.
      c. Walls: Scrub surfaces with stiff-bristle brush until remover and existing coatings residue no longer adhere to substrate. Add clean water as necessary to aid scrubbing.
      d. Use towels, mops, or wet vacuums to collect liquid residue. Use caution when vacuuming solvent-containing residue.
   5. Neutralize pH of stripped surfaces after using acidic-based or alkaline-based removers as recommended by remover manufacturer.
      a. Brush apply prepared neutralizer to treated surfaces in gentle scrubbing manner. Allow neutralizer to remain on surface for time period recommended by manufacturer.
      b. Rinse treated area thoroughly, and remove all traces of paste residue and solubilized coating.
      c. Test surfaces to ensure neutralization has been achieved using pH papers, pH pens, or pH indicator solutions. Repeat applications of neutralizer until surfaces test between pH 5.0 and pH 9.0.
      d. Allow neutralized surface to dry thoroughly. Before applying new surface coatings, retest surfaces to confirm adequate neutralization and prevent surface discoloration or failure of new coatings.
   6. Ensure that chemicals and coating residue are removed from substrate.

C. Leave surfaces in clean, residue-free condition, ready for subsequent restoration procedures.

3.06 INSTALLATION

A. Do not mix or apply materials when the ambient temperature or humidity are outside of range recommended by their manufacturers.

B. Schedule conservation treatments to be carried out during appropriate environmental conditions to avoid weather-related failures.

3.07 REPAIR

A. Masonry Unit Patching: Patch units indicated on drawings and as follows:
   1. Units with holes.
   2. Units with chipped edges or corners measuring more than 3/4 inch (19 mm) in least dimension.
   3. Units with deep deterioration or spalling greater than 3/4 inch (19 mm) in least dimension and 1/4 inch or greater in depth.

B. Mortar Mixes (Sandstone):
   1. Mask off areas to be kept free of mortar.
   2. Mix materials in proportions specified for each coat.
   3. Wash prepared surface with water and a soft brush.

4. Slurry Coat: Apply with brush and rub vigorously into surface.
5. Scratch Coat: Press first scratch coat into slurry coat while slurry coat is moist. Score each scratch coat before initial drying to provide a key for subsequent coats. Maximum 3/8-inch (8 mm) thickness for each scratch coat.
6. Finish Coat: Apply finish coat after patch has been built up to the required thickness.
7. Surface Finishing: Finish surface while patch is partially cured to leather hardness to match the original masonry tooling or existing condition.

C. Patching Compound - Brick and Cast Stone:
1. Remove loose material. Provide square cut edges along perimeter of patch area, carefully removing material to depth of at least 1/4 inch. Within body of patch, remove material as necessary for patch depth of at least 1/2 inch. Feathered edges are not allowed.
2. Mask off areas to be kept free of compound.
3. Mix components as recommended by manufacturer and as follows:
   a. Mix compound in individual batches to match each unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.
4. Rinse surface to be patched and leave damp, without standing water.
5. Apply with trowel or similar implement into and over area to be repaired.
6. Match existing adjacent finish.

3.08 MASONRY UNIT REPLACEMENT

A. Cut out damaged and deteriorated masonry to prevent damage to adjacent materials.

B. Support structure as necessary prior to cutting out units.

C. Cut away loose or unsound, adjoining masonry as directed.

D. Build in new and salvaged units for new work as specified in other sections.

E. Mortar Mix: Match existing. Contractor to perform mortar analysis. .

F. Ensure that anchors are correctly located and built in.

G. Install built-in masonry work to match and align with existing, with joints and coursing true and level, faces plumb and in line. Build-in all openings, accessories, and fittings.

3.09 REPOINTING

A. Perform repointing prior to cleaning masonry surfaces.

B. Cut out loose or disintegrated mortar in joints to minimum 1/2-inch (6 mm) depth or until sound mortar is reached.

C. Use hand tools only. Do not use power tools.

D. Exercise appropriate caution to prevent damage to existing masonry.

E. When cutting is complete, remove dust and loose material with air jet.

F. Premoisten joints and apply pointing mortar. Pack tightly in maximum 1/4-inch (6 mm) layers. Form a smooth, compact concave joint to match existing.

G. Moist cure for 72 hours.

3.10 PAINTING STEEL UNCOVERED DURING THE WORK

A. Steel Exposed During Masonry Work: For steel that will remain in place, prepare and paint it as follows:
1. Surface Preparation: Remove paint, rust, and other contaminants according to SSPC-SP2, "Hand Tool Cleaning" or as required by paint manufacturer's recommendations.
2. Antirust Coating: Immediately paint exposed steel with two coats of zinc-rich antirust coating in thickness recommended by paint manufacturer.

B. Notify COR if thickness of any steel member is found to be reduced from rust more than 1/16 inch.

3.11 RESTORATION CLEANING

A. Preclean surfaces and remove large particles with wood scrapers or nonferrous wire brush.

B. Perform cleaning and rinsing of exterior masonry only during daylight hours.

C. Neutralize pH of stripped surfaces after using acidic-based or alkaline-based removers as recommended by remover manufacturer.

D. Preparatory Exterior Masonry Cleaning: Use safe spray pressures for each type of item to be cleaned.
   1. Account for use of detergent and abrasives in cleaning solutions when setting pressure and flow of spray.
   2. Start with using low-pressure spray at 100 to 400 psi (0.69 to 2.76 MPa) and 4 to 6 gpm (0.25 to 0.4 L/s) flow rate. Move to medium-pressure spray if low-pressure is not effective.
      a. Use medium-pressure spray at 400 to 800 psi (2.76 to 5.52 MPa) and 4 to 6 gpm (0.25 to 0.4 L/s).
      b. Use high-pressure spray at 800 to 1,200 psi (5.52 to 8.27 MPa) and 4 to 6 gpm (0.25 to 0.4 L/s) flow rate only with COR approval.

E. Restoration Cleaners:
   1. Do not use acidic chemical cleaners on limestone, marble, concrete, or other calcareous masonry materials.
   2. Apply restoration cleaner on masonry using brush or roller in accordance with manufacturer's instructions.
   3. Provide a second application if required to match mock-up area.
   4. Allow sufficient time, as recommended by manufacturer, for solution to remain on masonry.

F. Restoration Poultices:
   1. For poultices requiring mixing with water, comply with manufacturer's instructions for desired troweling consistency.
   2. Apply poultice to surface with plasterer's trowel or paste extrusion equipment. Apply a uniform 1/4-inch (6 mm) coating.
      a. Cover poultice area with film recommended by manufacturer. Remove air pockets and ensure smooth overall adhesion. Press the film against poultice and tape or seal edges.
   3. Leave poultice on masonry surface for time period recommended by manufacturer. In extreme humidity, adjust time as recommended by manufacturer. Trial testing may be required to determine the most effective dwell time.
      a. Remove film. If still wet, let poultice dry for additional 2 to 4 hours. Drying times may vary with environmental conditions such as temperature, wind, and humidity.
   4. Remove poultice and dissolved staining matter as recommended by manufacturer. Remove as much poultice residue from the surface as possible.

G. Washing or Rinsing Vertical Surfaces:
   1. Rinse from the bottom up with potable water applied at 600 psi (4140 kPa) and at a rate of 6 gpm (24 L/min) through a 15 to 45 degree fan spray tip.
      a. Heat water to between 150 and 180 degrees F (65 and 82 degrees C).
      b. Use adjustable equipment capable of reducing water pressure and flow rate as needed for sensitive surfaces.
      c. Rinse with water and pressure sufficient to flush restoration cleaner and dissolved soiling from the masonry surface and surface pores without damaging masonry. Do not leave cleaning procedure residues on masonry.

H. Washing or Rinsing Horizontal Surfaces:
   1. Wash surface thoroughly with fresh water using a sponge or cloth. Let surfaces dry thoroughly.

3.12 CLEANING

A. Remove stains, efflorescence, or other excess resulting from the work of this section. Do without delay to avoid penetration and setting.

B. Remove excess mortar, smears, and droppings as work proceeds and upon completion.

C. Clean surrounding surfaces.

END OF SECTION

DIVISION 05 -- METALS

SECTION 05 03 00
CONSERVATION TREATMENT FOR PERIOD METALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. The following scope areas are included in this specification: steel windows, aluminum hangar doors, and copper friezes above hangar doors. See Structural for restoration of structural members.

B. Restoration cleaning of metal surfaces.

C. Repair of damaged metal elements.

D. Replacement of metal elements.

E. Refinishing of metal surfaces including high-performance coatings.

1.02 RELATED REQUIREMENTS

A. Section 01 35 91 – Historic Preservation Treatment Procedures: For general historic preservation project requirements.

B. Section 09 96 00 – High Performance Coatings.

1.03 PRICE AND PAYMENT PROCEDURES

A. Unit Prices:
   1. Basis of Measurement for steel window elements: By linear foot (linear meter).
   2. Basis of Measurement for aluminum muntins: By linear foot.
   3. Basis of Measurement for aluminum sheets: By square foot.
   4. Basis of Measurement for copper sheets: By square foot.

1.04 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.

E. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

F. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.

G. ASTM B138/B138M - Standard Specification for Manganese Bronze Rod, Bar, and Shapes; 2011 (Reapproved 2017).

H. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction; 2022.

I. 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; 2023.

J. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

1.05 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work of this section.
   1. Require attendance of parties directly affecting work of this section.
   2. Review installation conditions, procedures, and coordination with related work.

1.06 SUBMITTALS

A. See Section 01 33 23 Submittal Procedures for submittal procedures.

B. Restoration Schedule: Detailed description of areas to be restored including assessment of problem areas proposed procedures. Include the following:
   1. Photographic documentation of areas to be restored, prior to restoration work.

C. Product data.

D. Shop Drawings: Indicate details of connections and anchors for metal elements. Detail shoring, bracing, and temporary or permanent support.

E. Patterns for Casting Molds: For each distinct piece, provide patterns from which molds will be fabricated.
   1. Include documentation of dimensioning and structural changes during the casting process. Indicate allowances made for contraction or shrinkage.

F. Samples: Submit four samples of each type of replication or reproduction casting to show matching color, texture, and detail.

G. Manufacturer's Instructions: For cleaning materials, indicate special procedures and conditions requiring special attention.

H. Conservation treatment quality control plan.

I. Restorer's qualification statement.

1.07 QUALITY ASSURANCE

A. Conservation Treatment Quality Control Plan: Prior to commencing work of this section, receive written approval of plan of proposed metal restoration and cleaning work. Include the following:
   1. Description of methods of lead dust containment (refer to Hazmat Report).
   2. Description of sequencing, work procedures, materials, and tools proposed for each type of conservation treatment.
      a. Effects of weather variations on treatment sequencing, construction schedule, and protection of completed work.
   3. Description of methods for providing a safe working environment.
   4. Description of methods for deconstruction of individual metal items and tools and methods for cleaning for reuse.
   5. Description of methods and approach to removal of corrosion from steel.
   6. Description of methods and approach for assuring repair materials match and are compatible with historic materials.
   7. Description of methods and approach to periodic and final cleaning of metal surfaces.

B. Restorer Qualifications: Company specializing in period metal restoration with minimum five years of documented experience.

1.08 MOCK-UPS

A. See Section 01 40 00 - Quality Requirements for additional requirements.
   1. Paint-removal mockup: Test paint removal products on a 2-foot by 2-foot area as determined by the COR for each metal substrate type.
   2. Full Restoration Mock-ups: Clean and refinish a full hangar door panel, a full steel window and a 4-foot (1.2 m) by 4-foot (1.2 m) nominal area of the hangar frieze corrugated metal panels and

molded trim profiles to indicate safe and effective means and methods of cleaning and refinishing each type of metalwork. COR to determine which windows, hangar door panels and the area of the copper frieze to be mocked up.

a. Approved full restoration mock-up areas, including results of procedures employed, will remain and become the quality standard for work of this section.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver cleaning, restoration, and new materials and products neatly stacked and tied on pallets or in other appropriate packaging for transportation. Store clear of ground with adequate waterproof covering.

PART 2 PRODUCTS

2.01 METAL MATERIALS FOR REPLICATION OR REPRODUCTIONS

A. Steel Components:
   1. Sections, Shapes, Plate, and Bar: ASTM A36/A36M.
   2. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.
      a. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation CS (commercial steel).
      b. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel).
   3. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230 with G40/Z120 coating.
   4. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.
   5. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

B. Aluminum Components: ASTM B221/B221M.
   1. Aluminum Sheet: ASTM B209/B209M.
   2. Sections, Shapes, Plate, and Bar: ASTM B0221M-21.
   3. Fasteners: Aluminum rivets: ASTM B316/B316M.

C. Bronze Components: ASTM B138/B138M.
   1. Copper Sheet: ASTM B370, H00 temper; cold-rolled copper sheet. Corrugated or crimped to match existing.
   2. Copper Alloy UNS C83600 - Ounce Alloy - Castings: ASTM B62.

2.02 METAL-FILLED EPOXY PATCHING MATERIALS

A. Aluminum-Filled Putty: Two-component, resin and hardener; 100 percent solids, for patching, bonding, and resurfacing.
   1. Products:
      a. Abatron Mastershop Series, Metal-filled Epoxy Compounds: MetalFix P, or equal.
      b. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Tensile Strength at 7 Days: 2,800 psi (19.30 MPa), minimum.
   3. Flexural Strength at 7 Days: 4,900 psi (33.78 MPa), minimum.
   4. Compressive Strength at 7 Days: 5,500 psi (37.92 MPa), minimum.

B. Bronze-Filled Putty: Two-component, resin and hardener; 100 percent solids, for patching, bonding, and resurfacing.
   1. Products:
      a. Abatron Mastershop Series, Metal-filled Epoxy Compounds: BronzeWeld P, or equal.
      b. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Tensile Strength at 7 Days: 2,400 psi (16.54 MPa), minimum.
   3. Flexural Strength at 7 Days: 4,300 psi (29.64 MPa), minimum.
   4. Compressive Strength at 7 Days: 4,000 psi (27.57 MPa), minimum.

C. Steel-Filled Putty: Two-component, resin and hardener; 100 percent solids, for patching, bonding, and resurfacing.
   1. Products:
      a. Abatron Mastershop Series, Metal-filled Epoxy Compounds: FerroBond P, or equal.
      b. Substitutions: See Section 01 67 00 - Product Requirements.

2.03 CLEANING MATERIALS

A. Cleaning Agent: Detergent type.

B. Soap: Mild soap with approximately 8.0 pH.

C. Corrosion Inhibitor/Cleaner for Copper Alloys: Solution of 1.41 ounces (40 g) benzotriazole per one gallon (3.78 L) of warm water.

D. Abrasive: Silicon carbide abrasive pads, standard commercially available pumice stone, or stainless steel wool.
   1. Do not use plain steel wool on aluminum, bronze or other copper alloy materials.

2.04 PAINT REMOVERS

A. Water-Based: Formulated without methylene chloride or methanol, to remove multiple coats of oil-based, water-based, acrylic-based, epoxy-based, urethane-based, elastomeric, and lead-based paints.
   1. Products: PROSOCO, Inc: Enviro Klean SafStrip, or equal.
      a. Substitutions: See Section 01 67 00 - Product Requirements.
   2. Formulation: Thixotropic paste or gel.
   3. Acidic Type: 2.1 pH.
   4. Surface Neutralization After Use: Not required.

B. Solvent Based: Formulated without chlorinated solvents, acids, and caustics; to remove multiple coats of oil-based, water-based, acrylic-based, epoxy-based, urethane-based, elastomeric, and lead-based paints, and lacquers and enamels.
   1. Products: PROSOCO, Inc: Enviro Klean Safety Peel 1, or equal.
      a. Substitutions: See Section 01 67 00 - Product Requirements.
   2. Formulation: Thixotropic paste or gel.
   3. Neutral Types: 8.02 pH.
   4. Alkaline Types: 14.0 pH.
   5. Surface Neutralization After Use: Required, using product recommended by paint removal product manufacturer.
   6. Applications: For use on exterior and interior surfaces.

C. Methylene Chloride Based: Not allowed.

2.05 ACCESSORY MATERIALS

A. Fasteners, General: Same basic metal and alloy as metal items being joined, unless indicated otherwise. Do not use incompatible metals that promote galvanic action.
   1. Nonferrous Metals Fastened to Carbon Steel or Iron Supports: Use Type 304 stainless steel fasteners.

B. Galvanic Separator for Dissimilar Metal Contact: Primer or with sealant or tape recommended by manufacturer for the purpose.

PART 3 EXECUTION

3.01 PERIOD TREATMENT, GENERAL

A. See Section 01 35 91 for special procedure requirements related to elements and features of historical significance and value.

3.02 EXAMINATION

A. Verify that surfaces to be cleaned and restored are ready for work of this section.

3.03 PREPARATION

A. Protect surrounding elements from damage from restoration procedures.
   1. Hangar doors to be removed from tracks prior to on-site restoration.
   2. Steel windows and copper frieze elements to be restored in place.

B. Remove and store removable items located in areas to be restored including, but not limited to, fixtures, fittings, finish hardware, and accessories; items shall be cleaned and returned to a fully functioning state and reinstalled upon completion of restoration work.

C. Separate areas to be protected from restoration areas to prevent damage.

D. Mask or cover adjacent surfaces and permanent equipment. Secure coverings without tapes that leave residue, or nails. Do not use impervious sheeting which produces condensation.
   1. Use materials that will withstand cleaning and restoration procedures.

E. When using liquid cleaning methods, install drainage devices to prevent runoff over adjacent surfaces, unless those surfaces are impervious to damage from runoff.

F. Do not allow cleaning runoff to drain into sanitary or storm sewers.

G. Do not attach scaffolding, ladders, or working platforms to the building without written authorization and instructions from COR.

3.04 HANGAR DOOR RESTORATION PROCEDURE

A. The following procedures are to summarize the scope of work only. Contractor shall perform the following procedures in whichever order they deem most appropriate and safe:
   1. Dismantle each existing hangar door panel from the upper and lower tracks. Tag all doors clearly so they can be reinstalled in the original locations. Note that much of the existing glazing is damaged. Contractor to take appropriate safety precautions during dismantling.
   2. Remove and properly dispose of all existing gasketing and door sweeps and associated hardware.
   3. Remove and properly dispose of existing non-historic pilot doors and associated hardware. It is assumed all eight (8) pilot doors are non-historic.
   4. Remove all existing glazing including glazing putty and aluminum glazing clips. Tag and salvage sound original historic wireglass glazing for reinstallation (refer to drawings for determination of historic glazing locations). Properly dispose of all cracked, damaged, existing glazing, glazing putty, and clips.
   5. Dismantle all operable hardware including upper track wheels, lower track wheels and door pulls. Tag and salvage for cleaning and reinstallation.
   6. Existing aluminum exterior lower panels are to remain in place unless otherwise slated for replacement per the drawings. Contractor to check rivet connections for soundness. Contractor to remove all damaged rivets and non-compatible fasteners (i.e. steel bolts).
   7. Remove all existing coatings from aluminum panels and framing members. See section 3.08 of this specification.
   8. Repair all framing members as noted in the structural drawings. Reshape and/or repair all damaged glazing muntins.
   9. Replace all missing fastener locations within framing members and aluminum panels. All fasteners shall be compatible with aluminum.
   10. Prime and paint all framing members and aluminum panels. Refer to specification section 09 96 00 “High-Performance Coatings.”
   11. Reinstall salvaged glazing at original locations. Install replacement glazing at all other locations. Provide new glazing putty and aluminum glazing clips.
   12. Confirm all salvaged door hardware is functional prior to reinstallation. Replace all damaged/missing fasteners. If door hardware is damaged beyond repair, contractor to review salvaged hardware (located within Hangar 4), for replacement parts. If contractor exhausts salvaged hardware items, contractor to fabricate new in-kind hardware replacements. Reinstall hardware.
   13. Install eight (8) new pilot doors. Refer to drawings for door details.
   14. Install weatherstripping to include rubber gaskets and door sweeps. Refer to drawings for details.
   15. Reinstall all hangar door panels. Confirm all panels are fully operable, meaning that panels can be pulled by a single individual and slid the full length of the tracks in order to fully open the doors.

3.05 REPAIR

A. General: Perform repairs in properly equipped fabrication facility or in situ, in accordance with Conservation Treatment Quality Control Plan and mock-up.

B. Welding: Use for reattachment of steel elements.
   1. Select appropriate electrode for welding.
   2. Select appropriate type and profile of weld for effective repair.
   3. Preparation for Refinishing: Use techniques appropriate to the repair, such as deburring, surface grinding, planishing, fine sanding, and polishing.

C. Patching: Use compatible patching compound on nonstructural cracks and surface area with small defects such as chips or where corroded portions of the metal have been removed.

3.06 GENERAL REQUIREMENTS FOR RESTORATION CLEANING

A. Perform in situ cleaning and rinsing of exterior elements only during daylight hours.

B. Perform in situ cleaning and rinsing of interior elements with adequate artificial lighting.

3.07 COPPER ALLOY RESTORATION CLEANING

A. Preclean surfaces and remove large particles with nonferrous brush.

B. Clean with mild soap and soft cloth using fine abrasives such as diatomaceous earth products and solvents such as ordinary mineral spirits.

C. Clean persistent stains or badly corroded areas using a fine bronze-wool abrasive and mineral spirits or similar approved solvent.

3.08 REMOVAL OF EXISTING COATINGS

A. Hazmats have been encountered on this project. Refer to hazmat report for locations and specifications for proper abatement and/or disposal.

B. Remove existing coatings. Observe remover manufacturer's instructions. Leave metal in a clean, chemical-free, pH neutral condition free of residue.

C. Removal of Coatings: Use techniques least likely to damage metal elements. Test effectiveness of proposed techniques on a small area prior to determining appropriateness of their use. Testing mock-up must be approved by COR prior to fully removing all existing coatings.

1. Steel: Blast steel in place to remove existing coatings and surface rust. Use the gentlest blast medium to start, slowly building up to the most appropriate medium to remove existing coatings and rust without damaging the metal.
2. Aluminum: Gently remove flaking and peeling coatings with a plastic scraper. Apply water-based paint remover to strip existing coatings to bare metal.
3. Copper: Hand scrape and remove loose paint using a bronze wire brush. Apply sufficient pressure to remove flaking paint and corrosion, but avoid scoring the metal surfaces or damaging detail components of the element. Apply water-based paint remover to strip existing coatings to bare metal.

3.09 APPLICATION OF PROTECTIVE COATINGS FOR COPPER ALLOY

A. Prepare and clean substrates in accordance with coating manufacturer's instructions.

B. Remove cleaning product residue by washing surfaces at least twice with mineral spirits or similar approved solvent.

C. After removing cleaning product residue, wipe with inhibitor/cleaner solution.

D. Apply high-performance paint coating system within four hours of cleaning where indicated.

1. For exterior elements, do not apply in inclement weather or when RH exceeds 60 percent.
2. Use conventional spray equipment.

3.10 IN SITU RESTORATION

A. Do not mix or apply materials or products when ambient temperature or humidity are outside of range recommended by their manufacturers.

B. Schedule conservation treatments to avoid weather-related failures.

3.11 REINSTALLATION OF REPAIRED ELEMENTS

A. Separate dissimilar metals to prevent corrosion by galvanic action by painting contact surfaces with primer or with sealant or tape recommended by manufacturer for the purpose.

B. Reinstall.

3.12 FINAL CLEANING

A. Remove stains resulting from the work of this section without delay.

B. Clean surrounding surfaces.

END OF SECTION

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel.
2. Grout.

B. Related Requirements:
1. Section 05 50 00 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications and other steel items not defined as structural steel.
2. Section 09 96 00 "High-Performance Coatings" for surface-preparation and priming requirements.

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.3 COORDINATION

A. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.

4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer, fabricator and testing agency.

B. Welding certificates.

C. Mill test reports for structural steel, including chemical and physical properties.

D. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Nonshrink grout.

E. Survey of existing conditions.

F. Source quality-control reports.

G. Field quality-control and special inspection reports.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint or to SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

E. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 360.
3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

B. W-Shapes: ASTM A 992/A 992M.

C. Channels and Angles: ASTM A 36/A 36M.

D. Plate and Bar: ASTM A 36/A 36M.

E. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563, Grade DH, (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 490 (ASTM F 959M, Type 10.9), compressible-washer type with plain finish.

C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip or mechanically deposited zinc coating.
2. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with mechanically deposited zinc coating finish.

D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Mechanically deposited zinc coating.

E. Unheaded Anchor Rods: ASTM F 1554, Grade 36.

1. Configuration: Straight.
2. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
5. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

F. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.

1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
4. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

G. Threaded Rods: ASTM A 36/A 36M.

1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
2. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened or ASTM A 36/A 36M carbon steel.
3. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C or Mechanically deposited zinc coating, ASTM B 695, Class 50.

2.3 PRIMER

A. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20, ASTM A 780/A 780M.

2.4 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.
6. Surfaces enclosed in interior construction.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels, and shelf angles attached to structural-steel frame and located in exterior walls.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Baseplates and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

   1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

END OF SECTION 05 12 00

DIVISION 06 -- WOOD, PLASTIC, AND COMPOSITES

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonstructural dimension lumber framing.

B. Sheathing.

C. Fire retardant treated wood materials.

D. Electrical room mounting boards.

E. Concealed wood blocking, nailers, and supports.

F. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

A. Section 07 51 00 - Roofing Assembly.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

B. ASTM D2898 - Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010 (Reapproved 2017).

C. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

D. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2019a.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

F. AWPA U1 - Use Category System: User Specification for Treated Wood; 2025.

G. PS 1 - Structural Plywood; 2023.

H. PS 2 - Performance Standard for Wood Structural Panels; 2018.

I. PS 20 - American Softwood Lumber Standard; 2025.

J. SPIB (GR) - Standard Grading Rules; 2021.

1.04 SUBMITTALS

A. See Section 01 33 23 Submittal Procedures for submittal procedures.

B. Testing: Provide compatibility testing certificates for chemical treatments.

C. Product Data: Provide technical data on sheathing, wood preservative materials, and application instructions.

D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Forest Certification: Provide wood products made from forests certified by an FSC-accredited certification body.

1.06 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

1.07 WARRANTY

A. See Section 01 67 00 Product Requirements for additional warranty requirements.

B. Correct defective work within a two-year period commencing on Date of Substantial Completion.

C. Manufacturer Warranty: Provide two-year manufacturer warranty for roof sheathing commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species: Spruce-Pine-Fir (South), unless otherwise indicated.
   2. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   3. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
   4. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.

B. Provide sustainably harvested wood; see Section 01 67 00 Product Requirements for requirements.

C. Provide wood harvested within a 500 mile (805 km) radius of the project site.

D. Lumber salvaged from deconstruction or demolition of existing buildings or structures is permitted in lieu of sustainably harvested lumber provided it is clean, denailed, and free of paint and finish materials, and other contamination; identify source.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).

B. Sizes: Nominal sizes as indicated on drawings, S4S.

C. Moisture Content: S-dry or MC19.

D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS

A. Roof Sheathing: PS 2 type, rated Structural I Sheathing.
   1. Bond Classification: Exterior.
   2. Span Rating: 60.
   3. Performance Category: 3/4 PERF CAT.

B. Roof Sheathing: Plywood structural panel; PS 20. ANSI/HPVA HP-1-2020.

C. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch (19 mm) thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.04 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
   3. Anchors: Toggle bolt type for anchorage to hollow masonry.

2.05 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
   2. Material Compatibility Requirements: Must be compatible with copper roofing and sheet metal assemblies.
   3. Products:
      a. Hoover Treated Wood Products: PyroGuard, or equal.
      b. Substitutions: See section 01 67 00 Product Requirements.
   4. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Interior rough carpentry items are to be fire retardant treated.
      c. Treat rough carpentry items as indicated.
      d. Do not use treated wood in applications exposed to weather or where the wood may become wet.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. 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.

C. Provide the following specific nonstructural framing and blocking:
   1. Handrails.

2. Grab bars.
3. Toilet accessories.

3.04 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

B. Provide wood curb at each roof opening except where prefabricated curbs are specified and where specifically indicated otherwise; form corners by alternating lapping side members.

3.05 INSTALLATION OF CONSTRUCTION PANELS

A. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
   1. Nail panels to framing; staples are not permitted.

B. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches (610 mm) on center on all edges and into studs in field of board.
   1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
   2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
   3. Install adjacent boards without gaps.

3.06 TOLERANCES

A. Framing Members: 1/4 inch (6 mm) from true position, maximum.

B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet (2 mm/m) maximum, and 1/4 inch in 30 feet (7 mm in 10 m) maximum.

3.07 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for additional requirements.

3.08 CLEANING

A. Waste Disposal: See Section 01 74 19 - Construction Waste Management and Disposal.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

DIVISION 07 -- THERMAL AND MOISTURE PROTECTION

SECTION 07 51 00
ROOFING ASSEMBLY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hot Fluid Applied Roofing Membrane, conventional application.

B. Insulation, flat and tapered.

C. Vapor retarders.

D. Cover boards.

E. Roofing cant strips and accessories.

1.02 REFERENCE STANDARDS

A. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2022.

B. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2023a.

C. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method; 1983 (Reapproved 2018).

D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

E. FM (AG) - FM Approval Guide; Current Edition.

F. NRCA (RM) - The NRCA Roofing Manual; 2025.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of associated counterflashings installed by other sections as the work of this section proceeds.

B. Preinstallation Meeting: Convene one week before starting work of this section.
   1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.04 SUBMITTALS

A. See Section 01 33 23 Submittal Procedures for submittal procedures.

B. Product Data: Provide data indicating membrane and bitumen materials, base flashing materials, insulation, vapor retarder, and surfacing.

C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, and setting plan for tapered insulation.

D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact.

B. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.

C. Protect foam insulation from direct exposure to sunlight.

1.07 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather.

B. Apply roofing membrane when ambient temperature is within manufacturer's recommended temperature range.

C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

E. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.08 WARRANTY

A. See Section 01 67 00 Product Requirements for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations: Obtain roofing materials and sheet flashings from single source from single manufacturer.

B. See Section 01 67 00 Product Requirements for substitution procedures.

C. Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

1. High Temp Vapor Retarder:
   a. Carlisle: CCW 705 HT
   b. Or Equal
2. Hot Fluid Applied, Rubberized Asphalt Roofing Membrane:
   a. Tremco:TREMproof 6100
   b. Or Equal
3. Insulation:
   a. Owens Corning: EnergyGuard Polyiso Insulation
   b. Or Equal
4. Cover Boards:
   a. Blue Ridge Fiberboad: Structodek HD fiberboard roof board
   b. Or Equal
5. Polyurethane Top and Bottom Coats:
   a. Tremco: AlphaGuard Bio
   b. Or Equal
6. Fiberglass Reinforcing Sheet:
   a. Tremco: AlphaGuard Bio
   b. Or Equal

2.02 SHEET MATERIALS

A. High-temperature-resistant vapor retarder: self adhesive and suitable for use directly behind metal cladding.

B. Reinforcing Fabric: Manufacturer's recommended, spun bonded plyester fabric.

C. Reinforcing Fabric: Manufacturer's recommended, fiberglass.

2.03 HOT FLUID APPLIED MATERIALS

A. Hot Fluid-Applied, Rubberized-Asphalt roofing Membrane: Single component; 100 percent solids; hot fluid-applied, rubberized asphalt.

2.04 COVER BOARDS

A. Cover Boards: Coated cellulosic fiberboard complying with ASTM C208.
   1. Classifications: Type II, Grade I.
   2. Board Thickness: 1/2 inch (12.7 mm).
   3. Insulation Thermal Resistance, R-value (RSI-value): 1.3 (0.23), nominal.

2.05 INSULATION

A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
   1. Classifications:
      a. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.
         1) Class 1 - Faced with glass fiber reinforced cellulosic facers on both major surfaces of the core foam.
         2) Compressive Strength: Classes 1-2-3, Grade 1 - 16 psi (110 kPa), minimum.
         3) Thermal Resistance, R-value (5.7): At 1 inches (38 mm) thick; Class 1, Grades 1-2-3, 8.4 (1.48) at 75 degrees F (24 degrees C).
   2. Board Size: 48 by 96 inches (1,220 by 2,440 mm).
   3. Board Thickness: 2.5 inches (64 mm).

2.06 LIQUID APPLIED POLYURETHANE SYSTEM

A. Components:
   1. Primer (as required per substrate)
   2. Base Coat: Tremoco - AlphaGuard Bio Base Coat
      a. Or Equal
   3. Reinforcement: Tremoco - AlphaGuard Bio
      a. Or Equal
   4. Top Coat: Tremoco - AlphaGuard Bio
      a. Or Equal

B. Materials shall meet the folloing criteria:
   1. Tensile Strength: > 300 psi (ASTM D412)
   2. Elongation: > 250% (ASTM D412)
   3. Adhesion: > 2.0 pli to various substrates (ASTM D903)
   4. Ponding Water Resistance: Pass (ASTM D4799)

2.07 ACCESSORIES

A. Cant and Edge Strips: Bitumen-impregnated wood fiberboard, compatible with roofing materials; cants formed to 45-degree angle, tapered edge strips, and other configurations as detailed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 PREPARATION - WOOD DECK (HANGAR AND LEAN-TO ROOFS)

A. Verify flatness and tightness of joints in wood decking; fill knot holes with latex filler.

B. Seal joints of plywood with tape.

3.03 PREPARATION - CONCRETE DECK (WPA INFILL AND BOILER ROOM ROOFS)

A. Fill surface honeycomb and variations with latex filler.

B. Do not begin work until repaired concrete substrate has cured at least 28 days and moisture content is five percent or less.

1. Test for Concrete Moisture Content: No beading water under plastic after 16 hours when tested in accordance with ASTM D4263.
2. Test for Relative Humidity in Concrete: Not greater than 75 percent when tested in accordance with ASTM F2170.

3.04 INSTALLATION - VAPOR RETARDER, CONVENTIONAL

A. Apply to deck surface in accordance with roofing and vapor retarder manufacturers' instructions.

B. Extend vapor retarder under cant strips and blocking.

3.05 INSTALLATION - INSULATION, CONVENTIONAL

A. Ensure vapor retarder is clean and dry, continuous, and ready for application of roofing system.

B. Attachment of Insulation: Mechanically fasten each layer of insulation to deck in accordance with roofing manufacturer's instructions and FM (AG) Factory Mutual approved requirements.

C. Cover Boards: Mechanically fasten cover boards in accordance with roofing manufacturer's instructions and FM (AG) Factory Mutual requirements.

D. Lay subsequent layers of insulation with joints staggered minimum 6 inches (152 mm) from joints of preceding layer.

E. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

F. Do not apply more insulation than can be covered with membrane in same day.

3.06 INSTALLATION - MEMBRANE

A. Install built-up bituminous roofing system in accordance with manufacturers recommendations and NRCA (RM) applicable requirements.

B. Equiviscous Temperature (EVT) at Point of Application: Comply with NRCA (RM) recommendations.

C. Apply membrane plies, weather lap edges and ends, and mop with 20 lb/100 sq ft (9 kg/9.3 sq m) of bitumen per ply. Apply plies two on two in same direction.

D. Apply smooth, free from air pockets, wrinkles, fish-mouths, or tears.

E. At end of day's operation, install two plies membrane and bitumen glaze coat for cut-off. Glaze exposed felts. Remove cut-off before resuming roofing.

F. At intersections with vertical surfaces:
   1. Extend membrane and base sheet over cant strips and up a minimum of 4 inches (100 mm) onto vertical surfaces.
   2. Mop on base flashing of two additional plies of felt and one ply of base flashing material.

G. Around roof penetrations, mop in and seal flanges and flashings with two additional plies of felt.

H. Coordinate installation of roof drains and related flashings.

3.07 CLEANING

A. Remove bituminous markings from finished surfaces.

B. In areas where finished surfaces are soiled by bitumen or other source of soiling caused by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.

C. Repair or replace defaced or damaged finishes caused by work of this section.

3.08 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, and other items indicated in Schedule.

B. Sealants for joints within sheet metal fabrications.

C. Precast concrete splash pads.

1.02 REFERENCE STANDARDS

A. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction; 2022.

B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

C. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2017 (Reapproved 2023).

D. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).

E. CDA A4050 - Copper in Architecture - Handbook; Current Edition.

F. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.04 SUBMITTALS

A. See Section 01 33 23 – Submittal Procedures for submittal procedures.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with (3) years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. Copper: ASTM B370, cold rolled 20 oz/sq ft, 22 gauge, 0.027 inch (0.69 mm) thick; natural finish.

2.02 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18-inch (450 mm) long legs; seam for rigidity, seal with sealant.

2.03 GUTTERS AND DOWNSPOUTS

A. Gutters: Profile as indicated.

B. Downspouts: Profile as indicated.

C. Gutters and Downspouts: Size indicated on drawings.

D. Gutters and Downspouts: Size for rainfall intensity determined by a storm occurrence of 1 in 100 years in accordance with SMACNA (ASMM).

E. Accessories: Profiled to suit gutters and downspouts.
   1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
   2. Gutter Supports: as indicated on drawings.
   3. Downspout Supports: Brackets.

F. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3,000 psi (21 MPa) at 28 days, with minimum 5 percent air entrainment.

G. Seal metal joints.

2.04 FLASHING

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

2.05 ACCESSORIES

A. Fasteners: Same material and finish as flashing metal, with soft neoprene washers.

B. Underlayment: ASTM D226/D226M, organic roofing felt, Type I, No. 15.

C. Slip Sheet: Rosin-sized sheathing paper.

D. Primer Type: Zinc chromate.

E. Concealed Sealants: Non-curing butyl sealant.

F. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

G. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch (0.38 mm).

3.03 INSTALLATION

A. Comply with drawing details.

B. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.

C. Apply plastic cement compound between metal flashings and felt flashings.

D. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

E. Seal metal joints watertight.

F. Solder metal joints for full metal surface contact, and after soldering wash metal clean with neutralizing solution and rinse with water.

G. Secure gutters and downspouts in place with concealed fasteners.

H. Slope gutters 1/4 inch per 10 feet (2.1 mm per m), minimum.

I. Set splash pads under downspouts.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for field inspection requirements.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

SECTION 07 92 00
JOINT SEALANTS AND SEALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonstaining silicone joint sealants
B. Urethane joint sealants.
C. Mildew-resistant joint sealants.
D. Butyl joint sealants.
E. Latex joint sealants.
F. Acoustical joint sealants.
G. Preformed Joint Seals.
H. Joint backings and accessories.
I. Owner-provided field quality control.

1.02 REFERENCE STANDARDS

A. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).
B. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.
C. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
D. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.
E. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).

1.03 SUBMITTALS

A. See Section 01 33 23 – Submittal Procedures for submittal procedures.
B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.
   5. Substrates for which use of primer is required.
   6. Substrates for which laboratory adhesion and/or compatibility testing is required.
   7. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
   8. Sample product warranty.
   9. Certification by manufacturer indicating that product complies with specification requirements.
C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
E. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.

F. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

G. Installation Plan: Submit at least four weeks prior to start of installation.

H. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.

I. Field Quality Control Plan: Submit at least two weeks prior to start of installation.

J. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.

K. Installation Log: Submit filled-out log for each length or instance of sealant installed.

L. Field Quality Control Log: Submit filled-out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

M. Manufacturer's qualification statement.

N. Installer's qualification statement.

O. Executed warranty.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.

C. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
   1. Adhesion Testing: In accordance with ASTM C794.
   2. Compatibility Testing: In accordance with ASTM C1087.
   3. Stain Testing: In accordance with ASTM C1248; required only for stone substrates.
   4. Allow sufficient time for testing to avoid delaying the work.
   5. Deliver sufficient samples to manufacturer for testing.
   6. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
   7. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

D. Installation Plan: Include schedule of sealed joints, including the following:
   1. Joint width indicated in Contract Documents.
   2. Joint depth indicated in Contract Documents; to face of backing material at centerline of joint.
   3. Method to be used to protect adjacent surfaces from sealant droppings and smears, with acknowledgment that some surfaces cannot be cleaned to like-new condition and therefore prevention is imperative.
   4. Approximate date of installation, for evaluation of thermal movement influence.
   5. Installation Log Form: Include the following data fields, with known information filled out.
      a. Location on project.
      b. Sealant used.
      c. Primer to be used, or indicate no primer is used.
      d. Size and actual backing material used.
      e. Date of installation.
      f. Name of installer.
      g. Actual joint width; provide space to indicate maximum and minimum width.
      h. Actual joint depth to face of backing material at centerline of joint.
      i. Air temperature.

E. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
   1. Identification of testing agency.
   2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
      a. Test date.
      b. Location on project.
      c. Sealant used.
      d. Test method used.
      e. Date of test.
      f. Copy of test method documents.
      g. Age of sealant upon date of testing.
      h. Test results, modeled after the sample form in the test method document.
      i. Indicate use of photographic record of test.

F. Owner will employ an independent testing agency to perform the field quality control inspection and testing as referenced in PART 3 of this section and as follows, to prepare and submit the field quality control plan and log, and to provide recommendations of remedies in the case of failure.
   1. Contractor shall cooperate with testing agency and repair failures discovered and destructive test location damage.

G. Field Quality Control Plan:
   1. Visual inspection of entire length of sealant joints.
   2. Destructive field adhesion testing of sealant joints, except interior acrylic latex sealant.
      a. For each different sealant and substrate combination, allow for one test every 100 feet (30 m) in the first 1,000 linear feet (305 linear m), and one test per 1,000 linear feet (305 linear m) thereafter, or once per floor on each elevation.
      b. If any failures occur in the first 1,000 linear feet (305 linear m), continue testing at frequency of one test per 500 linear feet (152 linear m) at no extra cost to Owner.
   3. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.

H. Field Adhesion Test Procedures:
   1. Allow sealants to fully cure as recommended by manufacturer before testing.
   2. Have a copy of the test method document available during tests.
   3. Take photographs or make video records of each test, with joint identification provided in the photos/videos; for example, provide small erasable whiteboard positioned next to joint.
   4. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
   5. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
   6. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
   7. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

I. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
   1. Sample: At least 18 inches (457 mm) long.
   2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch (25.4 mm) by that percentage; if adhesion failure occurs before the 1-inch mark is that distance from the substrate, the test has failed.

3. If either adhesive or cohesive failure occurs before minimum elongation, take necessary measures to correct conditions and retest; record each modification to products or installation procedures.
4. Record results on Field Quality Control Log.
5. Repair failed portions of joints.

1.05 WARRANTY

A. See Section 01 67 00 – Product Requirements for additional warranty requirements.

B. Manufacturer Warranty: Provide 2-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.

C. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MATERIALS, GENERAL

A. Source Limitations: Obtain each type of material from a single source and from a single manufacturer.

B. Sealants and Primers: Provide products with acceptable levels of volatile organic compound (VOC) content.

C. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

D. Refer to Section 01 67 00 Product Requirements for substitution requirements.

E. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.02 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.

B. Single-Component, Nonsag, Non-Staining, Moisture-Curing Silicone Joint Sealant ASTM C 920, Type S, Grade NS, Class 100/50, Use NT; SWRI validated.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Tremco Incorporated; Spectrem 1 or approved Equal.

2.03 URETHANE JOINT SEALANTS

A. Single-Component, Nonsag, Moisture-Cure, Polyurethane Hybrid Joint Sealant: ASTM C 920, Type S, Grade NS, Class 35, Use NT.
   1. Basis-of Design Product: Subject to compliance with requirements, provide Tremco, Incorporated, Dymonic FC or approved Equal.
   2. Extrusion Rate ASTM C1183: 93.1 mL/min.
   3. Weight Loss ASTM C1246: Pass.
   4. Tack Free Time ASTM C679: 3 to 4 hr.
   5. Volatile Organic Compound (VOC) Content: 10 g/L maximum.
   6. Volatile Organic Emissions (VOE): Not greater than Greenguard Children & Schools Certification emissions levels.
   7. Color: As selected by Architect from manufacturer's standard line of not less than 15 colors.

B. Immersible, Single-Component, Pourable, Traffic Grade Polyurethane Joint Sealant: ASTM C 920, Type S, Grade P, Class 50, Use T and I.
   1. Basis-of Design Product: Subject to compliance with requirements, provide Tremco, Incorporated, Vulkem 45 SSL or approved Equal

2. Volatile Organic Compound (VOC) Content: 110 g/L maximum.
3. Volatile Organic Emissions (VOE): Not greater than Greenguard Children & Schools Certification emissions levels.
4. Color: As selected by Architect from manufacturer's standard line of not less than 5 colors.

2.04 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Tremco Incorporated; Tremsil 200 or approved Equal.

2.05 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Tremco Incorporated; TremPro JS-773, or approved Equal.

2.06 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Tremco Incorporated; Tremflex 834 or approved Equal.

2.07 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints: ASTM C834, nonsag, paintable, nonstaining latex acoustical sealant.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Tremco Incorporated, Tremflex 834 sealant or approved Equal.

2.08 PRE-FORMED SEALS

A. Preformed Foam Joint Seals [PS#2]: Manufacturer's standard preformed, pre-compressed, open-cell foam seal manufactured from urethane foam with minimum density of 10 lb/cu. ft. (160 kg/cu. m), impregnated with water-repellent agent. Provide factory-produced pre-compressed sizes selected to fit joint widths; coated on one side with a pressure-sensitive adhesive.
   1. Basis-of Design Product: Subject to compliance with requirements, provide Tremco, Willseal 600 or approved Equal.
   2. Thermal conductivity ASTM C 518: .28-0.30 BTU-in/hr-°F-ft2
   3. Thermal resistance ASTM C 518: 3.3-3.6 hr-°F-ft2/BTU
   4. Frame spread ASTM E84: 0
   5. Smoke development ASTM E84: 5
   6. Volatile Organic Compound (VOC) Content: 0 g/L maximum.
   7. Volatile Organic Emissions (VOE): Not greater than Greenguard Children & Schools Certification emissions levels.
   8. Color: Black or Grey as selected by Architect.

2.09 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

1. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
2. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.10 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

D. Adhesive: As recommended by pre-formed seal manufacturer.

2.11 JOINT SEALANT APPLICATIONS

A. Scope:
1. Do Not Seal:
a. Intentional weep holes in masonry.
b. Joints indicated to be covered with expansion joint cover assemblies.
c. Joints where sealant is specified to be furnished and installed by manufacturer of product to be sealed.
d. Joints where sealant installation is specified in other sections.
e. Joints between suspended ceilings and walls.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Properly prepare construction components adjacent to the work of this section to prevent damage and disfigurement due to this work.

C. Verify that backing materials are compatible with sealants.

D. Verify that backer rods are of the correct size.

E. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
3. Record each test on Preinstallation Adhesion Test Log as indicated.
4. If any sample fails, review products and installation procedures, consult manufacturer, or take other measures that are necessary to ensure adhesion; retest in a different location; if unable to obtain satisfactory adhesion, report to Architect.
5. After completion of tests, remove remaining sample material and prepare joints for new sealant installation.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION - SEALANT

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Provide joint sealant installations complying with ASTM C1193.

C. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:
   1. Width/depth ratio of 2:1.
   2. Neck dimension no greater than 1/3 of the joint width.
   3. Surface bond area on each side not less than 75 percent of joint width.

D. Install bond breaker backing tape where backer rod cannot be used.

E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

3.04 INSTALLATION - PREFORMED JOINT SEALS

A. Install this work in accordance with preformed joint seal manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Install only when ambient temperature is within recommended application temperature range of adhesive. Consult manufacturer when installing outside this temperature range.

C. Prepare joints and install seals in accordance with manufacturer's written recommendations.

D. Remove loose materials and foreign matter that could impair adhesion of sealant.

E. Do not stretch precompressed seal; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.

3.05 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. Owner will employ an independent testing agency to perform field quality control inspection and testing as specified in PART 1 under QUALITY ASSURANCE article.

C. Destructive Adhesion Testing: If there are any failures in first 1,000 linear feet (300 linear m), notify Architect immediately.

D. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

E. Repair destructive test location damage immediately after evaluation and recording of results.

3.06 JOINT-SEALANT SCHEDULE

A. Provide sealant types as indicated and if not indicated, provide in conformance with the following requirements.

B. Exterior Joints; Vertical and horizontal non-traffic surfaces, not subject to significant movement.
   1. Joint Locations;
      a. Control and expansion joints in unit masonry.
      b. Joints between metal panels.
      c. Joints between different materials, unless indicated otherwise.
      d. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
      e. Control and expansion joints in ceilings and other overhead surfaces.
      f. Other joints as indicated on Drawings.
   2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Interior joints; Vertical surfaces and horizontal nontraffic surfaces, not subject to significant movement.
   1. Joint Locations:
      a. Control joints on exposed interior surfaces of exterior walls.
      b. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
      c. Other joints as indicated on Drawings.
   2. Joint Sealant: Acrylic latex.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Mildew-resistant interior joints; Vertical and horizontal nontraffic surfaces.
   1. Joint Locations:
      a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
      b. Tile control and expansion joints where indicated.
      c. Other joints as indicated on Drawings.
   2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

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

F. Sound attenuation joints.
   1. Joint Locations:
      a. STC rated assemblies.
      b. Floor slab perimeter joints.
      c. Other joints as indicated on Drawings.
   2. Joint Sealant: Acoustical joint sealant.
   3. Joint Sealant Color: Architect to select color distinguishable from other sealants used on the project.

G. Movement and expansion joints.
   1. Joint Locations:
      a. Expansion joints
      b. Movement joints.
      c. Seismic joints.
      d. Other joints as indicated on Drawings.

2. Seal system: Pre-formed joint seals.
3. Seal Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION

DIVISION 08 -- OPENINGS

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Fire-rated hollow metal doors and frames.

C. Thermally insulated hollow metal doors with frames.

1.02 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware.

B. Section 08 80 00 - Glazing: Glass for doors.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ANSI/SDI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames; 2019.

C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2024.

D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.

E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.

H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

I. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.

J. ASTM C476 - Standard Specification for Grout for Masonry; 2023.

K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

L. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.

M. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

N. ITS (DIR) - Directory of Listed Products; Current Edition.

O. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.

P. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.

Q. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2024.

R. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.

S. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.

T. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.

U. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.

V. UL (DIR) - Online Certifications Directory; Current Edition.

W. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 33 23 Submittal Procedures for submittal procedures.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

D. Samples: Submit two samples of metal, 2 by 2 inches (51 by 51 mm) in size, showing factory finishes, colors, and surface texture.

E. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.

F. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

G. Manufacturer's Qualification Statement.

H. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

B. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:

1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
2. Accessibility: Comply with ICC A117.1 and ABAAS.
3. Door Edge Profile: Manufacturers' standard for application indicated.
4. Typical Door Face Sheets: Flush with Inlays.
5. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
6. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

7. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.

B. Hollow Metal Panels: Same construction, performance, and finish as doors.

C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.02 HOLLOW METAL DOORS

A. Products:
   1. Doors and frames to be from the same manufacturer.
   2. Allegion: Steelcraft Flush Doors, or equal.
   3. Substitutions: See Section 01 67 00 - Product Requirements.

B. Door Finish: Factory Primed and Finished.

C. Exterior Doors: Thermally insulated.
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 1 - Standard-duty.
      b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 20-gauge, 0.032 inch (0.8 mm), minimum.
      e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
   2. Door Core Material: Polystyrene, 1 lbs/cu ft minimum density.
      a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
   3. Door Thermal Resistance: R-Value of 6.0 minimum, for installed thickness of polystyrene.
   4. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

D. Interior Doors, Non-Fire-Rated:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 1 - Standard-duty.
      b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 20-gauge, 0.032 inch (0.8 mm), minimum.
      e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
   2. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

E. Interior Doors, Fire-Rated:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 1 - Standard-duty.
      b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 20-gauge, 0.032 inch (0.8 mm), minimum.
      e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
   2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
   3. Provide units listed and labeled by UL (DIR) or ITS (DIR).
      a. Attach fire rating label to each fire rated unit.
   4. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
   5. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

2.03 HOLLOW METAL FRAMES

A. Products:
   1. Doors and frames to be from the same manufacturer.
   2. Allegion: Steelcraft Metal Frames, or equal.
   3. Substitutions: Substitutions: See Section 01 67 00 - Product Requirements.

B. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

C. Exterior Door Frames: Knock-down type.
   1. Frame Metal Thickness: 18-gauge, 0.042 inch (1.0 mm), minimum.
   2. Frame Finish: Factory finished.
   3. Weatherstripping: Separate, see Section 08 71 00.

D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
   1. Frame Metal Thickness: 18-gauge, 0.042 inch (1.0 mm), minimum.
   2. Frame Finish: Factory finished.

E. Door Frames, Fire-Rated: Knock-down type.
   1. Fire Rating: Same as door, labeled.

2.04 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

B. Factory Finish: Complying with ANSI/SDI A250.3, manufacturer's standard coating.
   1. Color: As indicated on drawings.

2.05 ACCESSORIES

A. Glazing: As specified in Section 08 80 00, factory installed and as indicated on drawings.

B. Hardware: As specified in Section 08 71 00 Door Hardware.

C. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches (102 mm) as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.

E. Install door hardware as specified in Section 08 71 00.

F. Touch up damaged factory finishes.

3.03 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.

3.04 ADJUSTING

A. Adjust for smooth and balanced door movement.

3.05 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

SECTION 08 51 23
STEEL WINDOWS AND ALUMINUM SKYLIGHTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Replica Historic, thermally broken, Factory finished steel windows with fixed and operating sashes.

B. Replica Historic, single pane, factory finished steel windows with fixed and operating sashes.

C. Factory-installed glazing or Site-installed glazing.

D. Operating hardware and framed insect screens.

E. Aluminum skylight framing system.

F. Skylight glazing.

G. Fasteners, anchors, reinforcement, and flashings.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 Rough Carpentry: Wood support curbs.

B. Section 07 51 00 Roofing Assembly.

C. Section 07 62 00 Sheet Metal Flashing and Trim: Skylight counterflashing.

D. Section 07 92 00 - Joint Sealants and Seals: Sealing joints between frames and adjacent construction.

E. Section 08 80 00 - Glazing.

F. Section 09 96 00 – High-Performance Coatings: For factory-finishes for steel framing and aluminum.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

E. ASTM B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes; 2021.

F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes (Metric); 2021.

G. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

H. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

I. Steel Window Institute (SWI) (INTRO) - Architect's Guide to Steel Windows and Doors; Current Edition.

1.04 SUBMITTALS

A. See Section 01 33 23 Submittal Procedures for submittal procedures.

B. Product Data:

1. Steel Windows: Provide component dimensions, fasteners, anchors, and glass.

2. Aluminum Skylights: Provide manufacturer's specifications, standard details, and installation requirements.

C. Shop Drawings: Indicate opening dimensions, framed opening tolerances, affected related work; installation requirements, expansion and contraction joint locations and details, and sizes and locations for field welding.

D. Samples: Submit two, 36 by 36 inch (915 by 915 mm) in size, illustrating window frame and skylight frame section, finish surfaces, and glazing materials.

E. Test Reports: Prior to submitting shop drawings or starting fabrication, submit test report(s) by independent testing agency showing compliance with performance requirements.

F. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

G. Manufacturer's Qualification Statement.

H. Installer's Qualification Statement.

I. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Government's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Steel Window Manufacturer Qualifications:
   1. Company specializing in manufacturing windows specified in this section, with not less than 5 years of documented experience.
   2. Member of the Steel Window Institute.

B. Aluminum Skylight Manufacturer Qualifications:
   1. Minimum 15 years of experience in custom skylights
   2. Similar projects within the last 5 years

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

D. Allowable tolerances: Size dimensions + 1/16 inch.

E. Source Quality Control:
   1. Air infiltration test:
      a. Products must be independently lab tested in accordance with ASTM E283.
      b. Air infiltration to meet or exceed 0.30 CFM/SQFT with differential pressure across window unit of 6.24 PSF.
   2. Water penetration test:
      a. Products must be independently lab tested and meet or exceed ASTM E331.
      b. No water penetration for 15 minutes when window is subjected to a rate of flow of 5 gal./hr/sq.ft with differential pressure across window unit of 6.24 PSF. Pressure determined per job specific design pressure.
      c. When weeps are required, ASTM E547 cyclic testing standard with differential pressure across window unit of 6.24 PSF shall be standard. Pressure determined per job specific design pressure.
   3. Field Testing:
      a. Field testing criteria (when applicable) shall be in accordance with AAMA 502-12.
   4. Structural Test:
      a. Meets or exceeds ASTM E330. Window frames, muntins, mullions should be design to withstand 57 psf Ultimate/34 psf ASD design pressure per required ASCE 7-22.
   5. Quality of Power of 5 coastal finishing process shall meet or exceed the following designations (Coastal application – less than (1) mile from salt water and/or similar corrosive environments):
      a. Acid Pickling: SSCP-SP8.
      b. Hot Dip Galvanize: ASTM A123.
      c. Adhesion: ASTM D3359, no loss.

d. Hardness: ASTM D3363 (pencil), H min.
e. Salt Spray: ASTM B117, passes 3000 hrs.
f. Humidity: ASTM D2247, 3000 hours, few #8 blisters.
g. Impact Resistance (3mm): ASTM D2794, no loss.
h. Color Retention: ASTM D2244, 5 year less than or equal to 5 delta E.
i. Chalk Resistance: ASTM D4214, #8 rating.
j. Gloss Retention: ASTM D523, greater than or equal to 30 percent retention.

6. Upon request, the window manufacturer shall provide a test report from a qualified independent U.S. testing laboratory regularly engaged in testing windows to verify that products conform to test requirement as outlined.

1.06 MOCK-UP

A. See Section 01 40 00-Quality Requirements for additional requirements.

B. Construct mock-up that includes examples of materials and conditions required in finished skylight installation. Size mock-up one full-size window and one full-size skylight.

C. Locate window mock-up at a location to be viewed from the ground, and skylight mock-up in the WPA infill, and as directed by COR.

D. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect factory finished surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C).

B. Maintain this minimum temperature during and after installation of sealants.

1.09 WARRANTY

A. See Section 01 67 00 Product Requirements for additional warranty requirements.

B. Correct defective Work within a five-year period after Date of Substantial Completion.

C. Provide five year manufacturer warranty for insulated glass units from seal failure, interpane dusting or misting, and replacement of same.
1. Include coverage for degradation of color finish.

PART 2 PRODUCTS

2.01 STEEL WINDOWS

A. Products:
1. Hope's Windows, Inc: Landmark175 Series, or equal.
2. Substitutions: See Section 01 67 00 - Product Requirements.

B. Hot rolled steel sections, factory fabricated, factory finished, with glazing as scheduled, related flashings, anchorage and attachment devices.
1. Grade: Standard Intermediate design based on SWI (INTRO).
2. Sash Configuration: Match existing.

2.02 SKYLIGHTS

A. Products:
   1. Wasco (Part of the Velux Group), Pinnacle 350/600 System; Wells, ME; 800-388-0293, or equal.
   2. Substitutions: See Section 01 67 00 - Product Requirements.

B. Framing Materials:
   1. Framing Members: Extruded aluminum alloy 6063-T5 or T6, ASTM B221, with minimum effective thickness of 0.109 inches.
   2. Exterior Pressure Caps: Extruded aluminum alloy 6063-T5 or T6, ASTM B221, with minimum effective thickness of 0.090 inches.
   3. Concealed Flashing: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding flashing; compatible with adjacent materials.
      a. Exposed Flashing and Closures: Aluminum sheet alloy and temper of 1100-H14.
         1) Minimum Thickness: 0.032 inch Apron Flashing.
         2) Minimum Thickness: 0.062 inch Closures.
      b. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories; compatible with adjacent materials.
         1) Aluminum Retaining Cap Fasteners and Framing Members Fasteners: ASTM A 193/A 193M, Series 300 stainless-steel screws.
         2) Connections to Supporting Structure: Series 300 Stainless Steel or ASTM A 307, hot dipped galvanized steel fasteners.
         3) Framing-System Sealants: Single-component, non-sag, high performance, non-priming, gun-grade elastomeric polyurethane sealant.
         4) Sealant complies with ASTM C920, Type S, Grade NS, Class 25, Use T, NT, M, A, G, and O.
      c. Bituminous Paint: Cold-applied asphalt mastic paint complying with SSPC-Paint 12.

2.03 PERFORMANCE REQUIREMENTS

A. Wind Loads: Design and size components to withstand wind loads without damage or permanent set, when tested in accordance with ASTM E330/E330M, using pressure equal to 1.5 times specified design pressures, with 10 second duration of maximum load.

B. Design Pressure: In accordance with applicable codes.

C. Member Deflection: Limit member deflection to 1/200 of the longer dimension; with full recovery of glazing materials.

D. Overall Thermal Transmittance (U-value): 0.35, maximum, including glazing, measured on window sizes required for this project.

E. Water Leakage: None, when measured in accordance with ASTM E331 with a test pressure difference of 2.86 lbf/sq ft (136.85 N/sq m).

2.04 MATERIALS

A. Heavy intermediate triple weatherstripped windows shall be manufactured from solid hot rolled steel profiles.
   1. Profiles made from steel with flanges rolled integrally at the mill.
   2. Perimeter frames and ventilator profiles shall have glazing rebates providing an unobstructed glazing surface of at least 5/8".
   3. Glazing rebate surfaces must be perpendicular to the web or stem of the profile. Applied glazing rebate extensions and rebate surfaces that are tapered will not be acceptable.
   4. Combined weight of frame and ventilator profiles shall be a minimum of 3.50 pounds per lineal foot. Frame profile alone shall not weigh less than 1.70 pounds per lineal foot.
   5. All steel profiles must be a minimum of 1-3/4″ in depth.
   6. The frame and ventilator profiles shall have integral grooves located in the exterior and interior bedding contacts for the reception of triple weatherstripping.

B. Muntins.
   1. True Divided Lite Muntins (Single-Pane Steel Windows):
      a. Glazing rebate surfaces must be perpendicular to the stem of this profile. Rebate surfaces that are tapered will not be acceptable.
      b. 1-3/4" tee shall weigh min. 1.57 pounds per lineal foot, the 1-3/8" tee shall weigh min. 1.40 pounds per lineal foot and the 7/8" tee shall weigh min 1.16 pounds per lineal foot (specify).
      c. All steel muntin profiles must be a minimum of 1-3/4″ in depth.
   2. Simulated Divided Lite muntins (Thermally Broken Steel Windows):
      a. Hot-rolled stainless steel muntin – #84H profile shall be solid hot-rolled from stainless steel with tapers rolled integral at the mill. #84H muntins shall be solidly welded to perimeter framing and dressed smooth. 10-gauge flat profile muntins shall be solidly welded to perimeter framing and dressed smooth. Opposite side muntin shall be extruded aluminum Alloy 6063-T5 matching the profiles as detailed.
      b. Interior/exterior muntin - Profiles shall be extruded aluminum Alloy 6063-T5 matching the profiles as detailed.
   3. Glazing beads shall be extruded aluminum Alloy 6063-T5 with a minimum thickness of .062 inches.
   4. Weatherstripping shall be extruded vinyl, EPDM closed cell sponge, flexible silicone or polyethylene clad urethane foam.

C. Stainless Steel, Type 304: Complying with ASTM A666.

D. Fasteners: Non-ferrous Brass or Stainless steel.

E. Insect Screens:
   1. Frames shall be roll-formed 20-gauge stainless steel.
   2. Charcoal Aluminum mesh - .011 diameter wire woven to 16x18 OR Manufacturer's Standard highest transparency mesh.

F. Finishing:
   1. Exterior and Interior Colors: As scheduled in d
   2. Coastal – within (1) mile of salt water and/or similar corrosive environments.
      a. Cleaning.
      b. Pretreatment with Hot-Dip Galvanizing.
      c. Brush-Off Blast Cleaning.
      d. Epoxy Powder Primer.
      e. Polyester Powder Top Coat or Ultrathane polyurethane Top Coat.

2.05 GLASS AND GLAZING MATERIALS

A. Glass and Glazing Materials: See Section 08 80 00.

2.06 HARDWARE

A. Operator: Lever action handle fitted to projecting sash arms with limit stops.

2.07 FABRICATION

A. Fabricate steel windows in accordance with approved shop drawings.

B. Corners of frame and ventilator shall be mitered or coped then solidly welded. Exposed and contact surfaces shall be finished smooth flush with the adjacent surfaces. All interior and exterior rail bar and muntin joints shall be face welded and ground smooth.

C. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

D. Accurately fit and secure joints and corners. Make joints flush and hairline.

E. Prepare components with reinforcement for operating hardware.

F. Muntins (Steel Windows):
   1. True Divided Lite muntins shall be coped and welded to the perimeter frame. Muntin intersections shall be slotted, cross notched and welded. All interior and exterior muntin joints shall be face welded and ground smooth.
   2. Simulated Divided Lite Grids:
      a. Hot-rolled exterior muntins - #84H profile shall be mitered or coped and fully back welded at all intersection. 10-gauge steel flats shall be welded flush to vents, size of flat to be determined by design.
      b. Interior/exterior applied muntins - Profile shall be precut to meet perimeter frame. The intersections shall be milled to the extrusion profile. The muntin components shall be applied to the face of the glass with .045" VHB™ double adhesive tape after glazing.

G. Glazing:
   1. All windows shall be designed for inside or outside glazing as scheduled.
   2. Provide replaceable continuous glazing beads to suit the glass as specified.
   3. Glazing beads shall be cut and shop fitted to each glass lite prior to shipment.
   4. Manufacturer to provide correct glazing wedge and tape in accordance with the tested assembly.

H. Weatherstripping:
   1. All ventilators shall receive continuous triple weatherstripping that shall be applied to the integral weatherstrip grooves in the interior and exterior contact surfaces of the frame and ventilator profiles. Weatherstripping that is surface applied or requires additional retainer or requires screws for application shall not be acceptable.

I. Shop Finishing:
   1. Cleaning:
      a. All hot-rolled steel profiles must be acid pickled to white metal as defined by SSPC – SP8 creating a pristine, white metal substrate which is paramount to achieving ultimate finish performance.
   2. Pretreatment:
      a. Following welding and all machining operations, hot-rolled products and accessories are subjected to the following pretreatment process.
         1) Hot-Dip Galvanize.
         2) Parts are cleaned and immersed in a molten pool of pure zinc per ASTM A123 to create a dry film thickness (DFT) of 4 – 8 mils of cathodic protection.
         3) Quality Control.
         4) Mechanical Cleaning.
   3. Brush-Off Blast Cleaning:
      a. Galvanized parts shall be brush-off blast cleaned in accordance with SSPS-SP16 to profile surface prior to primer application.
      b. All Parts shall be oven heated prior to finishing to prevent outgassing through epoxy primer.
   4. Refer to Section 09 96 00 High-Performance Coatings for substrate-specific coating systems.

PART 3 EXECUTION

3.01 VERIFICATION OF EXISTING WINDOW CONDITIONS AND DIMENSIONS

A. Prior to demolition of existing steel windows and fabrication of new steel windows, window manufacturer shall verify all existing window dimensions in field, including mullion and muntin profiles and sightlines for replication.

3.02 EXAMINATION

A. Verify that wall openings and adjoining water-resistive barrier materials are ready to receive steel windows.

B. Verify that structural curb is ready to receive skylight system. Coordinate installation of roofing and other adjacent work to ensure weathertight construction.

3.03 INSTALLATION - WINDOWS

A. Install window frames and glass and glazing in accordance with manufacturers instructions.

B. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.

C. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.

D. Install operating hardware.

E. Install glass and infill panels in accordance with glazing method required to achieve performance criteria; see Section 08 80 00.

3.04 INSTALLATION – SKYLIGHTS

A. Install metal-framed skylights in accordance with manufacturer's instructions.

B. Set skylight structure plumb, level, and true to line, without warp or rack of frames or glazing panels. Anchor securely in place in accordance with approved shop drawings.

C. Maintain assembly dimensional tolerances, aligning with adjacent work.

D. Install base flashings in accordance with Section 07 62 00.

E. Install glass and infill panels in accordance with glazing method required to achieve performance criteria; see Section 08 80 00.

F. Touch up damaged finishes so repair is imperceptible from 6 feet (1.8 m) distance, and remove and replace components that cannot be acceptably touched up.

3.05 TOLERANCES - SKYLIGHTS

A. Maximum Variation from Plumb, Level, or Line: 1/8 inch per 10 feet (1 mm per 1 m), or 3/8 inch (9.5 mm) total in overall dimension.

B. Alignment of Two Adjoining Members Abutting in Plane: Within 1/16 inches (1.6 mm).

3.06 ADJUSTING

A. Adjust hardware for smooth operation and secure weathertight closure.

3.07 CLEANING

A. Remove labels and visible markings.

B. Wash surfaces by method recommended and acceptable to window manufacturer; rinse and wipe surfaces clean.

C. Remove excess glazing sealant by method acceptable to sealant manufacturer.

3.08 PROTECTION

A. Do not permit continuing construction activities near unprotected finish surfaces.

END OF SECTION

SECTION 08 52 00
WOOD WINDOWS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Factory-fabricated wood windows.

B. Glazing.

C. Operating hardware.

D. Insect screens.

E. Wood trim for exterior finishing.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 Rough Carpentry: Rough opening framing.

B. Section 07 92 00 - Joint Sealants and Seals: Sealing joints between frames and adjacent construction.

C. Section 08 80 00 - Glazing.

1.03 REFERENCE STANDARDS

A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for Windows, Doors, and Skylights; 2022, with Errata (2023).

B. AAMA 502 - Voluntary Specification for Field Testing of Newly Installed Fenestration Products; 2021.

C. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).

D. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015 (Reapproved 2023).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

A. See Section 01 33 23 Submittal Procedures for submittal procedures.

B. Product Data: Show component dimensions, anchorage and fasteners, glass, and internal drainage details.

C. Shop Drawings: Indicate opening dimensions, framed opening tolerances, affected related work, and installation requirements.

D. Samples: Two samples 36 by 36 inch (915 by 915 mm) in size illustrating window frame section, mullion section, screen and frame, factory finished surfaces, and glazing.

E. Operating Hardware: Two samples of each type of operating hardware.

F. Manufacturer's Certificate: Certify that products furnished meet or exceed specified requirements.

G. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:
   1. Evidence of AAMA Certification; label or other documentation.
   2. Evidence of WDMA Certification.
   3. Evidence of CSA Certification.
   4. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.

H. Test Reports: Prior to submitting shop drawings or starting fabrication, submit test report(s) by independent testing agency showing compliance with performance requirements in excess of those prescribed by specified grade.

I. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

J. Manufacturer's qualification statement.

K. Installer's qualification statement.

L. Specimen warranty.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect factory finished surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C).

B. Maintain this minimum temperature during and after installation of sealants.

1.09 WARRANTY

A. See Section 01 67 00 Product Requirements for additional warranty requirements.

B. Correct defective Work within a five-year period after Date of Substantial Completion.

C. Manufacturer Warranty: Provide 5-year manufacturer warranty for insulated glass units against seal failure, interpane dusting or misting, and replacement of same. Complete forms in Government's name and register with manufacturer.

D. Manufacturer Warranty: Provide 2-year manufacturer warranty against defects listed. Complete forms in Government's name and register with manufacturer or warrantor.
   1. Degradation of color finish.
   2. Delamination or separation of finish cladding from window member.

PART 2 PRODUCTS

2.01 WOOD WINDOWS

A. Wood Windows: Windows are to match existing in appearance, size and trim profiles. Contractor to salvage existing windows, as noted on drawings, for replication purposes. Wood frame and sash, factory fabricated and assembled.
   1. Exterior Finish: Shop Primed and Painted.
      a. Back prime all wood that faces masonry (i.e. head, jambs, sill).
   2. Interior Finish: Same as exterior.
      a. Back prime all wood that faces masonry (i.e. head, jambs, sill).
   3. Color: As indicated on drawings.
   4. Configuration: As indicated on drawings.
   5. Wood Species: Mahogany, preservative treated using treatment type suitable for required finish.

6. Frame and Sash Members: Mortise and tenon joints. Glue and steel pin joints to hairline fit, weather tight.
7. Weather Stop Flange: Continuous at perimeter of unit.
8. Clearances and Shim Spacing: Minimum required for installation and dynamic movement of perimeter seal.
9. Fasteners: Concealed from view.
10. Insect Screen: Locate on inside of windows.
11. Operable Units: Double weatherstripped.

2.02 COMPONENTS

A. Glazing: IGU-2. See Section 08 80 00 Glazing.

B. Frames: Match existing profile; flush solid wood glass stops of screw fastened type, sloped for positive drainage.

C. Sills:
1. Interior: Wood, match existing thickness; sloped for positive drainage; fits under sash; single piece full width of opening. Refer to drawings for details.
2. Exterior: Wood, match existing thickness; sloped for positive drainage; fits under sash; single piece full width of opening. Cast Stone. See Section 04 03 00 Treatment for Existing Masonry. Refer to drawings for details.

D. Insect Screens: Extruded aluminum frame with mitered and reinforced corners; screen mesh taut and secure to frame; secured to window with adjustable supports allowing screen removal without use of tools.
1. Supports: Spring-loaded steel pins; four per screen unit.
2. Screen Mesh: Charcoal Aluminum mesh - .011 diameter wire woven to 16x18 - OR window manufacturer's highest-transparency mesh.
3. Frame Finish: Baked enamel, color to match window interior color.

E. Operable Sash Weatherstripping: Wool pile; permanently resilient, profiled to effect weather seal.

F. Fasteners: Stainless steel.

G. Sealant and Backing Materials: See Section 07 92 00 of types as indicated.

H. Flashing: Provide related flashings, with necessary anchors and attachment devices.

2.03 HARDWARE

A. Double Hung Sash: Manufacturer’s standard balancing system.

B. Sash lock: Lever handle with cam lock. Solid Brass.

C. Pulls: Manufacturer's standard type.

PART 3 EXECUTION

3.01 VERIFICATION OF EXISTING WINDOW CONDITIONS AND DIMENSIONS

A. Prior to demolition, contractor shall salvage existing wood window W113 for replication (see additional information and reference photos on drawings). Prior to fabrication of new wood windows, window manufacturer shall verify all existing wood window dimensions in field, as well as sash, sill and trim profiles, and sightlines.

3.02 INSTALLATION

A. Install windows in accordance with manufacturer's instructions.

B. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.

C. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.

D. Set sill members and sill flashing in continuous bead of sealant.

3.03 TOLERANCES

A. Maximum Variation from Level or Plumb: 1/16 inch per 3 ft (1.6 mm per m) non-cumulative or 1/8 inch per 10 ft (3.2 mm per 3 m), whichever is less.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.

B. Repair or replace fenestration components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

A. Adjust hardware for smooth operation and secure weathertight closure.

3.06 CLEANING

A. Remove protective material from factory finished surfaces.

B. Wash surfaces by method recommended and acceptable to window manufacturer; rinse and wipe surfaces clean.

END OF SECTION

SECTION 08 71 00
DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for aluminum and hollow metal doors.

B. Hardware for fire-rated doors.

C. Thresholds.

D. Weatherstripping and gasketing.

E. Door Hardware Schedule.

1.02 RELATED REQUIREMENTS

A. Section 08 11 13 - Hollow Metal Doors and Frames.

1.03 REFERENCE STANDARDS

A. ABA Standards – Architectural Barriers Act.

B. BHMA A156.1 - Standard for Butts and Hinges; 2021.

C. BHMA A156.3 - Exit Devices; 2025.

D. BHMA A156.4 - Door Closers and Pivots; 2024.

E. BHMA A156.6 - Standard for Architectural Door Trim; 2021.

F. BHMA A156.7 - Template Hinge Dimensions; 2022.

G. BHMA A156.13 - Mortise Locks & Latches Series 1000; 2022.

H. BHMA A156.16 - Standard for Auxiliary Hardware; 2023.

I. BHMA A156.18 - Standard for Materials and Finishes; 2020.

J. BHMA A156.21 - Thresholds; 2025.

K. BHMA A156.22 - Standard for Gasketing; 2021.

L. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

M. ITS (DIR) - Directory of Listed Products; Current Edition.

N. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

O. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.

P. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

Q. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.

R. UL (DIR) - Online Certifications Directory; Current Edition.

S. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

B. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; attendance is required by affected installers and the following:

1. Architect.

2. Installer's Architectural Hardware Consultant (AHC).
3. Hardware Installer.
4. Owner's Security Consultant.

C. Keying Requirements Meeting:
1. Schedule meeting at project site prior to Contractor occupancy.
2. Attendance Required:
a. Contractor.
b. Contracting Officer.
c. Hardware Installer.
3. Agenda:
a. Establish keying requirements.
b. Verify locksets and locking hardware are functionally correct for project requirements.
c. Verify that keying and programming complies with project requirements.
d. Establish keying submittal schedule and update requirements.
4. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
a. Access control requirements.
b. Flow of traffic and extent of security required.
5. Record minutes and distribute copies within two days after meeting to participants, with two copies to Contracting Officer, meeting participants, and those affected by decisions made.
6. Deliver established keying requirements to manufacturers.

1.05 SUBMITTALS

A. See Section 01 33 23 Submittal Procedures for submittal procedures.

B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.

C. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
2. Provide complete description for each door listed.
3. Provide manufacturer name, product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.

D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

E. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
1. Submit manufacturer's parts lists and templates.

F. Keying Schedule:
1. Submit three (3) copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.

G. Manufacturer's qualification statement.

H. Installer's qualification statement.

I. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.

J. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 67 00 - Product Requirements, for additional provisions.
2. Lock Cylinders: Ten for each master keyed group.
3. Keys: Deliver keys to Owner as agreed upon during the keying requirements meeting.

1.06 QUALITY ASSURANCE

A. Standards for Fire-Rated Doors: Maintain one copy of each referenced standard on site, for use by Architect and Contractor.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience.

D. Supplier Qualifications: Company with certified Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC) to assist in work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.08 WARRANTY

A. See Section 01 67 00 – Product Requirements for additional warranty requirements.

B. Manufacturer's Warranty: Provide warranty against defects in material and workmanship for period indicated. Complete forms in Owner's name and register with manufacturer.
   1. Closers: Five years, minimum.
   2. Exit Devices: Three years, minimum.
   3. Locksets and Cylinders: Three years, minimum.
   4. Other Hardware: Two years, minimum.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Provide door hardware products that comply with the following requirements:
   1. Applicable provisions of federal, state, and local codes.
   2. Accessibility: Architectural Barriers Act (ABA) and ICC A117.1.
   3. Applicable provisions of NFPA 101.
   4. Fire-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
   5. Hardware on Fire-Rated Doors: Listed and classified by UL (DIR), ITS (DIR), testing firm acceptable to authorities having jurisdiction.

D. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's series. See Door Hardware Schedule at the end of this specification.

E. Fasteners:
   1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
      a. Aluminum fasteners are not permitted.
      b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
   2. Fire-Rated Applications: Comply with NFPA 80.
      a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.

b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.

F. Finishes: Stainless steel unless otherwise noted.

2.02 HINGES

A. Hinges: Comply with BHMA A156.1, Grade 1.
1. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.
a. Provide hinge width required to clear surrounding trim.
2. Provide hinges on every swinging door.
3. Provide non-removable pins on exterior outswinging doors.
4. Refer to hardware sets for hinge quantities.

2.03 FLUSH BOLTS

A. Flush Bolts: Comply with BHMA A156.16, Grade 1.
1. Flush Bolt Throw: 3/4 inch (19 mm), minimum.
2. Provides extension bolts in leading edge of door, one bolt into floor, one bolt into top of frame.
a. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.

2.04 EXIT DEVICES

A. Exit Devices: Comply with BHMA A156.3, Grade 1.
1. Products:
a. Allegion; Von Duprin: 98/99 Series.
b. Substitutions: See Section 01 67 00 - Product Requirements.
2. Lever design to match lockset trim.
3. Provide cylinder with cylinder dogging or locking trim.
4. Provide exit devices properly sized for door width and height.
5. Provide strike as recommended by manufacturer for application indicated.
6. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.

2.05 LOCK CYLINDERS

A. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
1. Provide cylinders from same manufacturer as locking device.
2. Provide cams and/or tailpieces as required for locking devices.
3. Comply with NPS USPP Best Cores requirement.

2.06 MORTISE LOCKS

A. Mortise Locks: Comply with BHMA A156.13, Grade 1, Security, 1000 Series.
1. Latchbolt Throw: 3/4 inch (19 mm), minimum.
2. Deadbolt Throw: 1 inch (25.4 mm), minimum.
3. Backset: 2-3/4 inch (70 mm) unless otherwise indicated.
4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
a. Finish: To match lock or latch.

2.07 DOOR PULLS AND PUSH PLATES

A. Door Pulls and Push Plates: Comply with BHMA A156.6.
1. Products:

a. Allegion; Von Duprin: 990 Series Exit Trim.
b. Substitutions: See Section 01 67 00 - Product Requirements.
2. Pull Type: Straight, unless otherwise indicated.
3. Push Plate Type: Flat, with square corners, unless otherwise indicated.
a. Edges: Beveled, unless otherwise indicated.
4. Material: Stainless Steel, unless otherwise indicated.

2.08 CLOSERS

A. Closers: Comply with BHMA A156.4, Grade 1.
1. Type: Surface mounted to door.
2. Provide door closer on each exterior door and as noted in the door hardware schedule.
3. At corridor entry doors, mount closer on room side of door.
4. At outswinging exterior doors, mount closer on interior side of door.

2.09 ASTRAGALS

A. Astragals: Comply with BHMA A156.22.
1. Type: Split, two parts, and with sealing gasket.
2. Material: Stainless steel, with neoprene weatherstripping.
3. Provide non-corroding fasteners at exterior locations.

2.10 THRESHOLDS

A. Thresholds: Comply with BHMA A156.21.
1. Provide threshold at each exterior door, unless otherwise indicated.
2. Type: Flat surface.
3. Material: Stainless steel.
4. Threshold Surface: Fluted horizontal grooves across full width.
5. Field cut threshold to profile of frame and width of door sill for tight fit.
6. Provide non-corroding fasteners at exterior locations.

2.11 WEATHERSTRIPPING AND GASKETING

A. Weatherstripping and Gasketing: Comply with BHMA A156.22.
1. Head and Jamb Type: Adjustable.
2. Door Sweep Type: Encased in retainer.
3. Material: Stainless steel, with brush weatherstripping.

2.12 FIRE DEPARTMENT LOCK BOX

A. Fire Department Lock Box:
1. Capacity: Holds 10 keys.
2. Finish: Manufacturer's standard dark bronze.

2.13 FINISHES

A. Finishes: Provide door hardware of same finish, unless otherwise indicated.
1. Primary Finish: 630; satin stainless steel, with stainless steel 300 series base material (former US equivalent US32D); BHMA A156.18.
2. Secondary Finish: 626; satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D); BHMA A156.18.
a. Use secondary finish in kitchens, bathrooms, and other spaces containing chrome or stainless steel finished appliances, fittings, and equipment; provide primary finish on one side of door and secondary finish on other side if necessary.

3. Exceptions:
   a. Where base material metal is specified to be different, provide finish that is an equivalent appearance in accordance with BHMA A156.18.
   b. Hinges for Fire-Rated Doors: Steel base material with painted finish, in compliance with NFPA 80.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.

C. Use templates provided by hardware item manufacturer.

D. Do not install surface mounted items until application of finishes to substrate are fully completed.

E. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list, unless noted otherwise on drawings.
   1. Mounting heights in compliance with ABA Standards.

F. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.03 CLEANING

A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

B. Clean adjacent surfaces soiled by hardware installation.

3.04 PROTECTION

A. Protect finished Work under provisions of Section 01 73 40 - Execution.

B. Do not permit adjacent work to damage hardware or finish.

3.05 DOOR HARDWARE SCHEDULE

Set: 1.0

Exterior Exit Double Doors: E102, E106, E108

2x Concealed Vert Rod Exit with Nightlatch
4x Cylinder
2x Pull
2x Closer – surface mount
1x Center meeting Astragal
6x Hinge
2x Sweep with drip edge

1x Threshold
- Perimeter Gasketing

Notes:
Perimeter and meeting stile gasket by door/frame manufacturer.

Set: 2.0

Exterior Exit Single Doors: E101, E103, E105, E107, E104

1x Concealed Vert Rod Exit with Nightlatch
2x Cylinder
1x Pull
1x Closer – surface mount
3x Hinge
1x Sweep with drip edge
1x Threshold
- Perimeter Gasketing

Notes:
Perimeter and meeting stile gasket by door/frame manufacturer.

Set: 3.0

Interior Exit Single Doors: L4101, L4104, L4106, L4107, L4108, L3101, L3105

1x Concealed Vert Rod Exit with Nightlatch
2x Cylinder
1x Pull
1x Closer – surface mount
3x Hinge
1x Sweep with drip edge
1x Threshold
- Perimeter Gasketing

Notes:
Perimeter and meeting stile gasket by door/frame manufacturer.

Set: 4.0

Interior Single Doors: L3103, L3106, L4102, L4105

1x Deadbolt lock
2x Cylinder
1x Pull (if adjacent to Hangar, pull should be on Hangar side of door)
1x Push Plate
1x Closer – surface mount
3x Hinge
1x Threshold

Set: 5.0

Interior Single Doors – Utility Spaces: L3107, L3109

1x Mortise lockset
2x Cylinder
2x Lever
1x Closer – surface mount
3x Hinge
1x Threshold

Set: 6.0

Interior Single Doors – Restrooms: L3108, L4107

1x Mortise lockset with occupancy indicator
1x Thumbturn lock (on restroom interior)
1x Cylinder
2x Lever
1x Closer – surface mount
3x Hinge
1x Threshold

Set: 7.0

Interior Double Doors: L3102, L3104, L4103

2x Deadbolt Lock
4x Cylinder
2x Pull (if adjacent to Hangar, pull should be on Hangar side of door)
2x Pushplate
1x Center meeting astragal
2x Closer – surface mount
6x Hinge
1x Threshold

Set: 8.0

Interior Double Door with Inactive Leaf: L4109, L4110, L4111

1x Concealed Vert Rod Exit with Nightlatch
2x Cylinder
1x Pull
1x Center meeting astragal
1x Closer – surface mount
2x Flush bolts for inactive leaf (one top and one bottom)
6x Hinge

1x Threshold

Set: 9.0

Interior Single Closet: W103

1x Mortise lockset
2x Cylinder
2x Lever
1x Closer – surface mount
3x Hinge
1x Threshold

Set: 10.0

Interior Double Door at WPA Infill: W101, W102

2x Mortise lockset
4x Cylinder
2x Pulls
6x Hinge – Heavy Duty – match existing
1x Center meeting astragal
1x Threshold
- Perimeter gasketing
2x Round door knobs (for inset door)
3x Hinges (for inset door)
- Perimeter gasketing (for inset door)

Notes:
Perimeter and meeting stile gasket by door/frame manufacturer.

Set: 11.0

Pilot Doors (inset into Hangar Rolling Doors): PN01, PN02, PN03, PN04, PS01, PS02, PS03, PS04

1x Deadbolt
2x Cylinder
2x Round door knobs
2x Hinge
- Perimeter gasketing

Notes:
Perimeter and meeting stile gasket by door/frame manufacturer.

END OF SECTION

SECTION 08 80 00
GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulating glass units.

B. Glazing units.

C. Glass coatings.

D. Glazing compounds.

1.02 RELATED REQUIREMENTS

A. Section 08 11 13 – Hollow Metal Doors and Frames

B. Section 08 51 23 - Steel Windows and Aluminum Skylights.

C. Section 08 52 00 - Wood Windows.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).

E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

F. ASTM C1036 - Standard Specification for Flat Glass; 2021.

G. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.

H. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

I. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.

J. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.

K. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.

L. GANA (GM) - GANA Glazing Manual; 2022.

M. GANA (SM) - GANA Sealant Manual; 2008.

N. GANA (LGRM) - Laminated Glazing Reference Manual; 2019.

O. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (Reaffirmed 2016).

P. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.

Q. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.

R. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.05 SUBMITTALS

A. See Section 01 33 23 Submittal Procedures for submittal procedures.

B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

D. Samples: Submit two samples 12 by 12 inch (305 by 305 mm) in size of each IGU Type and Glazing Type confirm compliance with construction documents as well as to confirm match of texture and printed pattern with Hangars 1&2 Glazing.

E. Samples: Submit manufacturer's range of colors of glazing sealant, for color selection.

F. Installer's qualification statement.

G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Government's name and registered with manufacturer.

H. Maintenance Materials: Furnish the following for Government's use in maintenance of project.
   1. See Section 01 67 00 - Product Requirements, for additional provisions.
   2. Extra Insulating Glass Units: One of each glass size and each glass type.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods. Maintain one copy on site.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
   1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
      a. Insulating Glass Certification Council (IGCC).

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.07 MOCK-UPS

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. Provide on-site glazing mock-up with the specified glazing components for each window type.

C. Locate where directed.

D. Mock-ups may remain as part of the Work, pending Government's approval.

1.08 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F (4 degrees C).

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.09 WARRANTY

A. See Section 01 67 00 Product Requirements for additional warranty requirements.

B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Design Pressure: Calculated in accordance with ASCE 7.
   2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   4. Glass thicknesses listed are minimum.

B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.
   1. In conjunction with weather barrier related materials described in other sections, as follows:

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   3. Solar Optical Properties: Comply with NFRC 300 test method.

2.02 GLASS MATERIALS

A. Float Glass: Provide float glass-based glazing unless otherwise indicated.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3, Low-Iron.
   2. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations, such as all glazed doors.
   3. Patterned (Textured) Printed Glass Type: ASTM C1036, Type II - Patterned Flat Glass, Quality - Q5, Form 3 - Patterned glass, with color and performance characteristics as indicated. Printed with Chickenwire imagery to match size and shape of Hangars 1 & 2 glazing, Low-Iron.

2.03 INSULATING GLASS UNITS

A. Fabricator: Certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.

B. Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
   3. Warm-Edge Spacers: Low-conductivity thermoplastic with desiccant warm-edge technology design.
      a. Spacer Width: As required for specified insulating glass unit.
      b. Spacer Height: Manufacturer's standard.
   4. Spacer Color: Dark gray.
   5. Edge Seal:
      a. Color: Gray.
   6. Purge interpane space with dry air, hermetically sealed.

C. Type IGU-1 - Insulating Glass Units: double glazed.
   1. Applications: Exterior glazing unless otherwise indicated - Steel Windows, Steel Skylights and Glazed Exterior Doors.
   2. Space between lites filled with argon.
   3. Outboard Lite: GL-1.
      a. Thickness: As required for application.
      b. Tint: Clear.
      c. Coating: Low-E (passive type), on #2 surface. Low to no visible tinting.
   4. Warm-edge spacer.
   5. Inboard Lite: GL-3.
      a. Tint: Clear.
   6. Total Thickness: 1 inch (25.4 mm).
   7. Thermal Transmittance (U-Value), Summer - Center of Glass: .20, nominal.
   8. Visible Light Transmittance (VLT): 70%, nominal.

D. Type IGU-2 - Insulating Glass Units: double glazed.
   1. Applications: Exterior glazing unless otherwise indicated - Wood Windows.
   2. Space between lites filled with argon.
   3. Outboard Lite: GL-2.
      a. Thickness: As required for application.
      b. Tint: Clear.
      c. Coating: Low-E (passive type), on #2 surface.
   4. Warm-edge spacer.
   5. Inboard Lite: GL-3.
      a. Tint: Clear.
   6. Total Thickness: 1 inch (25.4 mm).
   7. Thermal Transmittance (U-Value), Summer - Center of Glass: .20, nominal.
   8. Visible Light Transmittance (VLT): 70%, nominal.

E. Type IGU-3 - Insulating Glass Units: double glazed.
   1. Applications: Doors between Hangars and Lean-tos.
   2. Space between lites filled with argon.
   3. Outboard Lite: GL-3.
      a. Tint: Clear.
      b. Coating: None.
   4. Warm-edge spacer.
   5. Inboard Lite: GL-3.
      a. Tint: Clear.
      b. Coating: None.
   6. Total Thickness: 1 inch (25.4 mm).

F. Type IGU-4 - Insulating Glass Units: double glazed.
   1. Applications: Skylights.
   2. Space between lites filled with argon.
   3. Spacer Color: Black.
   4. Edge Seal Color: Black
   5. Outboard Lite: GL-1.
      a. Thickness: As required for application.
      b. Tint: Clear.
      c. Coating: None.
   6. Warm-edge spacer.
   7. Inboard Lite: GL-1.
      a. Thickness: As required for application.
      b. Tint: Clear.
   8. Total Thickness: Per manufacturer.

9.

2.04 GLAZING UNITS

A. Type GL-1 - Textured and Printed Glazing: Textured or rolled glass; translucent, showing shadows but not form.
   1. Products:
      a. Architectural Glass: https://architecturalglass.com/; Printed Wire Glass, or equal.
      b. Substitutions: See section 01 67 00 Product Requirements.
   2. Applications: Locations as indicated on drawings.
   3. Finish: F1 - Textured one side, Surface #1; ASTM C1036.
   4. Texture: Hammered to match existing Hangars 1&2 Glazing; ASTM C1036.
   5. Glass Texture: Cast.
   6. Style: As indicated on drawings.
   7. Tint: Clear.
   8. Glass Type: Fully tempered.
   9. Thickness: As required for application.
   10. Digital Printing: Surface #2, Chickenwire pattern to match existing Hangars 1 & 2 Wireglass.

B. Type GL-2 - Bird-Friendly Acid-Etched Glass:
   1. Products:
      a. Guardian Glass: Bird1st Etch or equal.
      b. Substitutions: See section 01 67 00 Product Requirements.
   2. Etched patterns on glass as full-surface bird protection.
   3. Applications: Outboard lite of IGU-2; Wood Windows.
   4. Glass Type: Monolithic; tempered safety glass.
   5. Glass Color: Ultra-clear glass.
   6. Glass Panel Thickness: 0.126 inch (3.2 mm), nominal.
   7. Bird-Friendly Pattern: As selected by Architect from manufacturers standard line.
      a. Acid-etched on exterior, Surface 1, of IGU with Low-e coating on Surface 2.
      b. Threat factor of 25 or less in accordance with American Bird Conservancy tunnel test.

C. Type GL-3 - Monolithic Exterior Vision Glazing:
   1. Products:
      a. Guardian Glass: UltraClear, or equal.
      b. Substitutions: See section 01 67 00 Product Requirements.
   2. Applications: Inboard Lite of Exterior IGUs (Both IGU-1 and IGU-2).
   3. Glass Type: Fully tempered safety glass.
   4. Tint: Clear.
   5. Thickness: 1/4 inch (6.4 mm), nominal.
   6. Low-iron.

2.05 GLAZING COMPOUNDS

A. Type GC-1 - Glazing Putty: Polymer modified latex recommended by manufacturer for outdoor use, knife grade consistency; gray color.

B. Type GC-4 - Polyurethane Sealant: Single component, chemical curing, nonstaining, nonbleeding; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 20 to 35; gray color.

C. Type GC-5 - Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; nonbleeding, nonstaining; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; gray color.
   1. Products:
      a. Tremco Commercial Sealants & Waterproofing: Proglaze, or equal.
      b. Substitutions: See Section 01 67 00 - Product Requirements.

2.06 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch (75 mm) long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.

C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.

2.07 SOURCE QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for additional requirements.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

B. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

C. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

D. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following: weld splatter, fire-safing, plastering, mortar droppings, and paint.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.

C. Monitor and report installation procedures and unacceptable conditions.

3.05 CLEANING

A. See Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.

B. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

C. Remove nonpermanent labels immediately after glazing installation is complete.

D. Clean glass and adjacent surfaces after sealants are fully cured.

E. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.06 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

DIVISION 09 -- FINISHES

SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Metal channel ceiling framing.

D. Gypsum wallboard.

E. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.

B. Section 07 92 00 - Joint Sealants and Seals: Sealing acoustical gaps in construction other than gypsum board or plaster work.

C. Section 09 30 00 - Tiling: Tile backing board.

1.03 REFERENCE STANDARDS

A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2020).

B. AISI S201 - North American Standard for Cold-Formed Steel Framing - Product Data; 2017.

C. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.

D. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).

E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

G. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

H. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.

I. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).

J. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2017).

K. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.

L. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.

M. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2023.

N. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.

O. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.

P. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.

Q. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

R. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2023.

S. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

T. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

U. ASTM E413 - Classification for Rating Sound Insulation; 2022.

V. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.

W. GA-600 - Fire Resistance and Sound Control Design Manual; 2024.

X. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

Y. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of gypsum board assemblies with size, location, and installation of service utilities.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

C. Sequencing: Install service utilities in an orderly and expeditious manner.

1.05 SUBMITTALS

A. See Section 01 33 23 Submittal Procedures for submittal procedures.

B. Product Data:
   1. Provide data on metal framing, gypsum board, accessories, and joint finishing system.
   2. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

C. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.

D. Steel Framing Industry Association (SFIA) Certification:
   1. Submit documentation that metal studs and connectors used on project meet or exceed requirements of International Building Code.
   2. Submit current documentation of contractor and fabricator accreditation. Keep copies of each on-site during and after installation, and present upon request.

E. Delegated Design Submittal: As indicated in this section by a professional structural engineer.
   1. Framing shop drawings signed and sealed by a professional structural engineer.
   2. Design calculations sufficient to demonstrate compliance with design criteria; signed and sealed by a professional structural engineer.
   3. Details and calculations for factory-made connectors, signed and sealed by a professional structural engineer.

F. Test Reports: For stud framing products that do not comply with AISI S220 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

G. Qualification Statements:
   1. Delegated Designer's Qualification Statement.
   2. Installer's Qualification Statement.

1.06 QUALITY ASSURANCE

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. Delegated Designer Qualifications: Perform framing design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

C. SFIA Code Compliance Certification Program: www.CFSteel.org/#sle: Use metal studs and connectors certified for compliance with International Building Code.

D. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

E. Documents at Project Site: Maintain at the project site a copy of manufacturer's instructions, erection drawings, and shop drawings.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.

B. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.

C. Store metal products to prevent corrosion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Comply with requirements for Contractor's design-related professional design services indicated in Section 01 40 00 - Quality Requirements.

B. Design Requirements: Design metal framing systems, components and connectors to withstand specified design loads in compliance with ICC (IBC), ASCE 7, AISI S100, and AISI S240.

C. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.

D. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.

E. Design Criteria: In accordance with applicable codes.
   1. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
   2. Seismic Criteria: Comply with ASCE 7 and with local authorities having jurisdiction:
   3. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

2.02 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
   1. See PART 3 for finishing requirements.

B. Fire-Resistance-Rated Assemblies: Provide completed assemblies as indicated on drawings.
   1. ICC IBC Item Numbers: Comply with applicable requirements of ICC IBC for the particular assembly.
   2. Gypsum Association File Numbers: Comply with requirements of GA-600 for the particular assembly.
   3. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.03 METAL FRAMING MATERIALS

A. Material and Product Requirements Criteria: AISI S201.

B. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.
   1. Structural Grade: As required to meet design criteria.
   2. Corrosion Protection Coating Designation: G40, or equivalent in accordance with AISI S220.

C. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
   1. Products:
      a. ClarkDietrich: ProSTUD, or equal.
      b. Substitutions: See Section 01 67 00 - Product Requirements.
   2. Studs: C-shaped with knurled or embossed faces.
   3. Thickness and Depth: Depth as indicated on the drawings; thickness and structural grade as required to meet design criteria.
   4. Runners: U shaped, sized to match studs.
   5. Ceiling Channels: C-shaped.
      a. Products:
         1) Same manufacturer as other framing materials.
         2) Substitutions: See Section 01 67 00-Product Requirements.
   6. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).
      a. Product:
         1) Same manufacturer as other framing materials.
         2) Substitutions: See Section 01 67 00 - Product Requirements.

D. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection and prevent rotation of studs while maintaining structural performance of partition.
   1. Product:
      a. ClarkDietrich: Fast Top Clip, or equal.
      b. Substitutions: See Section 01 67 00 - Product Requirements.
   2. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
   3. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot-dipped galvanized coating.
   4. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
   5. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-resistance rating of the wall assembly.

E. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.
   1. Product:
      a. ClarkDietrich: BlazeFrame Firestop Deflection Track, or equal.
      b. Substitutions: See Section 01 67 00 - Product Requirements.

F. Non-structural Framing Accessories:
   1. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.
      a. Product:
         1) ClarkDietrich: FastBridge Clip (FB33), or equal.
         2) Substitutions: See Section 01 67 00 - Product Requirements.

2.04 BOARD MATERIALS

A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Product:
      a. USG Corporation: Sheetrock Brand EcoSmart Panels Mold Tough Firecode X, or equal.
      b. Substitutions: See Section 01 67 00 - Product Requirements.
   2. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273, unless indicated otherwise.
      a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.
      b. Mold resistant board is required as indicated..
   4. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   5. Thickness:
      a. Vertical Surfaces: 5/8 inch (16 mm).
      b. Multi-Layer Assemblies: Thicknesses as indicated on drawings.

B. Cement Fiber Units: Noncombustible concrete panels; meets ASTM E136.
   1. Product:
      a. USG Corporation: Structo-crete Brand Structural Panels, or equal.
      b. Substitutions: See Section 01 67 00 - Product Requirements.
   2. Thickness: ¾” (19.05 mm)

C. Backing Board For Wet Areas: See Section 09 30 00 - Tiling for backing board material.

2.05 GYPSUM BOARD ACCESSORIES

A. Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
   1. Heavy Duty Corner Trim: Extruded aluminum trim with painted exposed metal corner used at all corners in high-traffic areas and where indicated.
      a. Product: Fry Reglet Corner Trim, DMCT-1250, or equal.
      b. Exposed Metal Width: 1 1/4 inch.
      c. Finish: Field painted.
      d. Substitutions: See Section 01 67 00 - Product Requirements.
   2. Corner Beads: Low profile, for 90 degree outside corners.
      a. Product:
         1) CertainTeed Corporation; No-Coat Drywall Corner, or equal.
         2) Substitutions: See Section 01 67 00 - Product Requirements.

B. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
   1. Fiberglass Tape: 2 inch (50 mm) wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
   2. Paper Tape: 2 inch (50 mm) wide, creased paper tape for joints and corners, except as otherwise indicated.
   3. Joint Compound: Setting type, field-mixed.

C. Finishing Compound: Surface coat and primer, takes the place of skim coating.

D. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

E. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch (0.84 to 2.84 mm) in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

F. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C1007AISI S220 and manufacturer's instructions.

B. Studs: Space studs at 16 inches on center (at 406 mm on center).
   1. Extend partition framing to structure where indicated and to ceiling in other locations.
   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.

C. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

D. Furring for Fire-Resistance Ratings: Install as required for fire-resistance ratings indicated and to GA-600 requirements.

E. Blocking: Install wood blocking for support of:
   1. Framed openings.
   2. Wall-mounted cabinets.
   3. Plumbing fixtures.
   4. Toilet partitions.
   5. Toilet accessories.
   6. Wall-mounted door hardware.

3.03 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
   1. Exception: Tapered edges to receive joint treatment at right angles to framing.

C. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

D. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

E. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Not more than 30 feet (10 meters) apart on walls and ceilings over 50 feet (16 meters) long.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.05 JOINT TREATMENT

A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.

B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.

C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
   3. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.

D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).
   2. Taping, filling, and sanding are not required at base layer of double-layer applications.

3.06 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

3.07 CLEANING

A. See Section 01 73 40 - Execution for additional requirements.

3.08 PROTECTION

A. Protect installed gypsum board assemblies from subsequent construction operations.

END OF SECTION

SECTION 09 30 00
TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tile for wall applications.

B. Backing board for wet areas.

C. Non-ceramic trim.

1.02 REFERENCE STANDARDS

A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2019.

B. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2023.

C. ANSI A108.1b - Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.

D. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.

E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive; 2023.

F. ANSI A108.5 - Setting of Ceramic Tile with Dry-Set Cement Mortar, Modified Dry-Set Cement Mortar, EGP (Exterior Glue Plywood) Modified Dry-Set Cement Mortar, or Improved Modified Dry-Set Cement Mortar; 2023.

G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 2023.

H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2024).

I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 2023.

J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017 (Reaffirmed 2022).

K. ANSI A108.12 - Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2023.

L. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2021).

M. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2020.

N. ANSI A108.20 - American National Standard Specifications for Exterior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs; 2020.

O. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2021.

P. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.

Q. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018 (Reapproved 2023).

R. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2024.

S. TCNA (HB-GP) - Handbook for Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs Installation; 2023.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.

1.04 SUBMITTALS

A. See Section 01 33 23 Submittal Procedures for submittal procedures.

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

C. Samples: Two of each type of specified tile.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Installer's Qualification Statement:
   1. Submit documentation of National Tile Contractors Association (NTCA) or Tile Contractors' Association of America (TCAA) accreditation.

F. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 67 00 - Product Requirements, for additional provisions.
   2. Extra Tile: 1 percent of each size, color, and surface finish combination, but not less than 6 of each type.

1.05 QUALITY ASSURANCE

A. Maintain one copy of ANSI A108/A118/A136, TCNA (HB), and TCNA (HB-GP) on-site.

B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.

C. Installer Qualifications: Natural Stone Institute (NSI) Accredited Commercial B Contractor (light commercial): www.naturalstoneinstitute.org/#sle.

D. Installer Qualifications:
   1. Company specializing in performing tile installation, with minimum of five years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Maintain ambient and substrate temperature above 50 degrees F (10 degrees C) and below 100 degrees F (38 degrees C) during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 TILE

A. Porcelain Tile: ANSI A137.1 standard grade.

1. Product:
    a. American Olean: Color Story Wall, or equal.
    b. Substitutions: See Section 01 67 00 - Product Requirements.
2. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
3. Size: As indicated on Drawings.
4. Thickness: 3/8 inch (9.5 mm).
5. Surface Finish: Glossy.
6. Color(s): As indicated on drawings.
7. Pattern: Running Bond, as indicated on drawings..
8. Trim Units: Matching cove base and Metal trim shapes in sizes indicated.

2.02 TRIM AND ACCESSORIES

A. Non-Ceramic Trim: Brushed stainless steel, style and dimensions to suit application, set with tile mortar or adhesive.
    1. Applications:
        a. Open edges of wall and floor tile.
    2. Product:
        a. Schluter-Systems; Jolly, or equal.
        b. Substitutions: See Section 01 67 00 - Product Requirements.

2.03 TILE BACKER BOARD

A. Backing board for wet areas: Meets or exceeds ASTM C1325.
    1. Product:
        a. USG Corporation: Durock Brand Cement Board with Edgeguard, or equal.
        b. Substitutions: See Section 01 67 00 - Product Requirements.
    2. Thickness: ¼” for non-rated wall assemblies.

2.04 SETTING MATERIALS

A. Product:
    1. Mapei Corporation: Kerapoxy, or equal.
    2. Substitutions: See Section 01 67 00 - Product Requirements.
        a. Provide setting and grout materials from same manufacturer.

B. Epoxy Adhesive and Mortar Bond Coat: ANSI A118.3.

2.05 GROUTS

A. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.

B. Product:
    1. Mapei Corporation: Kerapoxy, or equal.
    2. Substitutions: See Section 01 67 00 - Product Requirements.
        a. Provide setting and grout materials from same manufacturer.

C. Applications: Where indicated.

D. Color(s): Chosen by COR from manufacturer’s standard line of colors.

2.06 MAINTENANCE MATERIALS

A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
    1. Applications: Between tile and plumbing fixtures.
    2. Color(s): Light gray.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

3.02 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

3.03 INSTALLATION - GENERAL

A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.20, manufacturer's instructions, and TCNA (HB) or TCNA (HB-GP) recommendations, as applicable.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

E. Form internal angles square and external angles bullnosed.

F. Install non-ceramic trim in accordance with manufacturer's instructions.

G. Sound tile after setting. Replace hollow sounding units.

H. Keep control and expansion joints free of mortar, grout, and adhesive.

I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

J. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.

K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - WALL TILE

A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms.

3.05 CLEANING

A. Clean tile and grout surfaces.

END OF SECTION

SECTION 09 91 23
INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Do Not Paint or Finish the Following Items:
   1. Items shop or factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items, unless otherwise indicated.
   6. Marble, granite, slate, and other natural stones.
   7. Floors, unless specifically indicated.
   8. Ceramic and other tiles.
   9. Brick, architectural concrete, and cast stone.
   10. Glass.
   11. Pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 09 96 00 - High-Performance Coatings.

1.03 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.

C. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.

D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

E. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).

F. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

G. SSPC-SP 2 - Hand Tool Cleaning; 2024.

H. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning; 2006.

1.04 SUBMITTALS

A. See Section 01 33 23 Submittal Procedures, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
   2. MPI product number (e.g., MPI #47).
   3. Cross-reference to specified paint system products to be used in project; include description of each system.

4. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.
   2. Where sheen is not specified, discuss sheen options with COR before preparing samples, to eliminate sheens not required.
   3. Allow 30 days for approval process, after receipt of complete samples by COR.
   4. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, have been approved.

D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.

E. Manufacturer's Instructions: Indicate special surface preparation procedures.

1.05 MOCK-UP

A. See Section 01 40 00 - Quality Requirements, for general requirements for mock-up.

B. Provide panel, 3 feet (1 m) long by 3 feet (1 m) wide, illustrating paint color, texture, and finish for each color selected.

C. Locate where directed by COR.

D. Mock-up may not remain as part of the work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Minimum Application Temperatures for Paints: 50 degrees F (10 degrees C) for interiors unless required otherwise by manufacturer's instructions.

D. Provide lighting level of 80 fc (860 lux) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 PAINTS AND FINISHES - GENERAL

A. Product:
   1. Benjamin Moore Paints, Aura, or equal.
   2. Substitutions: See Section 01 67 00 - Product Requirements.
      a. Primer shall be from the same manufacturer as top coats.

B. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.

1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Supply each paint material in quantity required to complete entire project's work from a single production run.
3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

C. Volatile Organic Compound (VOC) Content:
1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

E. Colors: As indicated on drawings.
1. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.

2.02 PAINT SYSTEMS - INTERIOR

A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board and wood.
1. Two top coats and one coat primer.
2. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI #143, 144, 145, 146, 147, or 148.
3. Top Coat Sheen:
a. Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.
b. Eggshell: MPI gloss level 3; use this sheen at wall locations unless otherwise noted.
c. Semi-Gloss: MPI gloss level 5; use this sheen for wood trim and where indicated.
4. Primer: As recommended by top coat manufacturer for specific substrate.

2.03 PAINT SYSTEMS - EXTERIOR

A. Exterior Painting: See Section 09 96 00 - High-Performance Coatings.

2.04 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been adequately prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. Test shop-applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
   1. Gypsum Wallboard: 12 percent.
   2. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Masonry:

F. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

G. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

E. Sand wood and metal surfaces lightly between coats to achieve required finish.

F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection.

3.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 09 96 00
HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. High performance coatings for structural steel, steel, aluminum, copper and wood.

B. Surface preparation for structural steel, steel, aluminum, copper and wood.

1.02 RELATED REQUIREMENTS

A. Section 05 03 00 Conservation Treatment for Period Metals.

B. Section 08 11 13 Hollow Metal Doors and Frames.

C. Section 08 51 23 Steel Windows.

D. Section 08 52 00 Wood Windows.

1.03 REFERENCE STANDARDS

A. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

B. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

D. SSPC-SP 5/NACE No.1 - White Metal Blast Cleaning; 2006.

E. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning; 2006.

1.04 SUBMITTALS

A. See Section 01 33 23 Submittal Procedures for submittal procedures.

B. Product Data: Provide complete list of all products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified coating system(s) product is to be used in; include description of each system.
   4. If proposal of substitutions is allowed under submittal procedures, explanation of all substitutions proposed.

C. Samples: Submit two samples 8 by 8 inch (203 by 203 mm) in size illustrating colors specified for selection.

D. Manufacturer's Certificate: Certify that high-performance coatings comply with VOC limits specified.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

G. Maintenance Data: Include cleaning procedures and repair and patching techniques.

H. Maintenance Materials: Furnish the following for Government's use in maintenance of project.
   1. Extra Coating Materials: 1 gallon (4 liters) of each type and color.
   2. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the work of this section approved by manufacturer.

1.06 MOCK-UPS

A. See Section 01 40 00 - Quality Requirements for general requirements for mock-ups.

B. Provide mock-up of each coating system for each metal, steel and aluminum and copper, and wood illustrating coating, color, and surface sheen, for each specified coating. Mockup size to be determined on site by the Contracting Officer.

C. Locate where directed.

D. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Coating Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the coating product manufacturer.

C. Do not install materials when temperature is below or above manufacturer's approved product application temperature range.

D. Maintain this temperature range for the specified duration for each coating product.

E. Restrict traffic from area where coating is being applied or is curing.

PART 2 PRODUCTS

2.01 HIGH-PERFORMANCE COATINGS SCHEDULE

A. General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.
   1. Colors: As indicated on the architectural drawings.

B. Steel - Intumescent Coating System
   1. Location: As indicated on the structural drawings.
   2. Surface Preparation: 101952737 - SURFACE PREPARATION.
      a. Notes: Minimum surface preparation of SSPC-6, Commercial Blast Cleaning.
   3. Primer:

a. Product:
1) Sherwin Williams, B69A00120 - Zinc Clad 4100 A, or equal.
2) Substitutions: Section 01 60 00 - Product Requirements.
b. 1 coat.
c. Zinc-rich rust inhibiting primer.
4. Intermediate Intumescent Coat:
a. Product:
1) Sherwin Williams Firetex FX9502 Epoxy Intumescent, or equal.
2) Substitutions: Section 01 60 00 - Product Requirements.
b. 1 coat.
c. Epoxy intumescent coating.
5. Top Coat:
a. Product:
1) Sherwin Williams, B65WJ0351 - Hi-Solids Polyurethane 250 SG X WH S, or equal.
2) Substitutions: Section 01 60 00 - Product Requirements.
b. 1 coat.
c. Aliphatic, acrylic polyurethane resin.

C. Steel - High-Performance Coating System
1. Location: Structural steel not to receive intumescent coating and steel windows - new and repair of existing.
2. Surface Preparation: 101952737 - SURFACE PREPARATION.
a. Notes: Minimum surface preparation of SSPC-6, Commercial Blast Cleaning.
3. Primer:
a. Product:
1) Sherwin Williams, B69A00120 - Zinc Clad 4100 A, or equal.
2) Substitutions: Section 01 60 00 - Product Requirements.
b. 1 coat.
c. Zinc-rich, epoxy, rust inhibiting primer.
4. Intermediate Coat:
a. Product:
1) Sherwin Williams, B58W00610 - Macropoxy® 646 Fast Cure Epoxy Part A Mill White, or equal.
2) Substitutions: Section 01 60 00 - Product Requirements.
b. 1 coat.
c. High build, polyamide epoxy.
5. Top Coat:
a. Product:
1) Sherwin Williams, B65WJ0351 - Hi-Solids Polyurethane 250 SG X WH S, or equal.
2) Substitutions: Section 01 60 00 - Product Requirements.
b. 1 coat (Option: 2 coats).
c. Aliphatic, acrylic polyurethane resin.

D. Aluminum - High-Performance Coating System
1. Location: Hangar doors and aluminum skylights.
2. Surface Preparation: 101952737 - SURFACE PREPARATION.
a. Notes: Minimum surface preparation of SSPC-1, Solvent Cleaning. S-W 12, Previously Coated Surfaces should also be followed.
3. Primer:
a. Product:
1) B58W00610 - Macropoxy® 646 Fast Cure Epoxy Part A Mill White, or equal.
2) Substitutions: Section 01 60 00 - Product Requirements.

b. 1 coat.
c. High build, polyamide epoxy.

4. Top Coat:
   a. Product:
      1) Sherwin Williams, B65WJ0351 - Hi-Solids Polyurethane 250 SG X WH S, or equal.
      2) Substitutions: Section 01 60 00 - Product Requirements.
   b. 2 coats.
   c. Aliphatic, acrylic polyurethane resin.

E. Copper - High-Performance Coating System
1. Location: Hangar Door Frieze elements to include but is not limited to corrugated copper sheet on the vertical surface as well as molded copper trim around the edges of the frieze.
2. Surface Preparation: Once cleaned to bare metal (or if new), surface must be free of grease, oil, dirt, fingerprints, drawing compounds and surface passivation treatment chemicals prior to coating application.
3. Primer:
   a. Product:
      1) Sherwin Williams, CC-A2 Industrial Wash Primer, or equal.
      2) Substitutions: Section 01 60 00 - Product Requirements.
   b. 1 coat.
   c. Industrial wash primer.
4. Top Coat:
   a. Product:
      1) Sherwin Williams Pro Industrial™ Industrial Enamel HS Alkyd Gloss B54-Z1400 Series, or equal.
      2) Substitutions: Section 01 60 00 - Product Requirements.
   b. 2 coats.
   c. Industrial enamel or silicone alkyd enamel.

F. Wood - High-Performance Coating System
1. Location: Windows, Roof Decking.
2. Surface Preparation: Sand and clean as-needed.
3. Primer:
   a. Product:
      1) Sherwin Williams, Exterior Latex Waterbased Wood Primer B42W08141, or equal.
      2) Substitutions: Section 01 60 00 - Product Requirements.
   b. 1 coat.
   c. Waterbased Latex Primer.
4. Topcoat:
   a. Product:
      1) Sherwin Williams, Pro Industrial™ Waterbased Alkyd Urethane Enamel Gloss B53-1050/2050 Series, B53-2250 Series, or equal.
      2) Substitutions: Section 01 60 00 - Product Requirements.
   b. 2 coats.
   c. Waterbased Alkyd Urethane Enamel.
   d. Sheen: Gloss for windows, Low Sheen/Matte for roof decking.

G. Shellac: Pure, white type.

2.02 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of coated surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Do not begin application of coatings until substrates have been properly prepared.

C. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.

D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

3.02 PREPARATION

A. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.

B. Clean surfaces of loose foreign matter.

C. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.

D. Remove finish hardware, fixture covers, and accessories and store.

E. Existing Painted and Sealed Surfaces:
   1. Strip existing paint and coatings from surface.
   2. Clean with mixture of trisodium phosphate and water to remove surface grease and foreign matter.

3.03 PRIMING

A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

3.04 COATING APPLICATION

A. Apply coatings in accordance with manufacturer's written instructions, to thicknesses specified and recommendations in MPI - Architectural Painting and Specification Manual.

B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

3.05 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for general requirements for field inspection.

3.06 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

B. Clean surfaces immediately of overspray, splatter, and excess material.

C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

D. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

3.07 PROTECTION

A. Protect finished work from damage.

END OF SECTION

DIVISION 10 -- SPECIALTIES

SECTION 10 28 00
TOILET ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial toilet accessories.

B. Utility room accessories.

1.02 RELATED REQUIREMENTS

A. Section 09 30 00 – Tiling.

B. Section 22 40 00 - Plumbing Fixtures: Under-lavatory pipe and supply covers.

1.03 REFERENCE STANDARDS

A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.

B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

C. ASTM C1036 - Standard Specification for Flat Glass; 2021.

D. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.05 SUBMITTALS

A. See Section 01 33 23 Submittal Procedures, for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.01 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

B. Keys: Provide keys for each accessory to Government (coordinate number of keys with CO); master key lockable accessories.

C. Stainless Steel Sheet: ASTM A666, Type 304.

D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.

E. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

F. Adhesive: Two component epoxy type, waterproof.

G. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

2.02 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

2.03 COMMERCIAL TOILET ACCESSORIES

A. Toilet Paper Dispenser: Double roll, surface mounted bracket type, stainless steel, eccentric-shaped plastic spindle for 1/2 revolution delivery designed to prevent theft of tissue roll.
   1. Product:
      a. Bobrick, Surface-Mounted Multi-Roll Toilet Tissue Dispenser, B-2888, or equal.
      b. Substitutions: Section 01 67 00 - Product Requirements.

B. Combination Towel Dispenser/Waste Receptacle: Recessed flush with wall, stainless steel; seamless wall flanges, stainless steel piano hinge, flush tumbler locks.
   1. Waste receptacle liner: Reusable, heavy-duty vinyl.
   2. Towel dispenser capacity: 600 C-fold or 800 multifold.
   3. Waste receptacle capacity: 3.8 gallons (14.4 liters).
   4. Products:
      a. Bobrick, TrimLineSeries Recessed Paper Towel Dispenser and Waste Receptacle, B-38034, or equal.
      b. Substitutions: Section 01 67 00 - Product Requirements.

C. Automated Soap Dispenser: Liquid soap dispenser, wall-mounted, with stainless steel cover and window to gauge soap level, tumbler lock.
   1. Minimum Capacity: 30 ounces (.85 liters).
   2. Products:
      a. Bobrick, Automatic Wall-Mounted Soap Dispenser, B-2012, or equal.
      b. Substitutions: Section 01 67 00 - Product Requirements.

D. Mirrors: Stainless steel framed, 1/4 inch (6 mm) thick annealed float glass; ASTM C1036.
   1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
   2. Size: 18"x30".
   3. Frame: .5 inch (12.7 mm)channel shapes, with mitered and welded and ground corners, and tamperproof hanging system; bright polished finish.
   4. Products:
      a. Bobrick, Mirror with Stainless Steel Channel Frame, B-165, or equal.
      b. Substitutions: Section 01 67 00 - Product Requirements.

E. Grab Bars: Stainless steel, smooth surface.
   1. Standard Duty Grab Bars:
      a. Push/Pull Point Load: 250 pound-force (1112 N), minimum.
      b. Dimensions: 1-1/2 inch (38 mm) outside diameter, minimum 0.05 inch (1.3 mm) wall thickness, concealed flange mounting, 1-1/2 inch (38 mm) clearance between wall and inside of grab bar.
      c. Finish: Satin.
      d. Length and Configuration: As indicated on drawings.
      e. Products:
         1) Bobrick, Fino Collection 1-1/2" Diameter Stainless Steel Grab Bars with Concealed Flange, B-9806, or equal.
         2) Substitutions: Section 01 67 00 - Product Requirements.

F. Coat Hook: Stainless Steel, surface-mounted, concealed mounting flange.
   1. Finish: Satin Stainless Steel.
   2. Products:

a. Bobrick, Coat Hook, B-9542, or equal.

G. Sanitary Napkin Disposal Unit: Stainless steel, recessed, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
1. Products:
a. Bobrick, Recessed Sanitary Napkin Disposal, B-353, or equal.
b. Substitutions: Section 01 67 00 - Product Requirements.

2.04 UTILITY ROOM ACCESSORIES

A. Combination Utility Shelf/Mop and Broom Holder: 18 gauge (1.2 mm) thick stainless steel, Type 304, with 3/4 inch (19.05 mm) returned edges, 16 gauge (1.6 mm) steel wall brackets, 8" shelf.
1. Hooks: Four, 16 gauge (1.6 mm) stainless steel rag hooks at shelf front.
2. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
3. Length: 34 inches (863.6 mm).
4. Products:
a. Bobrick, Utility Shelf with Mop/Broom Holders and Rag Hooks, B-239, or equal.
b. Substitutions: 01 67 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

C. Verify that field measurements are as indicated on drawings.

3.02 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
1. Grab Bars: As indicated on drawings.
2. Other Accessories: As indicated on drawings.

3.04 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

DIVISION 22 -- PLUMBING

SECTION 22 00 00
GENERAL PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.01 REFERENCE

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

1.02 DESCRIPTION

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

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

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

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

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

F. Where Architectural features govern location of work, refer to architectural drawings.

G. Contractor may install additional piping, fittings and valves, not shown on drawings, for testing purposes or for convenience of installation. Where such materials are installed, they shall comply with specifications and shall be sized to be compatible with system design. Remove such installed materials when they interfere with design conditions or as directed by Contracting Officer.

1.03 RELATED WORK

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

B. Continuity of Service:
   1. No service shall be interrupted or changed without permission from Contracting Officer and Owner. Obtain written permission before any work is started.

C. When interruption of services is required, Contracting Officer, Owner, and other concerned parties shall be notified and shall determine a time.

D. Demolition:
   1. Division 02 - Selective Demolition.
   2. Perform demolition as required to accomplish new work.
   3. Accomplish work in neat workmanlike manner to minimize interference, annoyance or inconvenience such work might impose on Owner or other Contractors.
   4. Unless otherwise noted, remove from premises materials and equipment removed in demolition work.
   5. Equipment noted to be removed and turned over to Owner, shall be delivered to Owner at place and time Owner designates.
   6. Where materials are to be turned over to Owner or reused and installed by Contractor, it shall be Contractor's responsibility to maintain condition of materials and equipment equal to that existing before work began. Repair or replace damaged materials or equipment at no additional cost to Owner.
   7. Where demolition work interferes with Owner's use of premises, schedule work through Contracting Officer, Owner and with other Contractor to minimize inconvenience to Owner. Contracting Officer must approve schedule before Contractor begins such Work.

E. Concrete Work:
   1. Provide cast-in-place concrete as required by Contract Documents unless otherwise noted.
   2. Concrete shall comply with Division 03 - Concrete.
   3. Provide anchor bolts, metal shapes and templates required to be cast in concrete or used to form concrete for support of mechanical equipment.

1.04 REQUIREMENTS OF REGULATORY AGENCIES

A. Rules and regulations of Federal, State and Local Authorities and utility companies, in force at time of execution of Contract shall become part of this specification.

1.05 REFERENCE STANDARDS

A. Agencies or publications referenced herein refer to the following:
   1. AMCA - Air Movement and Control Association
   2. ANSI - American National Standards Institute
   3. AHRI - Air-Conditioning, Heating and Refrigeration Institute
   4. ASHRAE - American Society of Heating Refrigerating and Air Conditioning Engineers
   5. ASPE - American Society of Plumbing Engineers
   6. ASSE - American Society of Sanitary Engineering
   7. AWS - American Welding Society
   8. AWWA - American Water Works Association
   9. ASME - American Society of Mechanical Engineers
   10. ASTM - American Society for Testing and Materials
   11. CDA - Copper Development Association
   12. CISPI - Cast Iron Soil Pipe Institute

13. FMG - FM Global
14. FS - Federal Specifications
15. IEEE - Institute of Electrical and Electronics Engineers
16. MCA - Mechanical Contractors Association
17. MSS - Manufacturers Standardization Society
18. NEC - National Electrical Code
19. NEMA - National Electrical Manufacturers Association
20. NFPA - National Fire Protection Association
21. NIST - National Institute of Standards & Technology
22. NSF - National Sanitation Foundation
23. NSPI - National Spa and Pool Institute
24. OSHA - Occupational Safety and Health Administration
25. PDI - Plumbing and Drainage Institute
26. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
27. UL - Underwriters Laboratories, Inc.
28. WQA - Water Quality Association

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

1.06 SUBMITTALS

A. Product Data:
1. Refer to Division 01 - Submittal Procedures.
2. Submit for equipment and systems as requested in the respective specification sections.
3. Unless otherwise indicated submittals shall be in electronic Portable Document Format (pdf) and bookmarks shall be included to facilitate navigation through submittal documentation.
4. Specifically mark general catalog sheets and drawings to indicate specific items submitted and its correlation to specific designation for product in drawings.
5. Specifically indicate proper identification of equipment by name and/or number, as indicated in specification and shown on drawings.
6. When manufacturer's reference numbers are different from those specified, provide correct cross-reference numbers for each item. Clearly mark and note submittals accordingly.
7. Submit complete record of required components when fixtures, equipment and items specified include accessories, parts and additional items under one designation.
8. Include composite wiring diagrams for electrically powered equipment and devices.
9. Where submittals cover products containing non-metallic materials, include "Material Safety Data Sheet" (MSDS) from manufacturer stating physical and chemical properties of components and precautionary considerations required.
10. Submit shop drawings or product data as soon as practicable after signing contracts. Submittals must be approved before installation of materials and equipment.
11. Submittals that are not complete, not permanent or not properly checked by Contractor will be returned without review.

B. Certificates and Inspections:

1. Obtain and pay for inspections required by authorities having jurisdiction and deliver certificates approving installations to Owner unless otherwise directed.

C. Operation and Maintenance Manuals:

1. Refer to Division 01 - Operation and Maintenance Data.
2. Upon completion of Work but before final acceptance of system, submit to Contracting Officer for approval, electronic version of operation and maintenance manuals in pdf format. 2" Electronic file shall contain bookmarks for each submittal contained in manual.
3. Organize manuals by specification section number and furnish table of contents and tabs for each piece of equipment or system.
4. Fire protection system shall be separately bound.
5. Manuals shall include the following:
   a. Copies of Shop Drawings and Product Data
   b. Manufacturer's operating and maintenance instructions. Include parts lists of items or equipment, with component exploded views and part numbers. Where manufacturer's data includes several types or models, designate applicable type or model.
   c. Electronic versions of O&M data with exploded parts lists where available
   d. Phone numbers and addresses of local parts suppliers and service companies
   e. Internet/WEB page addresses where applicable
   f. Wiring diagrams
   g. Startup and shutdown procedures
   h. Composite electrical diagrams
   i. Flow diagrams
   j. Lubrication instructions
   k. Factory and field test records (Refer to Test and Balancing in Part 3 of this section.)
   l. Valve identification charts as specified in Section 22 05 53 - Plumbing Systems Identification
   m. Access panel identification charts as specified in Section 22 05 53 - Plumbing Systems Identification
   n. Additional information, diagrams or explanations as designated under respective equipment or systems specification sections.
6. Instruct Owner's Representative in operation and maintenance of equipment. Instruction shall include complete operating cycle on all apparatus.
7. Furnish O&M Manuals and instructions to Owner prior to request for final payment.

D. Record Documents:

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

1.07 JOB CONDITIONS

A. Building Access:

1. Arrange for necessary openings in building to allow for admittance of all apparatus.

B. Electrical Coordination:

1. Electrical Contractor will make connections, from power source to starter or variable frequency drive and from starter or variable frequency drive, where specified, to motor.
2. Where starters or other similar control devices are furnished by this Contractor, they shall be installed by this Contractor and wired by Electrical Contractor.
3. Should any change in size, hp rating, voltage, or means of control be made to any motor or other electrical equipment after Contracts are awarded, this Contractor shall immediately notify Electrical Contractor of change. Additional costs due to these changes shall be responsibility of this Contractor.

C. Cutting and Patching:

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

D. Housekeeping and Cleanup:

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

1.08 WARRANTY

A. Refer to Division 01 for general warranty requirements.

B. Refer to technical sections for warranty requirement for each system.

1. Where no warranty requirements are called out, warrant equipment, materials, and workmanship to be free from defect as called out in Division 01.

C. Warrant that systems will operate without objectionable noise, vibration and uncontrolled expansion.

D. Repair, replace or alter systems or parts of systems found defective at no extra cost to Owner.

E. In any case, wherein fulfilling requirements of any warranty, if this Contractor disturbs any work warranted under another contract, this Contractor shall restore such disturbed work to condition satisfactory to Contracting Officer and warranty such restored work to same extent as it was warranted under such other contract.

F. Warranty shall include labor, materials, and travel time.

PART 2 - PRODUCTS

2.01 PRODUCT SUBSTITUTIONS

A. Refer to Division 01 - Product Requirements.

PART 3 - EXECUTION

3.01 GENERAL

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

B. Size of pipe segments shall be equal to largest pipe segment to which it is connected where size for pipes are not indicated. Transition to smaller size shall occur on side of fitting where smaller size is indicated.

3.02 DELIVERY, STORAGE, HANDLING, AND PROTECTION

A. Deliver products to the site under provisions of Division 01.

B. Store and protect products under provisions of Division 01.

C. Store in clean, dry space.

D. Maintain factory wrapping or provide cover to protect units from dirt, water, construction debris, and traffic.

E. Handle in accordance with manufacturer's written instructions.

F. Handle carefully to avoid damage to components, enclosure, and finish. Lift only with lugs provided for the purpose.

G. Provide supplemental heat if required to prevent equipment from moisture contamination.

H. Protect openings in equipment until connected to system to prevent entry of foreign materials.

3.03 EXCAVATION AND BACKFILL

A. Refer to Division 31 - Earthwork.

B. Provide excavation and backfill for underground work unless otherwise indicated. Blasting is not allowed on this project without written permission of Contracting Officer and Owner.

C. Backfill trenches beneath concrete floor and stair slabs within building and beneath concrete slabs, walks, stairs and drives at exterior of building with gravel fill and compact to same density as surrounding area.

3.04 FLOOR, WALL, ROOF AND CEILING OPENINGS

A. Coordinate location of openings, chases, furred spaces, etc., with appropriate Contractors. Provide sleeves and inserts that are to be built into structure during progress of construction.

B. Remove temporary sleeves, if used to form openings, prior to installation of permanent materials. Utilize minimum 24 ga galvanized sheet metal for permanent sleeves unless otherwise noted.

C. Provide Schedule 40 carbon steel pipe with integral water stop and 2" extension above floor slab for steel sleeves required in interior floor slabs.

D. Submit to Structural Engineer for review and approval size and location of core-drilled holes prior to execution.

E. Submit product data and installation details for penetrations of building structure. Include schedule indicating penetrating materials (metal pipe, plastic pipe, conduit, etc.), sizes of each, opening sizes and sealant products intended for use.

F. Where penetrations of fire-rated assemblies are involved, seal penetrations with appropriate firestopping systems as specified in Division 07 Thermal and Moisture Protection.

G. Submit complete penetration layout drawings showing openings in building structural members including floor slabs, bearing walls, shear walls, etc. Indicate and locate, by dimension, all required openings, including those sleeved, formed or core drilled. Drawings shall be approved prior to preparing openings in structural member.

H. Provide minimum 1" clearance around penetration openings intended for pipe. Where fire resistant penetrations are required, size openings in accordance with written recommendations of firestopping systems manufacturer.

I. Openings for underground pipes passing through foundations or under footings shall have minimum clearance of 1-1/2" to concrete. Do not disturb footing bearing soil.

J. Openings for underground pipe passing through on grade concrete slabs shall have minimum 1/4” clearance to concrete. Seal openings with urethane caulk.

K. Openings for insulated piping shall be sized based on outside diameter of insulation when it is specified or detailed to be continuous through opening.

L. Seal non-fire-rated floor penetrations with non-shrink grout equal to Embeco by Master Builders, or urethane caulk, as appropriate.

M. Seal non-fire-rated wall openings with urethane caulk.

N. Where penetrations occur through exterior walls into building spaces, use sleeves with integral water stop. For piping having outer surface temperature less than 150°F, use plastic (HDPE) sleeves, similar to PSI Link-Seal Model CS, rated to 150°F. For piping having outer surface temperature 150°F or higher, or where steel sleeves are shown or walls are fire rated, use steel sleeves with hot dip galvanizing, similar to PSI Link-Seal Model WS. Seal annular space between sleeves and pipe with Thunderline "Link-Seal" modular wall and casing seals, or sealing system by another manufacturer approved as equal by Contracting Officer. Where "Link-Seals" are used with insulated pipe, insulation shall be butted against seals on both sides. Sealing system shall utilize Type 316 stainless steel bolts, washers and nuts.

O. In lieu of openings as specified herein penetration systems as manufactured by Pro Set may be used, including sleeve couplings and plug.

P. If total ProSet system with Water Guard “CR” is used, opening shall not need additional water proofing or riser clamps.

Q. Finish and trim penetrations as shown on details and as specified.

R. Provide chrome or nickel-plated escutcheons where piping passes through walls, floors or ceilings and is exposed in finished areas. Size escutcheons to fit pipe and pipe covering for finished appearance. Finished areas shall not include mechanical/electrical rooms, janitors' closets, storage rooms, etc., unless suspended ceilings are specified.

3.05 EQUIPMENT SHUTOFF VALVES

A. Provide shutoff valves at equipment connected to piping system. Refer to valve section or system section for requirements of valve type.

3.06 EQUIPMENT ACCESS

A. Install piping, conduit and accessories to permit access to equipment for maintenance. Relocate piping, equipment or accessories to provide access at no additional cost to Owner.

B. Install equipment with sufficient maintenance space for removal, repair or changes to equipment. Provide ready accessibility to equipment without moving other future or installed equipment (including light fixtures) or system components.

C. Access doors in walls, chases, or inaccessible ceilings will be provided under Division 08 - Access Doors and Frames, unless otherwise indicated. Access doors for valves, shock stops or other equipment shall provide access for servicing, repairs, and/or maintenance.

D. Provide necessary coordination and information to the Trade Contractor under Division 08 - Access Doors and Frames. This information shall include required locations, sizes, and rough-in dimensions.

E. Provide access doors in walls, chases or above inaccessible ceilings for valves, shock stops, unions or equipment/devices requiring access for servicing, repairs or maintenance, unless otherwise noted. Access frames and doors shall be as manufactured by Milcor, Incorporated, or similar, of style applicable to surface. Provide access doors used in fire rated construction with UL (FRD) Label. Provide steel, prime coated access doors unless otherwise specified. Provide stainless steel doors in ceramic tile walls, toilet rooms, locker rooms and in areas subject to excessive moisture. Provide access doors of sufficient size to allow complete maintenance. Coordinate location of access doors with General Contractor and rough-in equipment accordingly.

3.07 EQUIPMENT SUPPORTS

A. Provide supporting steel not indicated on drawings as required for installation of equipment and materials including angles, channels, beams, hangers, etc.

3.08 EQUIPMENT GUARDS

A. Provide equipment guards over belt driven assemblies, pump shafts, exposed fans, and elsewhere as indicated in this Specification or required by Code.

B. Paint equipment guards bright yellow.

C. Equipment guards shall comply with OSHA requirements.

3.09 SUPPORT PROTECTION

A. In occupied areas, mechanical rooms and areas requiring normal maintenance access, guard certain equipment to protect personnel from injury.

B. Provide minimum 1/2" thick Armstrong Armaflex insulation or similar product applied with Armstrong 520 adhesive on lower edges of equipment and mechanical supporting devices suspended less than 7 ft above floors, platforms or catwalks in these areas.

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

3.10 PLUMBING SYSTEMS IDENTIFICATION

A. Refer to Section 22 05 53 - Plumbing Systems Identification

3.11 START-UP

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

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

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

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

E. Coordinate start-up with all trades.

3.12 CLEANING

A. Clean systems after installation is complete.

B. Clean piping and ductwork both internally and externally to remove dirt, plaster dust or other foreign materials. When external surfaces of piping are rusted, clean and restore surface to original condition.

C. Clean pipeline strainers to restore them to original condition or replace with new strainer elements.

D. Clean equipment and plumbing fixtures as recommended by manufacturers.

E. Replace throwaway or replaceable media air filters used during construction period with new filters or new filter media after construction has been completed and before building is turned over to Owner. Filter replacement shall be as hereinafter specified.

F. Blow and clean dirt, plaster dust and other foreign matter from coils, terminal devices, diffusers, registers and grilles.

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

H. Provide additional cleaning of individual piping systems and apparatus as hereinafter specified.

END OF SECTION

SECTION 22 05 20
PLUMBING EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section lists methods and materials for trench excavation and backfill for plumbing piping systems inside and outside the building.

1.02 RELATED WORK

A. Division 31 - Earthwork

1.03 REFERENCE

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

1.04 SUBMITTALS

A. List of materials to be used for backfill.

PART 2 - PRODUCTS

2.01 FILL MATERIAL

A. Intact native topsoil from the project area shall be retained whenever feasible. Should additional fill be needed, all fill must be of quality suitable for use in a National Park Unit. Any new soils/sediment brought on site must be tested and meet New York State Department of Environmental Conservation standards for general fill (6 CRR-NY 360.13). Any fill materials required for the project must be obtained from a park-approved source. Soils should not be amended.

B. Type 1 Fill:
   1. Material from excavation separated from materials, which do not compact by tamping and rolling. No stones larger than 3” and no building, organic, corrosive or frozen materials.

C. Type 2A Fill:
   1. Sand or gravel materials with none larger than 2” and of that portion passing #4 sieve less 5% to pass #200 sieve.

D. Type 2B Fill:
   1. Sand or gravel materials with none larger than 1/2” and of that portion passing #4 sieve less 5% to pass #200 sieve.

E. Type 3 Fill:
   1. Gravel of rounded to subangular shape, screened, which will pass 0.75” sieve and retained on #4 sieve.

F. Type 4 Fill:
   1. Pit run rock or gravel with maximum stone size of 1”.

G. Type 5 Fill:
   1. Pea gravel, screened, which will pass 0.375” sieve and retained on #4 sieve.

H. Type 6 Fill:
   1. Soils Engineer approved fill material, backfilled and compacted beneath building footprint.

PART 3 - EXECUTION

3.01 PREPARATION

A. Establish grade lines and locations of mains and manholes. Provide necessary stakes and batter boards.

B. Verify invert elevations of existing utilities prior to excavation for new utility piping.

3.02 EXCAVATION

A. Provide excavation for all underground work, including piping, manholes, catch basins, tanks, concrete structures, etc., unless otherwise shown or specified. Lay piping in open trench except when Contracting Officer gives written permission for tunneling.

B. Include all necessary clearing; tree removal; grubbing; pavement removal; substructure removal such as walls, footings and piers and all incidental work such as tunneling, sheet piling, shoring, underpinning, pumping, bailing and transportation. Coordinate excavation extending beyond construction limits with Contractor and Owner.

C. Blasting is not allowed on this project without written permission of Contracting Officer and Owner.

D. Use mechanical methods to remove rock in trenches for piping systems.

E. Include rock excavation in the Bid unless otherwise indicated.

3.03 PIPE INSTALLATION

A. Keep underground piping to proper line and grade and sealed at all times to prevent entrance of animals or foreign matter.

B. Provide bracing and sheet piling as necessary to support trenches. Comply with Local Regulations, applicable provisions of OSHA Regulations on trenching, or with provisions of “Manual of Accident Prevention in Construction” published by Associated General Contractors of America.

C. Under no circumstances lay pipe or install appurtenances in water. Keep trench free from water until pipe joint material has hardened.

D. Presence of ground water in soil or necessity of sheet piling or bracing trenches shall not constitute condition for which any increase may be made in Contract price, except when sheet piling is left in place on written order of Owner, Contract price will be adjusted.

E. Cut off sheet piling left in place not less than 2” below new finished grade. Do not remove sheet piling until trench is substantially backfilled.

F. Install underground plastic pipe per ASTM D2321.

G. Place underground piping outside and inside building in open excavated trenches. Where trench bottom does not contain stones larger than 1” in size or where bedrock is not encountered, trench may be excavated to final pipe grade. Where bedrock or stones larger than 1” is encountered, excavate entire length of trench to depth 4" below final pipe grade elevation and provide 4" of pipe bedding material compacted to minimum of 90% Standard Proctor Density consisting of Type 2B, 3 or 5 fill to establish final pipe grade. Shape bedding for clearance for all joints and fittings, tamped in place and graded evenly to ensure uniform bearing for full length of pipe. Do not support piping by blocking, planking or mounding of bedding material.

3.04 BACKFILL

A. Exterior:

1. Backfill outside building including all piping beyond construction limits only after piping and appurtenances have been inspected, recorded, tested and approved. Backfill around pipe by hand to depth of 12” above top of pipe with Type 2B, 3 or 5 fill in 6" layers. Take care not to disturb pipe or damage pipe coating. Compact backfill thoroughly with compactor of suitable weight or with approved mechanical tamper. No flooding or jetting with water is allowed.
2. Place backfill from 12” above pipe in layers not exceeding 8" in depth with Type 1 fill. Compact backfill material to the same density as surrounding area prior to that of excavation.
3. When excavating through areas which are to become walks, roads, driveways or parking areas of concrete, bituminous or exposed gravel surfacing or such areas are existing to remain; backfilling from 12” above pipe to subgrade shall be with Type 2A, 2B, 3 or 4 fill. Backfill in 12” layers and compact with mechanical means to density 95% modified proctor. Frequency of compaction testing shall be determined by testing consultant, based on site conditions, materials and workmanship.
4. When excavation occurs on public property or areas beyond property line, all excavation, pipe laying, backfilling, grading and surfacing shall conform as herein specified, except additional requirements for public utility or other authorities shall be complied with when in order. Check with each utility and incorporate cost of any additional requirements in Base Bid.

B. Interior:

1. Backfill inside building only after piping and appurtenances have been inspected and approved. Backfill to 12” above pipe with Type 2B, 3 or 5 fill in 6" layers. Remainder of backfill shall be Type 2A, 2B, 3, 4, or 6 fill in 12" layers.
2. Install lines passing under foundations with minimum of 1-1/2” clearance to concrete and ensure there is no disturbance of bearing soil.
3. Backfill piping suspended from slab on grade with Type 2B or 5 fill in 6” layers. Same fill materials shall be provided for 12” minimum on each side of pipe.

3.05 ROCK EXCAVATION

A. Consider material over 1 yd^3 in size encountered during excavation as rock. Rock excavation will be paid as extra if it cannot be removed by 200 net hp (150 net kW) crawler tractor with ripper attachment all in good running condition and operated by an experienced individual.

B. Excavate rock to 4” below intended pipe invert.

3.06 FINISHING

A. On completion of trenching and backfilling operations, restore grades to original elevation or to new subgrade elevation.

B. When trenching is through existing areas or beyond constructions limits, replace surfaces to existing conditions.

C. In landscaped areas use 6” of topsoil and sod to match existing elevations, or as otherwise approved by Landscape Architect.

END OF SECTION

SECTION 22 05 29
PLUMBING PIPING AND EQUIPMENT SUPPORTING DEVICES

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 22 07 00 - Plumbing Systems Insulation

1.02 REFERENCE

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

1.03 DESCRIPTION

A. Provide all supporting devices not provided as part of building structure or indicated on structural drawings or structural details, as specified and as required for proper supporting, anchoring, and guiding of piping, equipment, materials and systems.

B. Support for all conditions of operation, including variations in installed and operating weight of equipment, piping and ductwork, to prevent excess stress and allow for proper expansion and contraction.

1.04 SUBMITTALS

A. Product Data for each piping system for all pipe sizes and all applicable equipment including the following:
   1. Manufacturer's name
   2. Model numbers
   3. Materials of construction and load ratings lbs.
   4. Schedule of hangers and support devices with pipe support spacing
   5. Insulated pipe supports along with application chart or table including pipe support spacing.
   6. Insulation protection saddles and weight bearing insulation table
   7. Details and calculations for sizing supplementary steel utilized for trapeze or specially designed supports
   8. Structural attachments, inserts, and concrete anchors. Submit ICC-ES Evaluation Report for each type of anchor.
   9. Calculations and drawings for concrete inserts and anchors for each application
   10. Drawings showing specific locations of any weld attachments to structure, including weight supported by such attachments
   11. Drawings showing specific locations of any suspended loads which exceed 100 lbs within joist chord panel to be attached to open web steel joist structural members. Include weight supported by such attachments. (Panel is length of chord between two adjacent diagonal web members at point of connection to chord.)
   12. Equipment mounting devices
   13. Pipe guides and anchors

14. All other appropriate data

B. Submittals in PDF format shall be organized using PDF bookmarks per detailed instructions on assembling submittal packages identified under Submittal Requirements section of 22 00 00 - General Plumbing Requirements.

1.05 DESIGN CRITERIA

A. Materials and application of pipe hangers and supports shall conform to the latest requirements of ANSI B31/ASME B31.1 Code for Pressure Piping and MSS Standard Practice SP-58-2018 (Pipe Hangers and Supports Materials, Design, Manufacture, Selection, Application, and Installation), except as supplemented or modified herein.

B. Support materials shall be steel or stainless steel unless specifically indicated.

C. Support devices shall be factory fabricated and have published load ratings.

D. Unless otherwise indicated, design supports, anchors, and related components with safety factor in accordance with AISC Manual of Steel Construction, but not less than 2.0.

E. Determine maximum deflection using the following equation.

F. Maximum deflection of support members, including trapeze supports, shall be in accordance with the following equation, but shall not exceed 0.3":

D = L/240

Where D = Max deflection in "

L = Support member length in "

G. Unless otherwise indicated, hangers, support devices and hardware shall be steel and shall have factory standard black, primed, galvanized or electroplated finish for indoor application, and hot-dipped galvanized finish for outdoor application and corrosive atmospheres. Coat cut edges, welds or any damaged finish with galvanized paint.

1. Corrosive atmospheres include the following locations:
   a. Exterior locations
   b. Chemical storage and hazardous waste storage rooms
   c. Food service/kitchen areas
   d. Locker/shower rooms
   e. Meter pits
   f. Utility tunnels
   g. Cage washroom (dirty and clean)
   h. Sterilizer/autoclave room

H. Materials in contact with pipe shall be galvanically compatible with piping material to eliminate conductive path for galvanic corrosion. Provide galvanic separation, such as nonmetallic coating or inserts between piping and metallic supports where piping and support materials have galvanic potential. Pipe insulation is acceptable galvanic separation. Galvanic potential shall be determined by table below:

	Galvanized Steel	**Carbon Steel**	**Stainless Steel (Type 304 or 316)**	**Copper Brass Bronze**
Copper, Brass, Bronze	Yes	Yes	No	NA
Stainless Steel (Type 304 or 316)	Yes Note (1)	Yes Note (1)	NA	
Carbon Steel	No	NA		
Galvanized Steel	NA			

(1) Required where stainless steel surface area near interface is equal or greater than steel surface area

I. Unless otherwise indicated, steel support devices exposed to ventilation air stream shall be stainless steel or steel with either galvanized finish or paint finish. Paint type shall be approved by Contracting Officer/ Engineer.

J. This Contractor is responsible for proper placement and sizing of supporting devices to accommodate insulation thickness and pitching of pipe. Coordinate with Contractor performing work specified in Section 22 07 00 - Plumbing Systems Insulation.

K. In addition to hangers specified in this Section, piping connected to pumps, compressors, and similar rotating or reciprocating equipment shall have vibration isolation hangers or supports for specified distance from such equipment. Refer to Section 23 05 50 - Vibration Isolation for required distance.

L. Where piping can be conveniently grouped to allow trapeze type supports, supporting steel shall be by means of standard structural shapes.

M. Hangers and rods shall be plumb when pipelines are at their normal operating temperatures.

N. Unless otherwise indicated, continuous insert channels are not allowed.

O. Punching, drilling, or welding of building structural steel is not allowed unless approved by Structural Engineer.

P. Refer to Structural Documents and ICC-ES Evaluation Report for application of concrete inserts and concrete anchors.

Q. Lateral braces shall be designed and detailed to apply loads as directly as possible to structural floor slabs, roof decks, or other building lateral elements. Braces shall not be applied to bottom flanges of steel beams or bottom chords of open web steel joists.

R. Coordinate with Contractor for any proposed weld attachments to building structure. This may result in use of welding codes or standards, which may apply to "structural work". and may necessitate repair of fireproofing and/or extension of fireproofing to support members. Execution of this work may be assigned to General Trades responsible for building structural steel. Cost for this work, however, will remain the responsibility of this Contractor.

S. Top or bottom chords of open web steel joists may be used to support loads, provided total load within panel does not exceed 100 lbs and load is placed concentric to joist. (Panel is length of chord between two adjacent diagonal web members at point of connection to chord).

T. Where fire rated fiberglass products are used for channel and support devices, the following properties shall apply:
   1. Flame Spread Properties
      a. Polyester Fiberglass (PF) Class 1 ASTM E84
      b. Vinylester Fiberglass (VF) Class 1 ASTM E84

U. Fasteners including concrete anchors for seismic application shall have ICC Evaluation Service Report (ESR) and meet requirements of local authorities.

PART 2 - PRODUCTS

2.01 STRUCTURAL SUPPORTS

A. Unless specifically indicated on structural drawings, design and provide all supporting devices including miscellaneous steel (angles, channels, beams, etc.), required for proper support of piping, equipment and materials.

2.02 PIPE HANGERS AND SUPPORTS (METALLIC)

A. Manufacturers: Anvil or, equal . Corresponding MSS Type is indicated where applicable.

B. Clevis and Roller Type Hangers:

System	Pipe Size	Clevis	Roller
Hot Pipes with Insulation (105°F and above)	2" and smaller	65 (MSS Type-1), 260 (MSS Type-1)	---
	2-1/2" to 6"	---	171 (MSS Type-41), 181 (MSS Type-43)
	8" and larger	---	171 (MSS Type-41)
Ambient Bare Pipes (61°F to 104°F)	2"and smaller	65 (MSS Type-1), 260 (MSS Type-1)	---
	2-1/2" and larger	260 (MSS Type-1), 216 (MSS Type-4)	---
	2"and smaller	65 (MSS Type-1), 260 (MSS Type-1)	---

Cold Pipes with Insulation (33°F to 60°F)	2-1/2" and larger	260 (MSS Type-1), 295 (MSS Type-1)	---
Cold Pipes with Insulation 32°F and below)	2" and smaller	65 (MSS Type-1), 260 (MSS Type-1)	---
	2-1/2" to 6"	260 (MSS Type-1)	171 (MSS Type-41), 181 (MSS Type-43)
	8" and larger	---	171 (MSS Type-41)

1. For pipe size 2-1/2" and larger, where there is transverse movement at support points due to thermal expansion/contraction, clevis type hangers similar to Anvil Figure 260 (MSS Type-1) may be used if vertical angle of hanger rod is less than 4°.

C. Flat Surfaces (Trapeze, Rack Type):

1. Use structural steel members such as struts, angles, channels and beams to support pipes as required. Select members properly for pipe support types and loading conditions. Refer to Part 1 for design criteria. Submit support details with type of members selected and load calculations. Provide straps, clamps, rollers or slides indicated below at each support point.

System	Pipe Size	Straps or Clamps	Rollers	Slides
Hot Pipes with Insulation (105°F and above)	2"and smaller	Anvil Klo-Shure	---	
	2-1/2"and larger	---	171 or 177(MSS Type-41), 271 (MSS Type-45), 274 (MSS Type-46)	257 or 436 with 212 or 432 clamps, Type 1, 2 or 3 for longitudinal movement only. Type 4, 5 or 6 for both longitudinal and transverse movement
Ambient Bare Steel Pipes (61°F to 104°F)	6" and smaller 8" and larger	B-Line BVT Unistrut Cush-a-Clamp	---	---
Ambient Bare (Copper) pipes (61°F to104°F)	all sizes	B-Line BVT Unistrut Cush-a – Clump		
	10" and smaller	137 (MSS Type-24)	---	---

Cold Pipes with Insulation (33°F to 60°F)	12" and larger	432	171 or 177 (MSS Type-41), 271 (MSS Type-45), 274 (MSS Type-46)	257 or 436 with 212 or 432 clamps, Type 1, 2 or 3 for longitudinal movement only and Type 4, 5 or 6 for both longitudinal and transverse movement.
Cold Pipes with Insulation (32°F to 59°F) and below)	2" and smaller	243, 244	---	---
	2-1/2" and larger	---	171 or 177 (MSS Type-41), 271 (MSS Type-45), 274 (MSS Type-46)	257 or 436 with 212 or 432 clamps, Type 1, 2 or 3 for longitudinal movement only and Type 4, 5 or 6 for both longitudinal and transverse movement.

D. Vertical Pipe within Wall Cavities

1. Use clamps, straps, inserts or channels to support pipes concealed in wall cavity. Select members for pipe support types and loading conditions. Refer to Part 1 for design criteria.
2. Provide clamps, strut channels, insulated supports, or brackets and inserts equal to manufacturer indicated below:

System	Pipe Size	Supports	Clamps, Brackets/Inserts	Pre-insulated Inserts
Hot and Cold Pipes with Insulation	All sizes	Anvil 137	HoldRite 260 series with SBIS bracket, Anvil 262	Anvil Klo-Sure, Pipe Shields A2000
Ambient Bare Pipes (61°F to 104°F	All sizes	Anvil 137, 138-R	Anvil 262	---
Ambient Bare Copper Pipes (61°F to 104°F)	All sizes	Anvil CT-138R	HoldRite 260 series with SBIS bracket	---

2.03 INSULATION PROTECTION SHIELDS

A. Anvil Fig. 167 (MSS Type-40) constructed of galvanized carbon steel. Per the latest edition of Standard MSS SP-58, select shield to accommodate outer diameter of insulation. Shield length and gauge for insulation compression strength not less than 15 psi, shall be as follows:

Pipe Size	Length	Gauge
1/4" thru 3"	12"	18
4"	12"	16
5" and 6"	18"	16

Pipe Size	Length	Gauge
8" thru 14"	24"	14
16" thru 24"	24"	12

2.04 INSULATED PIPE SUPPORTS

A. Description:

1. Products designed specifically for weight-bearing support of insulated pipes. Apply products in accordance with manufacturer's recommendations and requirements indicated below:
2. Refer to PART 3 – EXECUTION for application of Type A, Type B, and Type C Insulated Pipe Supports specified below.

B. General:

1. Supports shall be designed and rated for applied load, including weight of pipe, fluid, insulation, and any other imposed loads, with minimum 1.5 safety factor. Ratings shall be published by manufacturer and included in submittals.
2. High compressive strength inserts utilized to support loads shall encircle circumference of pipe. Block-style inserts are not allowed.
3. Supports shall be suitable for hot or cold pipe service as applicable.
4. Submit chart or table indicating selected model along with pipe sizes, rated loads, support device types and support spacing for each piping system.
5. Pipe support spacing shall be in accordance with manufacturer's recommendations but shall not exceed maximum spacing indicated under Hanger and Support Spacing in Part 3 of this Section.
6. Testing of insulation for compressive strength properties shall comply with ASTM D1621.
7. Insulation thickness shall match adjacent pipe insulation thickness.
8. Integrity of vapor barrier jacket shall be maintained continuously through support assembly.
9. Insulated pipe support style shall be specifically selected for the application and shall consider the following criteria at minimum:
    a. Vertical, lateral and axial support design load limits.
    b. Vertical, lateral, and axial support design travel limits
    c. Test or pre-operational loads that may exceed normal operating conditions
    d. Material for any items that will be welded directly to the pipe
    e. Loading and displacements caused by seismic, hydraulic surge, or other forces
    f. Temperature at support steel
10. All steel components shall have corrosion protection coating consisting of hot-dip galvanizing or zinc-rich primer coating.

C. Type A Insulated Pipe Supports (Light Duty)

1. Description:
    a. Pipe insulation specified in Section 22 07 00 - Plumbing Systems Insulation with insulation protection shields specified in this Section. Weight-bearing inserts are not required.
    b. Type B or Type C supports may be utilized in lieu of Type A supports.

D. Type B Insulated Pipe Supports (Standard Duty):

1. Manufacturers:

   a. SNAPP ITZ insulation inserts by KB Enterprise or equal.

   b. Klo-Shure insulation couplings may be used for cold pipes insulated with elastomeric insulation. Mount shall be 7 Series Strup Mount with metal clamps or Clevis System for clevis hangers.

   c. Type C supports may be utilized in lieu of Type B supports”

   d. Contractor may propose to utilize contractor-fabricated insulated pipe supports in lieu of manufactured Type B Supports. Use of contractor-fabricated assemblies is subject to approval of appropriate submittal data. Submit detail drawings of assemblies and product data showing equivalency to specified manufactured products for approval.

2. Description:

   a. Load-rated assembly consisting of high compressive strength insulation material completely encompassing circumference of pipe, vapor barrier jacket, and insulation protection shield.

   b. Insulation protection shield shall conform to ANSI/MSS SP-58. Shield shall be G90 galvanized steel and shall span full circumference of pipe insulation. Half-shields spanning lower 180° degrees arc of insulation outer circumference will be acceptable when used with clevis hangers.

   c. Axial length of insulation material shall be not less than 9" or 2" longer than insulation protection shields (1" minimum on each end), whichever is longer.

3. Insulation Materials:

   a. Hot Pipes 105°F to 250°F:

      1) Rigid closed cell, polyisocyanurate or phenolic insulation by ITW, Resolco, or Kingspan. Minimum compressive strength shall be 100 psi.

   b. Hot Pipes 251°F to 1200°F:

      1) High-density calcium silicate insulation similar to Johns Manville Thermo-12 Gold. Minimum compressive strength shall be 100 psi.

   c. Cold Pipes 60°F and below:

      1) Rigid closed cell, polyisocyanurate, phenolic insulation similar to ITW, Resolco, Kingspan, or cellular glass insulation similar to Pittsburgh Corning Foamglas.

2.05 HANGER RODS (METALLIC)

A. Rods shall conform to the latest MSS Standards except as modified herein. Furnish rods complete with adjusting and lock nuts.

B. Rods shall have electroplated zinc or hot dip galvanized finish.

C. Unless otherwise indicated, size rods for individual hangers and trapeze support as indicated in the following schedule. Rod size may be reduced one size for double rod hangers. Total weight of equipment, including valves, fittings, pipe, pipe content and insulation, shall not exceed limits indicated.

Max. Pipe Size with Single Rigid Rod	Rod Diameter inches	Max Load lbs of Hanger Rod (Not exceeding 650 °F Service Temp.)
2"	3/8	730
3"	1/2	1350
5"	5/8	2160
8"	3/4	3230

Max. Pipe Size with Single Rigid Rod	Rod Diameter inches	Max Load lbs of Hanger Rod (Not exceeding 650 °F Service Temp.)
12"	7/8	4480
18"	1	5900
30"	1-1/4	9500

D. Threaded rods are not allowed in clean rooms.

2.06 BOLTS, NUTS, STUDS AND WASHERS

A. ASTM A307, electroplated zinc finish

2.07 ROD ATTACHMENTS

A. Anvil Fig. 290 (MSS Type-17), galvanized finish

2.08 U-BOLTS

A. Anvil Fig. 137 (MSS Type-24), galvanized finish

2.09 BEAM CLAMPS

A. Beam Clamps: Anvil Fig. 133/134 (MSS Type-21), 218 (MSS Type-30), 228 (MSS Type-28 or 29) and 292 (MSS Type-28 or 29)

B. Top Beam Clamps: Anvil Fig. 227 (MSS Type-25)

C. C-Clamps: Anvil Fig. 86, 92 or 93 (MSS Type-19 or 23) with set screw and lock nut

2.10 ADJUSTABLE PIPE SADDLE SUPPORTS

A. Anvil Fig. 264 (MSS Type-38), galvanized finish. Provide Anvil Fig. 63 Type T stanchion with base, galvanized finish, where applicable.

2.11 RISER CLAMPS (BARE PIPE)

A. Anvil Fig. 261 (MSS Type-8), galvanized finish

B. B-Line B3373C, PVC coated carbon steel, in area at pipe contact, for bare copper tubing

C. Proset system, proseal plug and fire-fill for sleeved and cored holes.

2.12 RISER CLAMPS (INSULATED PIPE)

A. Unless otherwise indicated, insulated pipe riser clamps shall be Type C insulated pipe supports. Refer to Insulated Pipe Supports in Part 2.

B. Contractor may propose to utilize contractor-fabricated riser supports. Use of contractor-fabricated riser supports is subject to approval of appropriate submittal data. Submit support detail drawings, bearing stamp of Structural Engineer registered in project jurisdiction, for approval. Supports shall be engineered to withstand static and dynamic forces with minimum safety factor of 2.0. Submit insulation details addressing thermal break from building structure and vapor barriers.

2.13 CONCRETE ANCHORS

A. Manufacturers: Hilti or equal.

B. Anchors shall be selected, sized, and detailed by Contractor's structural engineer registered in project's jurisdiction, based on project conditions and in accordance with project building code. Calculations and drawings shall be submitted.

C. Anchors shall meet ICC Acceptance Criteria, and ICC-ES Evaluation Reports (ESRs) shall specifically list the current applicable codes.

D. Anchors installed in hardened concrete for purpose of transmitting structural loads from one connected element to another, or for safety related elements such as sprinkler pipes, heavy suspended pipes, and barrier rails shall have ICC-ES report demonstrating anchors have met requirements of AC 193 for mechanical anchors in concrete elements.

E. Post-installed expansion anchors and undercut anchors installed in hardened concrete shall be qualified for strength design and tested according to ACI 355.2. Designs shall be per the requirements of ACI 318, Appendix D.

F. Anchors for seismic load application shall be approved by ICC-ES Evaluation Reports to resist seismic loads and selected to meet project seismic design requirements. Refer to Section 22 05 48 - Plumbing Seismic Anchorage and Restraints and Structural drawings.

G. Anchors shall be zinc plated in accordance with ASTM B633.

H. Select anchors with load ratings based on cracked concrete conditions.

2.14 METAL FRAMING SUPPORT SYSTEM (STRUT SYSTEM)

A. Manufacturers: Unistrut or equal.

B. Channels shall have epoxy paint or electroplated zinc finish.

C. Channels shall not be lighter than 12 ga.

2.15 CASEWORK PIPE SUPPORTS

A. Hinged pipe clamp and Strutcatcher, nylon 12 Grilamid, Clic by Litchfield International.

B. Vibration isolation pipe clamp, yellow zinc chromate finish, B-Line BVT Series Vibraclamp or or equal.

2.16 FIXTURE SUPPLY SUPPORT

A. Acceptable manufacturers: Erico or equal.

B. Vertical Pipe Support:
   1. Galvanized steel stud support bracket, pre-drilled tube support mounting holes, adjustable stud width, Holdrite SB3 or equal.
   2. UV resistant nylon tube support, rated for (0-130°F through 0-130°F, resealable locking mechanism, Sioux Chief TouchDown clamp or equal.
   3. Support bracket and tube support to be from same manufacturer.

C. Through Stud Support:

1. Polypropylene stud insert for isolation of water tubing through metal wall studs, rated for maximum water temperature of 130°F, Sioux Chief 558 Series or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install supports to allow for free expansion of piping. Support piping from building structural members using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. At no time shall hangers and supports overload building structural members. Fasten ceiling plates and wall brackets securely to structure and test to demonstrate adequacy of fastening.

B. Select and size building attachments properly in accordance with MSS Standards and manufacturer's published load rating information.

C. Coordinate hanger and support installation to properly group piping of all trades.

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

E. Piping and ductwork shall be supported independently from other piping or ductwork.

F. Pipe hangers and supports shall not penetrate vapor barrier of pipe insulation.

G. Do not support equipment, or piping from metal roof decking or ceiling grid.

H. Install adequate supports so as not to over stress either piping or equipment to which piping is connected.

I. Refer to Section 22 00 00 - General Plumbing Requirements for requirements of personnel injury protection guards for supporting devices.

3.02 HANGER AND SUPPORT SPACING

A. Space pipe hangers and supports for horizontal pipe accordance with the following schedule, with exceptions as indicated herein:

B. Steel Pipe (Standard Weight and Extra Strong):

Pipe Size	Max Spacing
1-1/4" and smaller	7 ft-0"
1-1/2"	9 ft-0"
2"	10 ft-0"
2-1/"	11 ft-0"
3"	12 ft-0"
4"	14 ft-0"
6"	17 ft-0"
8"	19 ft-0"
10" and larger	20 ft-0"

C. Steel Pipe (Standard Weight and Extra Strong):

Pipe Size	Max Spacing
1-1/4" and smaller	7 ft-0"
1-1/2"	9 ft-0"
2"	10 ft-0"
2-1/2"	11 ft-0"
3" and larger	12 ft-0"

D. Copper Tube (Unless Otherwise Noted):

Pipe Size	Max Spacing
3/4" and smaller	5 ft-0"
1" to 1-1/4"	6 ft-0"
1-1/2" to 2-1/2"	8 ft-0"
3" and larger	10 ft-0"

E. Copper Tube (Domestic Water, Laboratory Water, Non-potable Water):

Pipe Size	Max Spacing
1-1/4" and smaller	6 ft-0"
1-1/2" and larger	10 ft-0"

F. Copper Tube (Domestic Water, Laboratory Water, Non-potable Water):

Pipe Size	Max Spacing
1-1/2" and smaller	6 ft-0"
2" and larger	10 ft-0"

G. Copper Tube (Medical Gases):

Pipe Size	Max Spacing
1/4"	5 ft-0"
3/8" and 1/2"	6 ft-0"
3/4"	7 ft-0"
1"	8 ft-0"
1-1/4"	9 ft-0"
1-1/2" and larger	10 ft-0"

H. Cast Iron Pipe:

1. Maximum hanger and support spacing shall be 10 ft for all pipe sizes. Provide minimum of one hanger per pipe section close to joint on barrel, at each pipe fitting, at change of direction and branch connections.
2. Support Cast Iron No-Hub pipe as recommended in CISPI Publication "Cast Iron Soil Pipe and Fittings Handbook, Chapter IV - Installation of Cast Iron Soil Pipe and Fittings."

I. Maximum spacing shown above may be restricted by strength of attachment to building structure. Submit data with calculations with published load ratings showing attachment to be utilized and maximum spacing allowable for that type of attachment and pipe size.

J. Spacing less than indicated above may be required to conform to building structure design or loading limitations.

K. Spacing less than indicated may be required depending on compressive strength of pipe insulation and insulated pipe supports.

L. If pipe size changes between support points, maximum spacing shall be based on the smaller pipe size.

M. If trapeze hangers are used to support multiple services, spacing shall be based on the most restrictive pipe size and material on trapeze hanger.

N. For non-metallic pipe, follow manufacturer's installation recommendations in addition to requirements noted herein.

O. Install supports for vertical piping and anchors as recommended by pipe manufacturer.

P. Place hangers and supports to meet requirements of Section 23 21 16 - Pipe and Pipe Fittings or specific pipe system sections, with regard to pitch for drainage and venting and clearance between services.

Q. Hangers and supports shall bear on outside of insulation when pipes are to be insulated.

R. Place hangers and supports within 1 ft of each fitting, such as elbows and tees, and at each valve, strainer, and other piping specialty for piping 4" and larger.

S. Place hanger or support at first elbow upstream of pump inlet and first elbow downstream of pump outlet.

3.03 INSULATED PIPE SUPPORTS APPLICATION

A. Install insulated pipe support at each support point of insulated pipe.

B. Pipe Size 1-1/2" and Smaller:
   1. Use Type A insulated pipe support. Pipe insulation specified in Section 22 07 00 - Plumbing Systems Insulation shall be continuous through support points.
   2. Use one shield (bottom) for clevis hanger.
   3. Use 2 shields (top and bottom) for roller hanger/support or strap/clamp support. Apply 2 metal straps to hold top and bottom shields onto insulation jacket.
   4. Type B or Type C insulated pipe supports may be used in lieu of Type A support.

C. Pipe Size 2" through 5":
   1. Use Type B insulated pipe supports. Refer to Part 2 for acceptable products.
   2. Type C insulated pipe supports may be used in lieu of Type B supports.

D. Pipe Size 6" and Larger:
   1. Use Type C insulated pipe supports. Refer to Part 2 for applicable products.

3.04 BEAM CLAMPS

A. Provide locknut for hanging rod at clamp.

B. C-clamps are allowed for rod size 3/8" or smaller and only for static loading such as air piping, cold water piping, fire protection piping and, other similar piping. C-clamps are not allowed for hot water piping and steam and steam condensate piping, except hot water runouts to terminal heating devices.

C. C-clamps are not allowed for open web steel joist application.

D. C-clamps are not allowed for seismic application.

3.05 TRAPEZE SUPPORTS

A. Construct trapeze supports with struts, angles, or channels and hang them by inserts or welded beam attachments and rods.

B. Determine trapeze supports spacing by the smallest pipe on trapeze.

C. If trapeze supports are used to support multiple services, support spacing shall be based on the most restrictive pipe size and material on trapeze supports.

D. Refer to Part 1, Design Criteria for maximum deflection allowed for trapeze supports.

3.06 CONCRETE ANCHORS

A. Anchor application, size, and placement shall be this Contractor's responsibility.

3.07 PIPE ROOF PENETRATION PROTECTIONS

A. Install at points where pipes are penetrating roof. Install as shown and according to manufacturer's installation instructions.

END OF SECTION

SECTION 22 05 33
ELECTRICAL HEAT TRACING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section specifies materials and installation methods necessary for electrical heat tracing system for domestic, laboratory, process, or other hot water distribution networks for freeze protection.

1.02 RELATED WORK

A. Section 22 05 29 - Plumbing Piping and Equipment Supporting Devices

B. Section 22 07 00 - Plumbing Systems Insulation

1.03 REFERENCE

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

1.04 SUBMITTALS

A. Manufacturer`s technical data and installation instructions for the following:
   1. Heat trace cable, voltage, phase, and temperature.
   2. Heat output chart for each pipe size.
   3. Circuit riser diagram.
   4. Circuit schedule with circuit length, breaker panel number, breaker number, and amperage.
   5. Contractor certification from heat trace manufacturer.
   6. Written warranty statement.

B. Shop drawings on items specified herein.

1.05 SHIPPING

A. Package accessory kits in individual plastic bags to prevent loss of components. Subject heat cable to high-frequency spark test and braids to dry dielectric test as instructed by manufacturer.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Items shall be new, UL Listed or FM approved for their intended use.

B. Heat trace cable shall meet requirements of IEEE 515.1 – Standard for the Testing, Design, Installation and Maintenance of Electrical Resistance Heat Tracing for Commercial Applications.

2.02 FREEZE PROTECTION HEAT TRACE

A. Manufacturers: Thermon or equal.

B. Heaters:
   1. Self-regulating type, 2 nickel-plated copper bus wires, self-regulating polymer core maintaining temperature of pipe above freezing. Cover heater with modified polyolefin dielectric jacket, tinned-copper braid jacket and outer modified polyolefin jacket. Heater shall be compatible with 208, 220, 240 or 277 V, single phase electrical power without transformers. XL-Trace by Pentair Thermal Management or equal.

C. Accessories:
   1. Include power connection kits, tee kits, end seal kits, splice kits, and transformers by same manufacturer as heater. Include fiberglass tape or cable ties to fasten heater to pipe.

D. Control:
   1. Manual control by means of switch.
   2. Automatic control by means of bulb-sensing thermostat with the following features:
      a. Stainless steel bulb on 10 ft capillary
      b. Set at 35°F with adjustable range of 25° to 325°F.
      c. Electrical rating of 22 amp with voltage from 125 to 480V AC
      d. NEMA - 4X metal enclosure
   3. Automatic control by means of an ambient sensing thermostat with the following features:
      a. Stainless steel air temperature sensor
      b. Set point of 35°F with adjustable range of 25° to 325°F
      c. Electrical rating of 22 amp with voltage from 125 to 480V AC
      d. NEMA - 4X metal enclosure
      e. nVent ECW-GF or equal

PART 3 - EXECUTION

3.01 INSTALLATION

A. Attach heater to clean, dry pipe with glass tape or nylon cable ties as stated in manufacturer`s installation instructions and terminate at end of exposed pipe.

B. Manufacturer shall supply isometric drawings as part of material package including heater layout, location of power points, and load chart. Plumbing Contractor shall obtain these isometrics and submit to engineer for review and approval prior to installation of heating cable. One set of "as built" drawings shall be turned over to Engineer upon completion of installation and testing.

C. Attach heat cable linearly or spirally to pipe as required to effectively distribute heat along pipe and develop proper temperature. Consult manufacturer`s data for sizing and spacing of heat cable strip.

D. Provide extra length of heat trace cable at power connections, tees and end seals to permit servicing.

E. Install heat cable and appropriate accessories and controls in conformance with applicable sections of Division 26 Electrical.

F. Power wiring, connections, GFI breakers, conduit, and other electrical accessories necessary for heat cable will be provided by Electrical Contractor.

G. Protect heat trace cable circuits with Ground Fault Interrupt (GFI). Coordinate with Electrical Contractor.

3.02 INSPECTION

A. Inspect heat cable installation with manufacturer`s representative prior to insulating piping. Manufacturer`s representative shall certify that heat cable is properly installed and successfully tested. Documentation shall be included in operation and maintenance manuals and/or Commissioning Documentation. Building occupancy will not be allowed without this Documentation.

3.03 TESTING

A. Electrician shall measure insulation resistance of heat cable with 1000 V DC megohmeter (megger) after plumber has attached heat cable to pipe and before thermal insulation has been installed. Insulation resistance, measured between braid and either bus wire, should be at least 20 megohms regardless of heat cable length. Record these readings for each circuit.

B. Contractor shall test continuity of both heater bus wires to verify connection of splices or tees.

C. If heat cable circuit fails either insulation resistance test or continuity test, electrician shall notify Plumbing Contractor. Plumbing Contractor must repair or replace circuits yielding unacceptable readings. Megger tests must be witnessed by Owner's Representative and manufacturer`s representative. Copy of test report shall be submitted to Engineer. Manufacturer`s representative shall retain one copy for their file and mail copy to factory for record.

END OF SECTION

SECTION 22 05 53
PLUMBING SYSTEMS IDENTIFICATION

PART 1 - GENERAL

1.01 REFERENCE

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

1.02 SUBMITTALS

A. Product Data: For identification materials and devices

B. Valve Schedules: For each piping system

C. Samples: Of color, lettering style, and graphic representation required for each identification material and device.

PART 2 - PRODUCTS

2.01 IDENTIFYING DEVICES

A. Marker System:
   1. Manufacturer's standard, preprinted with color coding, lettering size, and length of color field according to ASME A13.1.
   2. Use pressure-sensitive type or “snap-on” type.
   3. “Strap-on” type may be used for piping over 6” size, including insulation.

B. Valve Tags:
   1. Minimum 1-1/2” diameter, 0.032" thick, polished brass or 316 stainless steel.

C. Laminated Plastic Nameplates:
   1. Nameplates shall be approximately 1-1/2” x 4“, 1/16” thick, and have 1/2" high lettering. Face of plastic nameplates shall be black with white letters.
   2. Fasteners shall be self-tapping, stainless steel screws or contact type with permanent adhesive.

D. Underground Warning Tape:
   1. Underground warning tape, 5.0 mil overall thickness, 2” width minimum, aluminum foil core where required to be detectable, bonded polyethylene jacket. Brady “Identoline” or equal.
   2. Following services shall be provided with warning tape with colors and trace wire as indicated:
      a. Water Lines: Blue with black letters, (non) detectable
      b. Sanitary Sewer: Green with black letters, (non) detectable
      c. Storm Sewer: Green with black letters, (non) detectable

PART 3 - EXECUTION

3.01 GENERAL

A. After painting and/or covering is completed, identify equipment and piping as indicated. Locate identification as conspicuously as possible except where such would distract from finished area.

B. Where markers are used in high heat applications or exposed to harsh chemical or acid environments, specifically select marker materials for those applications.

C. Coordinate, obtain and confirm mechanical systems identification criteria and requirements from Owner.

3.02 PIPING SYSTEM IDENTIFICATION

A. Install pipe identification on each system.

B. Place flow directional arrows at each pipe identification location.

C. Identify all piping (except medical gas) not less than once every 25 ft, not less than once in each room, at each branch, adjacent to each access door or panel, at each valve and where exposed piping passes through walls and floors.

D. Identify piping with marker system.

1. For “strap-on” type, ensure marker is fitted snugly to pipe or pipe insulation surface with sufficient straps.

3.03 VALVE IDENTIFICATION

A. Identify valves with brass tags bearing system identification and valve sequence number in 1/2” black characters. Attach tag to valve body with brass jack chain and “S“ hook for brass tag and SS jack chain or SS braided wires with swag sleeves and “S“ hook for stainless steel tag. Non-metallic fasteners are not allowed.

B. Valve numbers shall be prefixed with corresponding piping system identification in 1/4” black letters.

C. Furnish typewritten valve schedule indicating valve number, fixtures, equipment or areas served by each numbered valve and incorporate in O&M Manuals.

3.04 EQUIPMENT IDENTIFICATION

A. Identify major equipment, including heat exchangers, pumps, water heaters, tanks, compressors, etc.

B. Identify equipment by stenciling equipment number and service in 2” high letters.

C. Identify equipment with marker system.

D. Identify equipment with laminated plastic nameplates.

E. Identify control equipment and panels with laminated plastic nameplates.

F. Nameplate Markings:
   1. Identify model number, size, capacity, electrical characteristics, serial number, along with other items scheduled for equipment on drawings.
   2. Indicate motor horsepower, voltage, phase, cycles, RPM, full load amps, locked motor amps, frame size, manufacturer's name and model number, Service Factor, Power Factor, efficiency, minimum circuit amps, minimum feeder conductor size, disconnect or fuse size, refrigerant, and other pertinent information.

G. Locate motor nameplates for easy reading. Relocate or provide new nameplates on motors if original nameplates are not located for easy reading.

3.05 UNDERGROUND WARNING TAPE

A. Install detectable warning tape 4" to 6" below grade to allow for accurate above surface detection.

B. Install non-detectable warning tape 6" to 12" below grade.

C. Repair and replace existing underground warning tape where disturbed by excavation.

END OF SECTION

SECTION 22 07 00
PLUMBING SYSTEMS INSULATION

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 22 05 29 - Plumbing Piping and Equipment Supporting Devices

1.02 REFERENCE

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

1.03 DESCRIPTION

A. Provide insulating materials and accessories as required for mechanical systems as specified below.

B. Insulating products delivered to construction site shall be labeled with manufacturer's name and description of materials.

1.04 DEFINITIONS

A. Concealed areas, where indicated in this Section, shall apply to shafts, furred spaces and space above finished ceilings, inaccessible tunnels and crawl spaces. All other areas, including walk-through tunnels, shall be considered as exposed.

B. Unless otherwise indicated, unit of thermal conductivity is Btu in/(h ft^2 °F).

C. Interstitial spaces are considered as concealed areas.

1.05 SUBMITTALS

A. Product Data for each piping system for all pipe sizes and all equipment, including but not limited to, the following:
   1. Manufacturer's name
   2. Schedule of insulating materials
   3. Insulation material and thickness
   4. Jacket
   5. Adhesives
   6. Fastening methods
   7. Fitting materials
   8. Intended use of each material
   9. Manufacturer's data sheets indicating density, thermal characteristics, temperature ratings
   10. Insulation installation details (manufacturer's installation instruction/details, Contractor's installation details, MICA plates where applicable)

11. Literature data sheet from sealants and adhesive manufacturers stating VOC compliance with USGBC LEED IEQ 4.1.
12. Literature data sheet from coatings and mastics (including lagging adhesives) manufacturers stating VOC compliance with USGBC LEED IEQ 4.2.
13. All other appropriate data

1.06 DELIVERY, STORAGE AND HANDLING

A. Insulation material shall be delivered to project site in original, unbroken factory packaging labeled with product designation and thickness. Shipment of materials from manufacturer to installation location shall be in weather-tight transportation. Protect insulation materials from moisture and weather during storage and installation. Protect insulation material against long exposure to UV light from sun.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Products used for or related to air conditioning and ventilating systems shall conform to NFPA 90A possessing flame spread index of not over 25 and smoke developed index no higher than 50.

B. Unless otherwise indicated, all products, material itself or on composite basis, shall have flame spread index not more than 25 and smoke developed index not more than 50, when tested in accordance with ASTM E84 or UL 723.

C. Pipe insulation installed outdoors may have smoke developed index not exceeding 450.

D. Insulation shall not contain formaldehyde

E. Foam insulation materials shall not use CFC or HCFC blowing agents in manufacturing process.

F. Insulation applied on stainless steel shall meet requirements of ASTM C795 and NRC 1.36.

2.02 INSULATION

A. Insulation materials shall be fire retardant, moisture and mildew resistant, vermin proof, and suitable to receive jackets, adhesives and coatings as indicated.

B. Glass fiber insulation shall be of inert inorganic material, non-corrosive to mechanical surfaces.

C. Insulating cement shall be Quick-Cote by PK Insulation MFG Co. or equal, with dry density of no more than 38 lb/ft³ thermal conductivity of 0.96 at 400°F mean temperature, and service temperature to 1200°F.

D. Filling and finishing cement shall be Super-Stik by PK Insulation MFG Co., or equal, with dry density of no more than 24 lb/ft³, thermal conductivity of 0.74 at 500°F mean temperature, and service temperature to 1900°F.

E. Type A Insulation (Flexible Elastomeric):
   1. Flexible, closed-cell, elastomeric cellular insulation.
      a. ASTM Standard: ASTM C534/C534M, Type I (tube form) or Type II (sheet form), Grade I

b. Thermal Conductivity: Maximum 0.28 at 75°F mean temperature

c. Water Vapor Permeability: Maximum 0.08 perm-"

d. Water Absorption: Maximum 0.2 % by volume

e. Service Temperature: -297 to 220°F

F. Type R Insulation (Rigid Mineral Fiber Pipe Insulation):

1. Mineral fiber (fiberglass) preformed pipe insulation faced with specified jacket.

a. ASTM Standard: ASTM C547, Type I

b. Density: Minimum nominal 3 lb/ft³

1) Thermal Conductivity: Maximum 0.23 at 75°F and 0.29 at 200°F

2) 0.29 at 200°F mean temperature

c. Service Temperature: To 850°F

2.03 JACKETS

A. Jacket puncture resistances shall be based on ASTM D781 test methods. Vapor barrier permeance ratings shall be based on ASTM E96/E96M Procedure A.

B. Type P-1 Jackets:

1. Heavy-duty, fire retardant material with glass fiber reinforcing and self-sealing lap. Jacket shall have neat, white Kraft finish suitable for painting, with burst strength of 1.5 Joules (50 beach units) minimum and tensile strength 45 lbs/in minimum. Vapor barrier shall be adhered to inner surface of jacket. Permeance shall not exceed 0.02 perm.

2.04 ADHESIVES, MASTIC, COATINGS, SEALANTS, AND REINFORCING MATERIALS

A. Adhesives and sealants shall comply with the South Coast Air Quality Management District SCAQMD 1168; VOC limits shall comply with Indoor Environmental Quality Section, Credit IEQ-4.1.

B. Coatings and mastics shall comply with VOC limits set forth by Green Seal BS-11 and comply with the South Coast Air Quality Management District SCAQMD 1113; VOC limits shall comply with Indoor Environmental Quality Section, Credit IEQ-4.2.

C. Products shall be compatible with surfaces and materials on which they are applied and shall be suitable for use at operating temperatures of systems to which they are applied.

D. Products shall be fire retardant, moisture resistant and mildew resistant and vermin proof.

E. Vapor Barrier Mastic: Below ambient insulation. Water vapor permeance shall be less than 0.08 perms at 45 mils dry film thickness per ASTM F1249.

F. Weather Barrier Breather Mastic: Above ambient insulation. Permeance shall be greater than 1.0 perms at 1/16" dry film thickness per ASTM E96/E96M.

G. Lagging Adhesive/Coatings: Indoors applications used in conjunction with canvas/glass cloth.

H. Metal jacketing sealant for aluminum jacketing.

I. Insulation joint sealant for Type P, Type PP, and Type G insulation.

J. Glass fiber fabric reinforcing shall be 10 x 10 mesh similar to Childers Chil Glas #10 or equal.

K. Wire mesh reinforcing shall be 22 ga, 1" galvanized.

L. Insulation cement shall be ANSI/ASTM C195, hydraulic setting mineral wool.

M. Finishing cement shall be ASTM C449.

N. Butt joint and longitudinal joint adhesive for Type A insulation shall be Armstrong 520 equal.

O. Weather-resistant protective finish for Type A insulation shall be Armstrong WB Armaflex finish or equal to.

2.05 METAL BANDS AND WIRES

A. Aluminum bands shall be 0.5 x 0.20" up to 48" diameter and 0.75 x 0.020" over 48" diameter.

B. Stainless steel bands shall be 0.5 x 0.015" or 0.75 x 0.015".

C. Stainless steel wires shall be 16 ga.

2.06 REMOVABLE INSULATING BLANKETS

A. Custom designed removable, reusable, flexible, blanket thermal insulation system.

B. Removable insulation system shall be custom designed for each individual item to provide close contour fit. Overlapping seams and gaps are not acceptable.

C. Removable insulation shall be designed to overlap adjoining pipe insulation by.

D. Insulation: Minimum 2" thick, 2.4 lb/ft³ density, 1000°F continuous service temperature thermal insulating wool; Owens Corning Fiberglass or equal.

E. Interior and Exterior Fabric: Minimum weight 0.59 kg/m² silicone rubber coated fiberglass cloth.

F. Securement: Blanket seams shall be closed with buckle and strap assembly (D ring closure).

G. Identification/Tagging: Label each removable insulation device with plastic or 304 stainless steel tag with raised letters. Tag as directed by Owner.

PART 3 - EXECUTION

3.01 APPLICATION

A. Provide insulation and jackets with minimum insulation thickness as indicated in the following schedule. The schedule applies to both exposed and concealed applications unless noted otherwise:

Piping System						
		Minimum Insulation Thickness According to Pipe Size				
Service	Jacket Type	Insulation Type	3/4" and Smaller	1" - 1-1/4"	1-1/2" - 3"	4" - 6"
Domestic Cold Water	P-1	R	1"	1"	1"	1"

	---	A	3/4"	3/4"	3/4"	3/4"
(Type A Insulation is an option)						
Domestic Hot Water and Hot Water Return 105-140°F	P-1	R	1"	1"	1-1/2"	1-1/2"
	---	A	1"	1"	1-1/2"	1-1/2"
(Type A insulation is an option.)						
Insulation thickness shall be the greater thickness specified for piping system or thickness specified above.						

3.02 INSTALLATION - GENERAL

A. All insulation installation methods shall be performed in accordance with the latest edition of National Commercial and Industrial Insulation Standards published by MICA (Midwest Insulation Contractors Association) and manufacturer's installation instructions, except as modified in this Section of specifications.

B. Install products with good workmanship, with smooth and even surfaces. Use full-length factory-furnished material where possible. Do not use scrap pieces.

C. Apply insulation only on clean, dry surfaces, after all rust and scale have been removed and testing of systems has been completed. Do not insulate any section of system that must be pressure tested until after it has been successfully tested. Any removal and reinstallation to correct system defects prior to end of guarantee period shall be accomplished at no expense to Owner.

D. Install insulating materials with necessary joints and terminations, to permit easy access and removal of equipment sections where inspection, service or repair is required, and to allow for expansion.

E. Where possible longitudinal joints in jackets shall face toward wall or ceiling.

F. Apply insulation to each pipe individually. Common insulation applied to adjacent pipes will not be accepted.

G. Unless otherwise indicated, pipe insulation shall be continuous through walls and floors.

H. Where multiple layers of insulation are used, stagger and secure each layer with metal bands.

I. Insulate water piping within casework up to penetration of casework pipe chase at fixture stop. Insulate water piping within walls up to pipe penetration through the wall at fixture stop when serving wall-mounted fixtures. Termination of insulation shall be in neat and workman like manner with insulation jacket cap.

J. Insulate the following systems for complete vapor barrier protection:
   1. Cold Water
   2. All equipment with surface temperature below 60°F

K. Apply Type A insulation for insulation and jackets requiring vapor barrier protection where specified insulations are cut for mounting sensors, control devices, parts of valves, devices or components which extend out from specified insulation to prevent condensation.

3.03 PIPING, VALVE AND FITTING INSULATION

A. Apply insulation to pipe, unions, flanges, fittings, valves and piping specialties with butt joints and longitudinal seams closed tightly. Valve insulation shall cover entire valve body including bonnets and packing nuts.

B. Laps on factory-applied jackets shall be 2" minimum width firmly cemented with lap adhesive, or shall be pressure sealing type lap.

C. Cover joints with factory furnished tape 3" minimum width) to match jacket. Cement firmly with lap adhesive. On systems requiring a vapor barrier (ASJ), vaporseal all longitudinal and butt joints ASJ/Saran seams with 4" wide coat of vapor barrier mastic or 3" minimum tape.

D. Where staples are used, they shall be on 6" maximum centers. When used for systems requiring vapor barrier, cover lap and staples with finish coat of vapor barrier mastic or 3" minimum tape.

E. For finishing of insulated pipe fittings and valves where surface temperature of insulation is not higher than 125°F, use one piece PVC fitting covers, minimum thickness of 20 mil. Fitting cover shall be Johns Manville Zeston 2000 PVC, PROTO Fitting Covers, or similar by other manufacturers listed. Where fitting and valve insulation requires vapor barrier, seal joints of PVC covers with vapor barrier adhesives. Insulation type, R-value and density of insulation used at fittings shall match insulation of adjacent piping. Install insulation at pipe fittings and valves completely prior to applying PVC covers.

   1. For Type R (Rigid glass fiber) pipe insulation, PVC fitting covers with flexible mineral fiber blanket insulation inserts are acceptable, except those located in mechanical rooms within 6' above floor. For fitting covers located in mechanical room within 6' above floor, insulation inserts shall be pre-molded rigid fiber glass type wrapped around elbows.

F. Stove pipe style insulation on elbows (Detail A on Plate 2-200 of MICA 8th Edition) is not allowed. It may be used for closed cell elastomeric insulation.

G. Where terminations of pipe insulation are required, insulation shall have tapered ends, built up and finished as specified for fittings.

H. For pipes 1" and smaller, install specified pipe insulation and jacket continuous through hanger or support locations. Install insulation protection shields to protect insulation from compressing.

I. For pipes 1-1/2" and larger, where manufactured pre-insulated pipe supports are used at hanger or support locations, extend insulation to insulated pipe supports. Where vapor barrier is required, this Contractor shall be responsible for continuity of vapor barrier at insulated pipe supports. 3" wide vapor barrier tape on hot and cold systems at pipe supports.

J. For pre-insulated pipe supports and insulation protection shields, refer to Section 22 05 29 - Plumbing Piping and Equipment Supporting Devices.

K. For Contractor-fabricated anchors, secure insulation directly to pipe surface and extend insulation up anchor for distance of 4 times insulation thickness. For pre-insulated anchors, cover entire surface of anchors with Type A insulation. Where applicable, take special care to assure vapor seal at anchor.

L. Where mechanical grooved pipe connections are used in piping system, insulate couplings as specified for pipe.

M. Piping, fittings and valves not to be insulated:
   1. Valves furnished with removable insulation/jacket

3.04 EQUIPMENT INSULATION

A. Where multiple layers of insulation are required, stagger and secure each layer with stainless steel bands.

B. Install removable insulation where access is required for cleaning, repair and inspection. Construct removable insulation with Type A insulation for cold equipment and Type R insulation with V-1 jacket for hot equipment. Do not apply bonding adhesive to equipment surface.

C. Provide removable insulating blankets on expansion joints.

D. Do not insulate over equipment nameplates or ASME stamps. Bevel and seal insulation at these locations.

E. Equipment not to be insulated:
   1. Equipment furnished with factory insulation.

3.05 EQUIPMENT AND COMPONENTS

A. Acoustical Barrier Materials:
   1. Provide 2" thick Type R insulation with Type D-1 jacket as inner layer. Over insulation install acoustical barrier materials as outer layer in accordance with manufacturer's installation instruction.
   2. Refer to plans for equipment requiring acoustical barrier materials.

3.06 PROTECTIVE INSULATION SHIELD (A-1 JACKET) FOR PIPE JACKETS EXTERIOR TO BUILDING

A. Unless otherwise indicated, install shields (A-1 jacket) around insulated pipe and fittings exterior to building. Seal water and vapor tight at terminations.

B. Longitudinal overlap shall be at least 2" wide with vapor barrier sealant.

C. Secure jacketing with 3/4" wide 0.015" stainless steel or 3/4" wide 0.020" aluminum bands and wing seals on maximum 18" centers.

END OF SECTION

SECTION 22 11 14
EXTERIOR SERVICES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section lists materials and methods for utility piping systems outside footprint of building(s) under construction. Provide piping extensions to and from 5 ft of construction indicated and necessary to complete each service connection with utilities. Maintain pitch and depth of cover noted and necessary for utility connections and piping protections. Repair damaged areas to existing conditions.

B. Provide connections to utility services. Include connections, fees, and assessments in Bid.

1.02 RELATED WORK

A. Section 22 05 20 - Plumbing Excavation and Backfill

B. Section 22 05 53 - Plumbing Systems Identification

1.03 REFERENCE

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

1.04 QUALITY ASSURANCE

A. Order piping with each length marked with manufacturer`s name or trademark and type of pipe; with each shipping unit marked with purchase order number, metal or alloy designation, temper, size, and supplier`s name.

B. Installed material not meeting specification requirements must be replaced with material that meets these Specifications without additional cost to Owner.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Promptly inspect shipments to ensure material is undamaged and complies with Specifications.

B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends from damage. End caps shall remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

C. Off-site storage agreements will not relieve Contractor from using proper storage techniques.

D. Storage and protection methods must allow inspection to verify products.

1.06 SUBMITTALS

A. Manufacturer`s technical data for the following:
   1. Sanitary pipe and fittings

2. Storm pipe and fittings
3. Water main pipe and fittings
4. Joints
5. Manholes, catch basins, and inlets
6. Castings (frames, grates, covers)
7. Valves

B. Shop drawings on items specified herein.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials specified herein shall be new unless otherwise noted.

2.02 SANITARY SEWER PIPE AND FITTINGS

A. Underground 15" and Smaller:
1. Cast iron
a. Pipe: Cast iron soil pipe, hub and spigot, service weight, ASTM A74
b. Fittings: Cast iron, hub and spigot, service weight, ASTM A74
c. Joints: Neoprene rubber compression gaskets, ASTM C564

B. Underground 15" and Larger:
1. Reinforced Concrete:
a. Pipe:
1) Reinforced concrete culvert, Class III, ASTM C76
2) Elliptical concrete culvert, ASTM C507, rubber gasket joints, ASTM C443
b. Joints:
1) Rubber gasket joints, ASTM C443
2) Bell and spigot ends with opposing shoulder or confined O-ring seal configuration, ASTM C302

2.03 STORM SEWER PIPE AND FITTINGS

A. Underground 15" and Smaller:
1. Cast iron
a. Pipe: Cast iron soil pipe, hub and spigot, service weight, ASTM A74 4
b. Fittings: Cast iron, hub and spigot, service weight, ASTM A74
c. Joints: Neoprene rubber compression gaskets, ASTM C564

B. Underground 15" and Larger:
1. Reinforced Concrete
a. Pipe:
1) Reinforced concrete culvert, Class III, ASTM C76

2) Elliptical concrete culvert, ASTM C507, rubber gasket joints, ASTM C443

b. Joints:

1) Rubber gasket joints, ASTM C443

2) Bell and spigot ends with opposing shoulder or confined O-ring seal configuration, ASTM C302

2. Concrete apron end walls shall be manufactured with reinforcement and conform to requirements of Class III Wall B ASTM C76.

2.04 MANHOLES, CATCH BASINS, AND INLETS

A. Reinforced precast manhole sections, Specification ASTM C478/C478M. Size as required to accommodate piping shown.

B. Frames and grates, gray cast iron, ASTM A48/A48M Class 30, non-rocking 24" diameter opening, and 425 lbs minimum weight. Frame and grate shall be Campbell or equal.

C. Flexible pipe connector for structures, ASTM C443 and ASTM C923/C923M KOR-N-SEAL or equal.

D. Frames and grates, gray cast iron, equal to Neenah number shown on drawings.

E. Sanitary sewer manhole lids shall have self sealing gaskets firmly glued in place at factory.

F. Provide manhole steps of polypropylene coated reinforcing rod for manholes, catch basins, and inlets 6 feet and deeper. Steps are manufactured by MA Industries, Figure PS-1-PF, ASTM D2146 and ASTM C478/C478M or equal. Install 16" on center.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify local utility datum and baseline information prior to start of construction. Notify Contracting Officer or Engineer of discrepancies before proceeding with construction. Verify existing piping inverts and elevations prior to excavation for new installation, and notify Engineer of deviations.

B. Investigate site conditions verify utility locations and elevations before start of excavation. Discrepancies will be checked with Engineer before proceeding with construction.

3.02 UNDERGROUND WARNING TAPE

A. Provide warning tape for exterior buried utilities per Section 22 05 53 - Plumbing Systems Identification.

3.03 SANITARY SEWER

A. Install exterior piping below predicted frost level and not less than 5 ft bury depth to top of pipe wherever possible. Where piping is located above predicted frost level, provide frost protection in accordance with SPS 382.30.

B. Install sewer lines in straight alignment. Changes of directions shall be made by use of proper fittings or manholes. No joint deflection allowed. Install sewers at uniform grade between manholes unless otherwise noted.

3.04 STORM AND CLEARWATER WASTE SEWER

A. Verify invert elevations and building elevations prior to installation. Install exterior piping pitched to drain at indicated elevations and slope.

B. Install exterior piping below predicted frost level and not less than 5 ft bury depth to top of pipe wherever possible. Where piping is located above predicted frost level, provide frost protection in accordance with SPS 382.30.

C. Install sewer lines in straight alignment. Make changes of directions by use of proper fittings or manholes. No joint deflection allowed. Install sewers at uniform grade between manholes unless shown or otherwise noted.

D. Install pipe and fittings according to recommendations of pipe manufacturer. Keep material at proper temperature to assure proper jointing.

3.05 CLEANING

A. Before testing, water mains and sewers shall be flushed to clean construction debris from mains and sewers. Valves and fire hydrants shall be operated to ensure proper functioning, including drainage through weep holes.

3.06 TESTING

A. Hydrostatically test water mains at 1-1/2 times working pressure, but in no case greater than 150 psi, for minimum of 2 h. No leakage shall occur. If leakage is evident, defective joint or fitting shall be replaced with new material; no caulking of leaking joints allowed. After repair is made system shall be retested. Do not backfill piping until successfully tested.

B. Where water mains are installed as fire mains, test per NFPA Pamphlet 24 at 200 psi or 50 psi above normal system pressure, whichever is greater for minimum of 2 h.

C. Sewer lines shall be tested for leakage by either infiltration tests or exfiltration tests, as appropriate. Prior to testing for leakage, trench shall be backfilled up to at least lower half of pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving joints uncovered to permit inspection.

D. Visible leaks encountered shall be corrected regardless of leakage test results. When water table is 2 ft or more above top of pipe at upper end of pipe line section to be tested, infiltration shall be measured using suitable weir or other device acceptable to Engineer.

E. When Engineer determines infiltration cannot be properly tested, exfiltration test shall be made by filling line to be tested with water so that head of at least 2 ft is provided above both water table and top of pipe at upper end of pipe line. Filled line should be allowed to stand until pipe has reached its maximum absorption, but not less than 4 h.

F. After absorption, head shall be re-established. Amount of water required to maintain this water level during 2 h test period shall be measured.

G. Leakage as measured by either infiltration test or exfiltration test shall not exceed 0.4 gal per " diameter per 100 ft of pipe line per h. When leakage exceeds maximum amount specified, make corrections and retest.

3.07 DISINFECTION

A. Disinfect water piping in the following manner:
   1. Clean and flush water pipe with water until water at remote tap is clear.
   2. Fill water systems with solution containing 50 ppm of chlorine (minimum concentration). Allow solution to stay in water system for 24 h. Alternate use solution of 200 ppm of chlorine (minimum concentration) for 3 h.
   3. Flush water system of chlorine solution.
   4. Allow clean water to stand in system for 24 h. Take sample from remote tap for bacteriological test.

B. Do not use water system for potable water supply until safe bacteriological test is obtained. Repeat steps 1 through 4 until safe water system is obtained.

3.08 BACTERIOLOGICAL TESTS

A. Take representative water samples and test to ensure bacteriologically safe water supply system. Include HPC (Heterotrophic Standard Plate Count) test and test for presence of Pseudomonas aeruginosa and regular coliform bacteria test. HPC test maximum containment level of 500 organisms/ml. Perform bacteriological tests shortly before Owner`s acceptance of building. If tests fail, make corrections and retest.

B. Prior to connection to existing inactive water main or building branch main, perform bacteriological tests specified herein after pre-flushing main. If test fails, notify Engineer and Owner prior to proceeding further.

END OF SECTION

SECTION 22 11 18
WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. All components shall comply with NSF 61 and NSF 372 to be compliant with requirement for lead content of ≤0.25% maximum weighted average.

1.02 RELATED WORK

A. Section 22 05 20 - Plumbing Excavation and Backfill

B. Section 22 05 29 - Plumbing Piping and Equipment Supporting Devices

C. Section 22 05 33 - Electrical Heat Tracing

D. Section 22 05 53 - Plumbing Systems Identification

E. Section 22 07 00 - Plumbing Systems Insulation

1.03 REFERENCE

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

1.04 QUALITY ASSURANCE

A. Order pipe with each length marked with manufacturer`s name or trademark and type of pipe; with each shipping unit marked with purchase order number, metal or alloy designation, temper, size, and supplier`s name.

B. Installed material not meeting specification requirements must be replaced with material that meets these Specifications without additional cost to Owner.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Promptly inspect shipments to ensure material is undamaged and complies with specifications.

B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends from damage. End caps shall remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

C. Offsite storage agreements will not relieve Contractor from using proper storage techniques.

D. Storage and protection methods must allow inspection to verify products.

E. Before shipping, piping shall be cleaned, free of rust and scale, and chemically treated to protect inside of pipe from rusting and furnished with end caps.

1.06 SUBMITTALS

A. Manufacturer`s technical data for the following:
   1. Pipe
   2. Fittings
   3. Joints
   4. Valves
   5. Unions and Flanges
   6. Dielectric fittings
   7. Water hammer arrestors
   8. Expansion joints
   9. In-line Centrifugal Pumps
   10. Pressure Booster Pump

B. Shop Drawings on items specified herein.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials as specified shall be new unless otherwise noted.

B. Materials shall be provided from list of approved manufacturers. Home Market, Generic Broker, or Wholesaler's house brands are not acceptable.

2.02 PIPE, FITTINGS, AND JOINTS

A. Underground -2-1/2" and Smaller:
   1. Copper:
      a. Pipe: Copper tube, Type K, soft (annealed) temper in coils, ASTM B88
      b. Fittings:
         1) Cast copper alloy, solder joint, pressure rated, ASME B16.18
         2) Wrought copper, solder joint, pressure rated, ASME B16.22
      c. Joints: Lead free (<0.2%) solder, ASTM B32, flux, ASTM B813
      d. Joints: Where joints are permitted, brazed, silver solder, BCuP-5 Type, AWS A5.8M/A5.8, 1250°F melting point minimum.
      e. Pre-insulated with polyurethane insulation and PVC jacket.

B. Underground (3") and Larger:
   1. Ductile Iron:
      a. Pipe: Ductile iron, Class 52, AWWA C151/A21.51, with standard cement mortar lining, AWWA C104/A21.4
      b. Fittings:
         1) Ductile iron or grey iron, mechanical joint, cement mortar lined, Class 250, AWWA C110/A21.10

2) Ductile iron, mechanical joint compact fittings, Class 350, AWWA C153/A21.53

c. Joints: Joint shall be restrained type equal to EBAA Iron Megalug 1100 restraint system for mechanical joint for ductile iron pipe, AWWA C111/A21.11 and AWWA C153/A21.53 Joints shall be designed to accommodate deflection after assembly up to 3 degrees.

d. Encasement: provide 8 mil tube or sheet polyethylene encasement of iron pipe and pipe fittings, AWWA C105/A21.5

C. Above Ground:

1. Copper (2 1/2" and Smaller):

a. Pipe: Copper tube, Type L, hard drawn, ASTM B88

b. Fittings:

1) Cast copper alloy, solder joint, pressure rated, ANSI/ASME B16.18

2) Wrought copper, solder joint, pressure rated, ANSI/ASME B16.22

3) Copper, press fit joint, EPDM O-ring, ASME B16.51, 0 degrees - 250°F, maximum 200 psi. Propress by ApolloPress by Apollo Flow Controls or equal.

c. Joints:

1) Lead free (<0.2%) solder, ASTM B32, flux, ASTM B813

2) Press fit joint, EPDM O-ring, made with electro-hydraulic crimping tool and jaw correct for pipe size.

d. Nipples: Red brass pipe, threaded

e. Exposed tubing and fittings in kitchen and areas subject to chemical cleaning shall have chrome plated finish.

2. Copper (3" thru 8"):

a. Pipe: Copper tube, Type L, hard drawn, ASTM B88

b. Fittings:

1) Cast copper alloy, solder joint, pressure rated, ANSI/ASME B16.18

2) Wrought copper, solder joint, pressure rated, ANSI/ASME B16.22

c. Joints: Brazed, BCuP-3 or BCuP-5 type, AWS A5.8M/A5.8, 1250°F minimum melting point

2.03 UNIONS AND FLANGES

A. General:

1. Unions, flanges and gasket materials to have pressure rating of not less than 150 psi at 180°F.

B. Copper (3" and Smaller):

1. Wrought copper union, Nibco Figure 633-W or equal.

C. Copper (4" and Larger):

1. Cast red brass flanges, alloy 844, ASTM B584, Class 150, Standard bolt pattern, ANSI B16.24 with neoprene gasket

2.04 VALVES

A. Shutoff Valves:

1. Ball Valves (2" and smaller):

a. Full Port, 2 Piece: Bronze body, ASTM B584, stainless steel ball and stem, teflon seats, stem extension with length according to installed system insulation thickness, 600 psi CWP pressure rating, Apollo Series 77CLF-240-01 or equal.

b. Insulated Handle: For insulated systems to prevent condensation on valve body with thermal and vapor seal, equal to Apollo Therma Seal or equal.

2. Butterfly Valves (3" and larger):

a. Threaded or Solder Ends: Bronze body, stainless steel disc and stem, viton disk seal, Milwaukee Series BB2

b. Wafer Type: Ductile iron body, 316 stainless steel disc mounted without pins or bolts, EPDM liner, stainless steel stem, copper or glass reinforced epoxy resin bushings (lower, upper and collar), 200 psi CWP pressure rating, 10 position lever handle through 6", gear operator 8" and larger, Apollo WD141

c. Grooved Type:

1) Cast brass body, aluminum-bronze disc, stainless steel stem. Disc shall be offset from stem centerline to provide full 360 degree seating. Elastomeric seal, copper tubing sized grooved ends, 300 psi CWP pressure rating, manual level or gear operator with handwheel for 3" to 6", Victaulic Series 608N.

2) Stainless steel body and disc, ASTM A351/A351M Grade CF8M, stainless steel stem. Disc shall be offset from stem centerline to provide full 360 degree seating. Seat and seal material shall be EPDM, grooved ends, 300 psi CWP pressure rating, manual lever lock handle or gear operator with handwheel, 3" to 8", Victaulic Series 861.

3. Gate Valves:

a. Size 2-1/2" and Smaller: Lead-free bronze body, bronze trim, 150 psi steam pressure rating, union bonnet, rising stem, Apollo 102TLF/102SLF or equal.

b. Size 3" and Larger: Nickel iron body and wedge, stainless steel trim, outside screw and yoke (OS&Y), 125 psi steam pressure rating, bolted bonnet, flanged pipe ends, Hammond IR1913-HIor equal.

B. Swing Check Valves:

1. Size 2" and Smaller:

a. Bronze body, ASTM B62, Y pattern, PTFE resilient disc, horizontal swing, 200 psi CWP rating, Apollo 163-LF series or equal.

C. Spring Check Valves:

1. Valves 2" and Smaller:

a. Bronze body, ASTM B584, in-line lift type with spring, Buna-N or PTFE disc, 250 psi CWP rating, Apollo 61LF-500 seriesor equal.

2. Size 1/2" thru 2":

a. Stainless steel body, in-line pattern, stainless steel seats, spring and valve disc. DFT, Inc. Basic Check, Model BSS, rated for 300 psi WSP or equal.

D. Mixing Valves

1. MV-4 Thermostatic Point of Use Tempered Water Mixing Valve

a. Acceptable manufacturers: Bradley or equal.

b. Mixing valve shall be bronze construction with dual thermostatic elements, high temperature limit stop, locked temperature regulator and integral thermometers on inlet, outlet and mixed water lines. Valve shall be rated for 125 psi operating pressure and be certified per ANSI Z358.1 requirements.

2.05 WATER METERS

A. Electromagnetic Flow Meter

1. Acceptable manufacturers: Badger or equal.
2. Meter shall be in-line electromagnetic type capable of measuring bi-directional flow. Meter shall have integral or remote converter with backlit graphic display and keypad. Meter shall be factory sized and programmed for its specific application and flow range. Meter shall be reprogrammable using converter keypad without use of special interface device or computer.
3. Meter flow tube shall be epoxy coated steel with polypropylene, PFA, or PTFE liner and 316 stainless steel sensing electrodes. Meter materials and finish shall meet AWA standards such as those listed in ASTM A536 and ASTM A126.
4. Meter body shall be lead-free bronze construction with stainless steel trim. Meter shall have thermoplastic piston, turbine chamber and turbine. Meter materials and finish shall meet AWWA Standard C700.
5. Meter shall be provided with ANSI Class 150 flanges.
6. Meter shall be selected for 10:1 turndown. Meter shall be wet-calibrated and accurate to within ±2% of reading. Meter shall be shipped with certificate of calibration.
7. Meter shall have 4-20 mA and programmable pulse output signals.
8. Meter shall provide instantaneous and totalized flow in gpm (L/m) and gal (L).

2.06 DIELECTRIC FITTINGS

A. Insulating nipple, metal casing, inert thermoplastic lining; Anvil Figure 7090 or equal.

B. Dielectric unions 2" and smaller; dielectric flanges 2-1/2" and larger; with iron female pipe thread to copper solder joint or brass female pipe thread end connections, non-asbestos gaskets and pressure rating of not less than 175 psi at 180°F. Watts Regulator Company or equal.

C. Copper-silicon casting, UNS C87850, threaded or grooved end. UL classified in accordance with NSF 61 for potable water service. Victaulic Style 647 or equal.

2.07 WATER HAMMER ARRESTORS

A. Mechanical Water Hammer Arrestors:

1. Piston-compressed air column type, with sealed air chamber.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install pipe and fittings in accordance with reference standards, manufacturer`s recommendations and recognized industry practices.

B. Maintain piping system in clean condition during installation. Remove dirt and debris from assembly of piping as work progresses. Cap open pipe ends where left unattended or subject to contamination.

C. Include connections to plumbing fixtures, to equipment by others, and to equipment requiring water. Provide proper backflow and back siphonage protection to safeguard potable water system from contamination.

D. Lay out water system so as to conform to intent of drawings. Coordinate piping with building features and work of other trades. Install water piping plumb and square with building. Plans indicate, general routing, provide additional offsets as required. Install piping with necessary swing joints and offsets to allow for expansion.

E. Install shut-off valves on branch lines near mains to avoid long dead-leg branches when valves are closed.

F. Install shut-off valves where indicated and at base of risers to allow isolation of portions of system for repair.

G. Do not install water piping within exterior walls.

H. Provide drain valves at base of risers and at low points of trapped piping 2" and larger where trapped water volume exceeds 5 gallons.

I. Provide dielectric fittings between dissimilar piping materials.

J. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including required service space for this equipment, unless piping is serving this equipment.

K. Install valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to equipment, fixtures and systems installed by others where same requires piping services indicated in this Section.

L. Install water pipe using proper pipe and fittings. Use reducing fittings for changes in pipe size.

3.02 UNDERGROUND WARNING TAPE

A. Provide warning tape for exterior buried utilities per Section 22 05 53 - Plumbing Systems Identification.

3.03 COPPER TUBING

A. Copper tubing shall be installed per Copper Development Association guidelines in addition to methods specified herein.

B. Soldered Copper Joints:
   1. Use non-acidic and lead free flux on cleaned pipe and fittings for soldered joints.
   2. Cut tube square, remove burrs from exterior of tube and ream interior of tube before assembly.
   3. Fill joints with solder by capillary action. Solder shall cover joint periphery. Wipe joint clean.
   4. Apply heat carefully to prevent damage to pipe, fittings and valves.
   5. Follow manufacturer`s recommendations when heating valves and equipment for soldered connections.

C. Brazed Copper Joints:
   1. Cut tube square, remove burrs from exterior of tube and ream interior of tube before assembly.
   2. Joints shall be cleaned and polished before brazing.
   3. Flux of any type shall not be used.
   4. Apply heat carefully to prevent damage to pipe, fittings and valves. Disassemble valves where possible to prevent damage to seats during brazing.

3.04 SPRING LOADED CHECK VALVES

A. Provide spring loaded check valve in each pump discharge line.

3.05 WATER METERS

A. Provide minimum of 5 pipe diameters of straight pipe on inlet of meter and minimum of 2 pipe diameters of straight pipe on outlet of meter.

B. Provide strainer on inlet to meter.

3.06 WATER HAMMER ARRESTORS

A. Use water hammer arrestors to control water hammer. Installed devices shall be sized and located according to manufacturer`s recommendations, PDI Standards, or as shown on drawings.

B. Use water hammer arrestors with flush valves and quick-closing valves. Provide access panels when water hammer arrestors are installed in non-accessible concealed locations.

3.07 DIELECTRIC UNIONS AND FLANGES

A. Install dielectric unions or flanges at points where copper-to-steel pipe connection is required in domestic water systems.

B. Install unions on equipment side of shutoff valves for items such as: water heaters, water softeners, pumps, filters, and similar equipment requiring periodic replacement.

3.08 CLEANING

A. Flush and clean piping prior to testing. Remove corrosion by mechanical or chemical means. Use chemicals that are non-toxic.

3.09 TESTING

A. Refer to Testing paragraph of Section 22 00 00 - General Plumbing Requirements.

B. Water test system may be applied to system in its entirety or in sections. Test piping with water to pressure of 100 psi for 2 h. No decrease in pressure allowed. Provide pressure gauge with shutoff and bleeder valve at highest point of system tested. Inspect joints in system under test.

C. Defective work or material shall be replaced or repaired as necessary and inspection and test repeated. Repairs shall be made with new materials. No caulking of threaded joints or holes will be allowed.

D. Do not conceal pipe until satisfactorily tested.

E. Testing with air will not be allowed.

3.10 BALANCING

A. Balance water distribution system. Adjust control valves for proper operation. Set balancing valves to maintain hot water in hot water system.

B. Balance flush valves, flow control valves and mixing valves for adequate flow and temperature to plumbing fixtures and equipment.

3.11 DISINFECTION

A. Disinfect water piping in the following manner:
   1. Clean and flush water pipe with water until water at remote tap is clear.
   2. Fill water systems with solution containing 50 ppm of chlorine (minimum concentration). Allow solution to stay in water system for 24 h. Alternately use solution of 200 ppm of chlorine (minimum concentration) for 3 h.
   3. Flush water system of chlorine solution.
   4. Allow clean water to stand in system for 24 h. Take sample from remote tap for bacteriological test.

B. Do not use water system for potable water supply until safe bacteriological test is obtained. Repeat steps 1 through 4 until safe water system is obtained.

3.12 BACTERIOLOGICAL TESTS

A. Take representative water samples and test to ensure bacteriologically safe water supply system. Include HPC (Heterotrophic Plate Count) test and test for presence of Pseudomonas aeruginosa as well as regular coliform bacteria test. HPC test maximum containment level of 500 organisms/ml. Perform bacteriological tests shortly before Owner`s acceptance of building. If tests fail, make corrections and retest.

B. When connecting to existing water supply of unknown quality, sample for analysis and comparison with finished water system analysis shall be taken prior to making new connection. This will allow isolating source of contamination from within scope of work or pre-existing water supply. Final conditions shall meet criteria specified above for areas within scope of work.

END OF SECTION

SECTION 22 13 14
SANITARY WASTE AND STORM DRAINAGE SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

This Section includes materials and methods for sanitary waste and vent, clearwater waste and vent, storm drainage, and overflow storm drainage piping systems within and including piping to 5 ft outside building wall.

1.02 RELATED WORK

A. Section 22 05 20 - Plumbing Excavation and Backfill

B. Section 22 05 29 - Plumbing Piping and Equipment Supporting Devices

C. Section 22 05 53 - Plumbing Systems Identification

D. Section 22 11 14 - Exterior Services

E. Section 22 11 18 - Water Distribution System

1.03 REFERENCE

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

1.04 QUALITY ASSURANCE

A. Order piping with each length marked with manufacturer`s name or trademark and type of pipe; with each shipping unit marked with purchase order number, metal or alloy designation, temper, size, and supplier`s name.

B. Installed material not meeting specification requirements must be replaced with material that meets these specifications without additional cost to Owner.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Promptly inspect shipments to ensure material is undamaged and complies with Specifications.

B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends from damage. End caps shall remain in place. Protect fittings by storage inside or by durable, waterproof, above ground packaging.

C. Offsite storage agreements will not relieve Contractor from using proper storage techniques.

D. Storage and protection methods must allow inspection to verify products.

1.06 SUBMITTALS

A. Manufacturer`s technical data for the following:
   1. Pipe and fittings
   2. Joints
   3. Cleanouts
   4. Floor drains and floor sinks
   5. Roof drains
   6. Downspout boots
   7. Downspout nozzles
   8. Air gap fittings
   9. Traps

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials herein specified shall be new, unless otherwise noted.

2.02 PIPE, FITTINGS, AND JOINTS

A. Interior Underground 15" and Smaller:
   1. Cast Iron:
      a. Pipe: Hubless cast iron pipe, ASTM A888, CISPI 301, NSF certified with material test reports from marked with collective trademark of Cast Iron Soil Pipe Institute or receive prior approval by Engineer.
      b. Fittings: Hubless cast iron fittings, ASTM A888, CISPI 301, NSF certified with material test reports from marked with collective trademark of Cast Iron Soil Pipe Institute or receive prior approval by Engineer.
      c. Joints: Heavyweight no-hub couplings with stainless steel clamps, FM 1680 Class 1, ASTM C-1540, Mission Heavyweight, Husky Series 4000, Ideal Tridon “HD”, or Clamp-All Hi-Torq 125

B. Interior Above Ground:
   1. Cast Iron:
      a. Pipe: Hubless cast iron pipe, ASTM A888, CISPI 301, NSF certified with material test reports from marked with collective trademark of Cast Iron Soil Pipe Institute or receive prior approval by Engineer.
      b. Fittings: Hubless cast iron fittings, ASTM A888, CISPI 301, NSF certified with material test reports from marked with collective trademark of Cast Iron Soil Pipe Institute or receive prior approval by Engineer.
      c. Joints: Heavyweight no-hub couplings with stainless steel clamps, FM 1680 Class 1, ASTM C-1540, Mission Heavyweight, Husky Series 4000, Ideal Tridon “HD”, or Clamp-All Hi-Torq 125
   2. Copper:
      a. Pipe: Type M copper tube, ASTM B88

b. Fittings:
   1) Cast copper drainage fittings (DWV), ANSI/ASME B16.23
   2) Wrought copper drainage fittings (DWV), ANSI/ASME B16.29
c. Joints: Lead free (<0.2%) solder, ASTM B32; flux, ASTM B813

2.03 CLEANOUTS

A. Provide recessed, solid brass, cleanout plugs where fittings are used as cleanouts. Provide taper-thread plug with Teflon tape thread wrap.

B. Floor Cleanouts: Cleanout with cast iron ferrule, adjustable top, nickel-bronze scoriated cover and frame, bronze taper-thread plug, equal to J.R. Smith 4033L. Provide flashing flange and clamp where cleanout is installed in elevated slabs, J.R. Smith 4033L-F-C or equal.

C. Floor Cleanouts, Tiled Areas: Cleanout with cast iron ferrule, adjustable square tile top, nickel-bronze scoriated cover and frame, and bronze taper-thread plug, J.R. Smith 4053L or equal. Provide flashing flange and clamp where cleanout is installed in elevated slabs, J.R. Smith 4053L-F-C or equal.

D. Floor Cleanouts, Unfinished Floors and Areas Outside Building: Cleanout with cast iron ferrule, adjustable round top, scoriated cast iron tractor cover, and bronze taper-thread plug, equal to J.R. Smith 4239L. Provide flashing flange and clamp where cleanout is installed in elevated slabs, J.R. Smith 4239L-F-C or equal.

E. Wall Cleanouts: Cleanout with cast iron counter sunk ferrule, bronze or brass taper-thread plug, secured stainless steel access cover, J.R. Smith 4472T or equal.

2.04 FLOOR DRAINS

A. Floor drains shall be in accordance with ANSI/ASME A112.21.1M. Provide with caulked or no-hub connection. Floor drains shall have internal seepage collar for embedding in floor construction and weep holes to provide adequate drainage to drainpipe. Include trap primer connection where indicated on drawings.

2.05 ROOF DRAINS AND OVERFLOW DRAINS

A. Roof drains and overflow drains shall have cast iron body with adjustable collar, cast-iron flashing ring, gravel stops, 10" diameter cast iron dome strainer, and cast iron underdeck clamp. J.R. Smith 1010Y-RC-CID or equal.

B. Expansion joints shall be cast iron joint with bronze pipe sleeve and neoprene gasket. J.R. Smith 1710 or equal.

2.06 AIR GAP FITTINGS

A. Air gap fittings constructed of cast iron with integral air gap having free area of at least twice the inlet area. J.R. Smith 3950 or equal.

2.07 DOWNSPOUT BOOTS

A. Downspout boots shall be cast iron with inlet hub that matches downspout, 2" offset away from wall, pipe spigot outlet, and wall fastening lugs, equal to Neenah R-4925 Series.

2.08 DOWNSPOUT NOZZLES

A. Downspout nozzles shall be polished bronze body, wall flange and threaded inlet, J.R. Smith #1770-PB or equal.

2.09 TRAPS

A. Same material as pipe or fittings unless specified with fixtures. Refer to Section 22 40 00 - Plumbing Fixtures. Provide 17 ga brass, chrome plated traps for exposed traps.

PART 3 - EXECUTION

3.01 INSTALLATION - GENERAL

A. Install pipe and fittings in accordance with reference standards, manufacturer`s recommendations and recognized industry practices.

B. Connect piping to fixtures, each piece of equipment, and drains. Install required piping as shown on drawings.

C. Grade horizontal lines with minimum of 1/4" per ft, except piping 4" diameter or larger which may be run at 1/8" per ft slope with approval of local authority.

D. Install piping parallel with building lines and at heights, which do not obstruct any portion of window, doorway, stairway, or passageway, except, as may be shown on plans. Install overhead piping as high as possible.

E. Grade vent pipe for complete drainage by gravity to soil or waste pipes. Vent terminations shall be set true and level. Locate vent piping at least 10 ft away from window, door or intake openings. Coordinate closely with roofing Contractor to prevent damage to roofing membrane. Flashing shall be in accordance with requirements of roofing manufacturer.

F. Where interferences develop, offset or reroute piping as required to clear interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. Consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

G. Provide protective sleeve covering of elastomeric pipe insulation, where piping and/or fittings are embedded in masonry or concrete.

H. Maintain piping in clean condition internally during construction.

I. Mitered ells, notched tees, and orange peel reducers are not allowed. Bushings are not allowed on threaded piping.

J. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including required service space for this equipment, unless piping is serving this equipment.

K. Set cleanouts true and level and protect properly throughout construction.

L. Set floor drains true and level and protect properly throughout construction. Weep holes shall be filled with removable material and kept free from concrete and other debris during construction. Weep holes shall be cleaned out for final working order. Provide safing for floor drains installed in elevated slabs.

M. Trap each fixture and piece of equipment requiring sanitary drainage connections. Trap seals shall be standard depth, except when deep seals are required by code. Traps shall be set true and level and located within limits of code requirements. Traps shall not be used as separator, interceptor or other type of device to retain solids. Traps shall be provided with thread type approved cleanout plugs when specified. Protect traps during construction and seal off to prevent stones, debris and other foreign matter from entering before use. Locate running traps for full accessibility with double cleanout.

N. Provide plugs or caps for pipe openings during construction to prevent debris from entering pipe. Temporary plug shall be plastic cap or equivalent.

3.02 UNDERGROUND WARNING TAPE

A. Provide warning tape for exterior buried sewers per Section 22 05 53 - Plumbing Systems Identification.

3.03 COPPER TUBING

A. Copper tubing shall be installed per Copper Development Association guidelines in addition to methods specified herein.

B. Soldered Copper Joints:
   1. Use non-acidic and lead free flux on cleaned pipe and fittings for soldered joints.
   2. Cut tube square, remove burrs from exterior of tube and ream interior of tube before assembly.
   3. Fill joints with solder by capillary action. Solder shall cover joint periphery. Wipe joint clean.
   4. Apply heat carefully to prevent damage to pipe, fittings and valves.
   5. Follow manufacturer’s recommendations when heating valves and equipment for soldered connections.

C. Grooved Copper Joints:
   1. All grooved end piping products shall be supplied by single manufacturer. Grooving tools shall be supplied by same manufacturer as grooved fittings and components.
   2. Install rolled groove copper pipe and fittings using equipment specifically for copper tube by mechanical coupling manufacturer.
   3. Use only those couplings and gaskets so designated for copper tube.
      a. The gasket style and elastomeric material (grade) shall be verified as suitable for intended service as specified.
      b. Gaskets shall be supplied by the grooved coupling manufacturer.
   4. Flaring of tube and fitting ends to IPS dimensions is not permitted.
   5. Grooved end shall be clean and free from indentations, projections, and roll marks in area from pipe end to groove for proper gasket sealing.
   6. Factory-trained field representative shall provide on-site training for Contractor’s field personnel in proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically review product installation. Contractor shall remove and replace any improperly installed products.

3.04 CAST IRON PIPE

A. No-hub Piping: Place gasket on end of one pipe of fitting and clamp assembly on end of other pipe or fitting. Firmly seat pipe or fittings ends against integrally molded shoulder inside neoprene gasket. Slide clamp assembly into position over gasket. Tighten fasteners to manufacturer`s recommended torque.

B. Install cast iron pipe and fittings as recommended by CISPI in their publication "Installation of Cast Iron Soil Pipe and Fittings".

C. Support piping at every coupling. Locate hanger within 18" of coupling.

D. Installations with multiple joints within a 4 ft developed length shall be supported at every second joint.

E. Secure base of risers with thrust restraints to prevent joint separation. Restraint shall be in accordance with CISPI recommendations.

F. Brace , horizontal piping 5" and larger to prevent horizontal movement. Install bracing at every branch connection and every change of direction in accordance with CISPI recommendations.

3.05 DUCTILE IRON PIPE

A. Clean pipe end and socket. Clean and lubricate pipe end and gasket with soapy water or gasket lubricant. Place gland and gasket, properly oriented, on pipe end. Insert pipe end fully into socket and press gasket evenly into recess keeping joint straight. Press gland evenly against gasket, insert bolts and hand tighten nuts. Make joint deflection prior to tightening bolts. Evenly tighten bolts in sequence to recommended torque.

B. Provide thrust blocks or restrained joints for piping sized 3" and larger. Provide thrust restraint at each change of direction exceeding 15 degrees and each fitting.

C. Pour concrete thrust blocks against compacted or undisturbed soil. Where soil-bearing capacity is less than 2000 psf or adjacent construction may affect soil-bearing capacity, use both concrete thrust blocks and strapped/rodded restraints or restrained joints. Field apply continuous anti-corrosion coating to strapped and rodded restraint components. Protect mechanical joints, nuts and bolts from concrete cover.

D. Anchors and tie rods can be provided in lieu of thrust blocks. Tie rods shall be 3/4" diameter steel rod. Clamps shall be 3/8" thick by 2" wide steel. Each clamp shall be secured with four 5/8" diameter bolts. Tie rods, clamps and bolts shall be liberally coated with asphaltum.

3.06 TESTING

A. Refer to Testing paragraph of Section 22 00 00 - General Plumbing Requirements.

B. Gravity Systems:

1. Water test may be applied to system either in its entirety or in sections. Piping shall be tightly plugged and submitted to 10 ft head of water located at highest point. Provide separate standpipe above highest point being tested or extend system to obtain required 10 ft head of water. Head shall be maintained for at least 30 minutes before inspection starts.

C. Defective work or material shall be replaced or repaired as necessary and inspection and test repeated. Repairs shall be made with new materials. No caulking of threaded joints or holes will be allowed.

D. Do not backfill pipe until successfully tested.

E. Testing with air will not be allowed.

END OF SECTION

SECTION 22 40 00
PLUMBING FIXTURES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section lists plumbing fixtures and accessories including method of installation.

1.02 RELATED WORK

A. Section 22 11 18 - Water Distribution System

B. Section 22 13 14 - Sanitary Waste and Storm Drainage Systems

1.03 REFERENCE

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

1.04 SUBMITTALS

A. One package of manufacturer's technical data for all items. Submittal shall be assembled brochure, showing cuts and full detailed descriptions for each item.

B. Shop drawings and product data on items specified herein.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials as specified shall be new unless otherwise noted.

B. Vitreous china fixtures shall be of highest quality, non-absorbent, hard-burned, and vitrified throughout.

C. Enameled ware shall be quality cast iron of uniform thickness and density, glazed to uniform depth and high gloss rubbed smooth, without chips or flaws, craze, or cracks, and completely acid resisting.

D. Stainless steel fixtures shall be 302/304 types of non-corrosive steel, 18 ga self-rim for cabinet sinks, 14 ga for free standing compartment type sinks. Sink material shall have satin finish and coved corners, with faucet holes punched to match specified faucet fitting.

E. Insulation for traps and supplies shall be molded closed cell vinyl insulation and shall meet ASTM E84 for flame and smoke spread. Insulation shall be vandal resistant and be color as listed.

2.02 WATER CLOSETS AND URINALS

A. Provide appropriate gaskets for fixture installation.

B. Provide bolts with chromium plated caps, nuts and washers.

2.03 WATER CLOSET SEATS

A. Heavy duty, elongated bowl, open front, plastic seat less cover, with stainless steel self-sustaining hinge, white, Bemis 1955-SSCT or equal.

2.04 DRAINS

A. Barrier-free Lavatories: Chrome plated brass offset grid drain, 1-1/4” seamless tailpiece, Chicago faucet 337-CP

2.05 TRAPS

A. Lavatories: P-traps shall be chrome plated brass body with cleanout plug, 17 ga seamless tubular wall bend, cast brass slip nuts and wall escutcheon. Trap size to match fixture connections.

B. Sinks: P-traps shall be chrome plated brass body with cleanout plug, 17 ga seamless tubular wall bend, cast brass slip nuts and wall escutcheon. Trap size to match fixture connections.

2.06 STOPS AND SUPPLIES

A. Lavatories: Angle pattern, lock shield cap, loose key handle, copper alloy control valve body, stem and gland nut, 1/2” NPT inlet x 3/8” compression outlet, Chicago Faucet 1017-ABCP or equal.

B. Sinks: Angle pattern, lock shield cap, loose key handle, copper alloy control valve body, stem and gland nut, 1/2” NPT inlet x 1/2” compression outlet, Chicago Faucet 1006-ABCP or equal.

C. Electric Water Cooler: Angle pattern, lock shield cap, loose key handle, copper alloy control valve body, stem and gland nut, 1/2” NPT inlet x 1/2” compression outlet, Chicago Faucet 1006-ABCP.

2.07 PROTECTIVE PIPE INSULATION COVERS

A. Manufactured plastic wraps for covering plumbing fixture hot and cold water supplies, trap and tailpieces shall comply with Americans with Disabilities Act (ADA) requirements.

B. Lavatories: Pre-wrapped off-set grid drain, 1-1/4” tailpiece, 1-1/2” x 1-1/2” cast brass p-trap with cleanout, 17 ga tubing outlet, includes insulation kit for water supplies and stops, McGuire Prowrap PW2125WC

2.08 PLUMBING FIXTURES

A. Refer to schedule on drawings for detailed fixture selection criteria not contained herein.

B. Submittal sheets for water closets, urinals, public lavatories and shower heads shall contain EPA WaterSense Label.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install plumbing fixtures as recommended by manufacturer. Caulk around fixtures mounted on irregular surfaces such as tile or stone with silicone sealant, same color as fixture.

B. Support fixtures with proper carrier for each use. Ensure that carrier is solidly anchored to prevent rocking whatever piping is used. Anchor bolts in carrier foot shall extend 3” minimum into concrete slab.

C. Install each fixture with trap easily removable for servicing and cleaning. Install fixture stops in readily accessible location for servicing.

D. Install barrier free fixtures in compliance with local code and Federal ADA Accessibility Guidelines. Install barrier free lavatory traps parallel and adjacent to wall and supplies and stops elevated to 27” above finished floor to avoid contact by wheelchair users.

E. Return fixture waste and supply piping into wall as high as practical under fixture. Provide accessible shutoff in fixture supply. Protect "barrier free" supply and drain piping with white colored wrap neatly trimmed to prevent contact with hot or sharp surfaces by user.

F. Coordinate with Electrical Contractor for electronic sensor wiring necessary to install "sensor" operated fixtures. Provide "shockstops" at supplies to solenoid activated fixtures.

G. Provide individual supplies to fixtures and rough-in fixture piping with adequate support to prevent movement fore, aft and laterally. Provide additional blocking as required.

H. Install flush valves for barrier-free water closets with operator handle facing wide side of toilet stall.

I. Provide unions at water connections to drinking fountains and electric water coolers.

3.02 PROTECTION

A. Protect finished surfaces of fixtures from accidental damage or discoloration by use of protective covering.

3.03 CLEANING

A. Prior to Owner acceptance, clean fixtures with compounds recommended by manufacturer and remove stains and marks from surrounding walls and countertops.

END OF SECTION

DIVISION 23 -- HVAC

SECTION 23 00 00
GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 REFERENCE

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

1.02 DESCRIPTION

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

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

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

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

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

F. Where Architectural features govern location of work, refer to architectural drawings.

G. Contractor may install additional piping, fittings and valves, not shown on drawings, for testing purposes or convenience of installation. Where such materials are installed, they shall comply with specifications and shall be sized to be compatible with system design. Remove such installed materials when they interfere with design conditions or as directed by Contracting Officer.

1.03 RELATED WORK

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

B. Continuity of Service:
   1. No service shall be interrupted or changed without permission from Contracting Officer and Owner. Obtain written permission before any work is started.

C. When interruption of services is required, Contracting Officer, Owner, and other concerned parties shall be notified and shall determine a time.

D. Demolition:
   1. Division 02 - Selective Demolition.
   2. Perform demolition as required to accomplish new work.
   3. Accomplish work in neat workmanlike manner to minimize interference, annoyance or inconvenience such work might impose on Owner or other Contractors.
   4. Unless otherwise noted, remove from premises materials and equipment removed in demolition work.
   5. Equipment noted to be removed and turned over to Owner, shall be delivered to Owner at place and time Owner designates.
   6. Where materials are to be turned over to Owner or reused and installed by Contractor, it shall be Contractor's responsibility to maintain condition of materials and equipment equal to that existing before work began. Repair or replace damaged materials or equipment at no additional cost to Owner.
   7. Where demolition work interferes with Owner's use of premises, schedule work through Contracting Officer, Owner and with other Contractor to minimize inconvenience to Owner. Architect Contracting Officer must approve schedule before Contractor begins such Work.

E. Concrete Work:
   1. Provide cast-in-place concrete as required by Contract Documents unless otherwise noted.
   2. Concrete shall comply with Division 03 - Concrete.
   3. Provide anchor bolts, metal shapes and templates required to be cast in concrete or used to form concrete for support of mechanical equipment.

F. Painting:
   1. Painting of mechanical equipment will be done under Division 09 unless specified otherwise or unless equipment is to be furnished with factory applied finish coats.
   2. Equipment
      a. Furnish equipment with factory applied prime finish unless otherwise specified.
      b. If factory finish on equipment furnished by Contractor is damaged in shipment or during construction, refinish equipment to satisfaction of Contracting Officer.

1.04 REQUIREMENTS OF REGULATORY AGENCIES

A. Rules and regulations of Federal, State and Local Authorities and utility companies, in force at time of execution of Contract shall become part of this specification.

1.05 REFERENCE STANDARDS

A. Agencies or publications referenced herein refer to the following:
   1. AGA - American Gas Association
   2. AMCA - Air Movement and Control Association
   3. ANSI - American National Standards Institute
   4. AHRI - Air-Conditioning, Heating and Refrigeration Institute

5. ASHRAE - American Society of Heating Refrigerating and Air Conditioning Engineers
6. ASPE - American Society of Plumbing Engineers
7. ASSE - American Society of Sanitary Engineering
8. AWS - American Welding Society
9. AWWA - American Water Works Association
10. ASME - American Society of Mechanical Engineers
11. ASTM - American Society for Testing and Materials
12. CDA - Copper Development Association
13. CISPI - Cast Iron Soil Pipe Institute
14. FMG - FM Global
15. FS - Federal Specifications
16. IEEE - Institute of Electrical and Electronics Engineers
17. MCA - Mechanical Contractors Association
18. MSS - Manufacturers Standardization Society
19. NEC - National Electrical Code
20. NEMA - National Electrical Manufacturers Association
21. NFPA - National Fire Protection Association
22. NIST - National Institute of Standards & Technology
23. NSF - National Sanitation Foundation
24. NSPI - National Spa and Pool Institute
25. OSHA - Occupational Safety and Health Administration
26. PDI - Plumbing and Drainage Institute
27. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
28. UL - Underwriters Laboratories, Inc.
29. WQA - Water Quality Association

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

1.06 SUBMITTALS

A. Product Data:
1. Refer to Division 01 - Submittal Procedures.
2. Unless otherwise indicated submittals shall be in electronic Portable Document Format (pdf) and bookmarks shall be included to facilitate navigation through submittal documentation.
3. Submit for equipment and systems as requested in the respective specification sections.
4. Specifically mark general catalog sheets and drawings to indicate specific items submitted and its correlation to specific designation for product in drawings.
5. Specifically indicate proper identification of equipment by name and/or number, as indicated in specification and shown on drawings.
6. When manufacturer's reference numbers are different from those specified, provide correct cross-reference numbers for each item. Clearly mark and note submittals accordingly.

7. Submit complete record of required components when fixtures, equipment and items specified include accessories, parts and additional items under one designation.
8. Include composite wiring diagrams for electrically powered equipment and devices.
9. Where submittals cover products containing non-metallic materials, include "Material Safety Data Sheet" (MSDS) from manufacturer stating physical and chemical properties of components and precautionary considerations required.
10. Submit shop drawings or product data as soon as practicable after signing contracts. Submittals must be approved before installation of materials and equipment.
11. Submittals that are not complete, not permanent or not properly checked by Contractor will be returned without review.

B. Certificates and Inspections:
1. Obtain and pay for inspections required by authorities having jurisdiction and deliver certificates approving installations to Owner unless otherwise directed.

C. Operation and Maintenance Manuals:
1. Refer to Division 01 - Operation and Maintenance Data.
2. Upon completion of Work but before final acceptance of system, submit to Contracting Officer for approval, 3 copies of operation and maintenance manuals in loose-leaf binders. If "one copy" is larger than 2" thick or consists of multiple volumes, submit only one set initially for review. After securing approval, submit 3 copies to Owner.
3. Organize manuals by specification section number and furnish table of contents and tabs for each piece of equipment or system.
4. Fire protection system shall be separately bound.
5. Manuals shall include the following:
   a. Copies of Shop Drawings and Product Data
   b. Manufacturer's operating and maintenance instructions. Include parts lists of items or equipment, with component exploded views and part numbers. Where manufacturer's data includes several types or models, designate applicable type or model.
   c. Electronic versions O&M data with exploded parts lists where available
   d. Phone numbers and addresses of local parts suppliers and service companies
   e. Internet/WEB page addresses where applicable
   f. Wiring diagrams
   g. Startup and shutdown procedures
   h. Composite electrical diagrams
   i. Flow diagrams
   j. Lubrication instructions
   k. Factory and field test records (Refer to Test and Balancing in Part 3 of this section.)
   l. Air and water balance reports
   m. Valve identification charts as specified in Section 22 05 53 - Plumbing Systems Identification
   n. Access panel identification charts as specified in Section 22 05 53 - Plumbing Systems Identification
   o. Additional information, diagrams or explanations as designated under respective equipment or systems specification sections.

6. Instruct Owner's representative in operation and maintenance of equipment. Instruction shall include complete operating cycle on all apparatus.
7. Furnish O&M Manuals and instructions to Owner prior to request for final payment.

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

1.07 JOB CONDITIONS

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

B. Electrical Coordination:
1. Refer to Section 23 05 13 - Motors for Mechanical Equipment
2. Contractor shall provide the following items as specified under their respective Division(s):
   a. Motors
   b. Electrically powered equipment
   c. Electrically controlled equipment
   d. Starters, where specified
   e. Variable frequency drives, where specified
   f. Control devices, where specified
   g. Temperature Control wiring
   h. Wiring diagrams to Electrical Contractor for apparatus indicating external connection and internal controls.
   i. Disconnect devices furnished with units (VFDs, chillers, prepackaged control devices, etc.)
      1) Devices shall have an interrupting rating not less than that of the upstream overcurrent device as shown on electrical drawings.
      2) Equipment electrical connection points shall be labeled with listed electrical short circuit current rating (SCCR). SCCR shall not be less than interrupting rating of upstream overcurrent device as shown on electrical drawings. SCCR shall be marked on equipment control enclosure in accordance with UL 508, or other acceptable, accredited third-party testing agency standards.
3. Electrical Contractor will provide the following devices required for control of motors or electrical equipment, unless noted otherwise.
   a. Starters
   b. Disconnect devices
   c. Control devices:
      1) Pushbuttons
      2) Pilot lights
      3) Contacts
   d. Conduit, boxes and wiring for power wiring.

e. Conduit, boxes and wiring for control wiring, except temperature control wiring.

4. Electrical Contractor will make connections, from power source to starter or variable frequency drive and from starter or variable frequency drive, where specified, to motor.
5. Where starters or other similar control devices are furnished by this Contractor, they shall be installed by this Contractor and wired by Electrical Contractor.
6. Should any change in size, hp rating, voltage, or means of control be made to any motor or other electrical equipment after Contracts are awarded, this Contractor shall immediately notify Electrical Contractor of change. Additional costs due to these changes shall be responsibility of this Contractor.

C. Cutting and Patching:

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

D. Housekeeping and Cleanup:

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

1.08 WARRANTY

A. Refer to Division 01 for general warranty requirements.

B. Refer to technical sections for warranty requirement for each system.

1. Where no warranty requirements are called out, warrant equipment, materials, and workmanship to be free from defect as called out in Division 01.

C. Warrant that systems will operate without objectionable noise, vibration and uncontrolled expansion.

D. Repair, replace or alter systems or parts of systems found defective at no extra cost to Owner.

E. In any case, wherein fulfilling requirements of any warranty, if this Contractor disturbs any work warranted under another contract, this Contractor shall restore such disturbed work to condition satisfactory to Contracting Officer and warranty such restored work to same extent as it was warranted under such other contract.

F. Warranty shall include labor, materials, and travel time.

PART 2 - PRODUCTS

2.01 PRODUCT SUBSTITUTIONS

A. Refer to Division 01 - Product Requirements.

PART 3 - EXECUTION

3.01 GENERAL

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

3.02 DELIVERY, STORAGE, HANDLING, AND PROTECTION

A. Deliver products to the site under provisions of Division 01.

B. Store and protect products under provisions of Division 01.

C. Store in clean, dry space.

D. Maintain factory wrapping or provide cover to protect units from dirt, water, construction debris, and traffic.

E. Handle in accordance with manufacturer's written instructions.

F. Handle carefully to avoid damage to components, enclosure, and finish. Lift only with lugs provided for the purpose.

G. Provide supplemental heat if required to prevent equipment from moisture contamination.

H. Protect openings in equipment until connected to system to prevent entry of foreign materials.

3.03 FLOOR, WALL, ROOF AND CEILING OPENINGS

A. Coordinate location of openings, chases, furred spaces, etc., with appropriate Contractors. Provide sleeves and inserts that are to be built into structure during progress of construction.

B. Remove temporary sleeves, if used to form openings, prior to installation of permanent materials. Utilize minimum 24 ga galvanized sheet metal for permanent sleeves unless otherwise noted.

C. Provide Schedule 40 carbon steel pipe with integral water stop for steel sleeves required in interior floor slabs.

D. Submit to Structural Engineer for review and approval size and location of core-drilled holes prior to execution.

E. Submit product data and installation details for penetrations of building structure. Include schedule indicating penetrating materials (metal pipe, plastic pipe, conduit, etc.), sizes of each, opening sizes and sealant products intended for use.

F. Where penetrations of fire-rated assemblies are involved, seal penetrations with appropriate firestopping systems as specified in Division 07.

G. Submit complete penetration layout drawings showing openings in building structural members including floor slabs, bearing walls, shear walls, etc. Indicate and locate, by dimension, all required openings, including those sleeved, formed or core drilled. Drawings shall be approved prior to preparing openings in structural member.

H. Provide minimum 1” clearance around penetration openings intended for pipe. Where fire resistant penetrations are required, size openings in accordance with written recommendations of firestopping systems manufacturer.

I. Openings for underground pipes passing through foundations or under footings shall have minimum clearance of 1-1/2” to concrete. Do not disturb footing bearing soil.

J. Openings for underground pipe passing through on grade concrete slabs shall have minimum 1/4” clearance to concrete. Seal openings with urethane caulk.

K. Openings for insulated piping shall be sized based on outside diameter of insulation when it is specified or detailed to be continuous through opening.

L. Openings for duct penetrations shall be no more than1/2" larger on all sides than size of duct or duct including duct insulation, if applicable. Where firestopping systems are required at penetrations, size in accordance with recommendations of firestopping systems manufacturer, but opening shall not exceed 1” average clearance on all sides. Openings for ducts with fire dampers shall be in accordance with fire damper installation requirements.

M. Duct penetrations through concrete floors in mechanical rooms containing liquid heat exchangers and/or pumps shall have 2” high water stopped curbs surrounding openings. This applies to mechanical rooms above the lowest floor level.

N. Seal non-fire-rated floor penetrations with non-shrink grout equal to Embeco by Master Builders, or urethane caulk, as appropriate.

O. Seal non-fire-rated wall openings with urethane caulk.

P. Where penetrations occur through exterior walls into building spaces, use sleeves with integral water stop. For piping having outer surface temperature less than 150°F, use plastic (HDPE) sleeves, similar to PSI Link-Seal Model CS, rated to 150°F. For piping having outer surface temperature 150°F or higher, or where steel sleeves are shown or walls are fire rated, use steel sleeves with hot dip galvanizing, similar to PSI Link-Seal Model WS. Seal annular space between sleeves and pipe with Thunderline "Link-Seal" modular wall and casing seals, or sealing system by another manufacturer approved as equal by Contracting Officer. Where "Link-Seals" are used with insulated pipe, insulation shall be butted against seals on both sides. Sealing system shall utilize Type 316 stainless steel bolts, washers and nuts.

Q. In lieu of openings as specified herein penetration systems as manufactured by Pro Set may be used, including sleeve couplings and plug.

R. If total ProSet system with Water Guard “CR” is used, opening shall not need additional water proofing or riser clamps.

S. Finish and trim penetrations as shown on details and as specified.

T. Provide chrome or nickel-plated escutcheons where piping passes through walls, floors or ceilings and is exposed in finished areas. Size escutcheons to fit pipe and pipe covering for finished appearance. Finished areas shall not include mechanical/electrical rooms, janitors' closets, storage rooms, etc., unless suspended ceilings are specified.

U. Trim duct penetrations exposed in finished areas with 2” wide galvanized or aluminum trim collars properly sized to fit duct. Collars shall be same gauge as duct, prime finish unless noted otherwise. Finished areas shall not include mechanical rooms, janitors' closets, storage rooms, etc., unless suspended ceilings are specified.

3.04 EQUIPMENT SHUTOFF VALVES

A. Provide shutoff valves at equipment connected to piping system. Refer to valve section or system section for requirements of valve type.

3.05 EQUIPMENT ACCESS

A. Install piping, conduit and accessories to permit access to equipment for maintenance. Relocate piping, equipment or accessories to provide access at no additional cost to Owner.

B. Install equipment with sufficient maintenance space for removal, repair or changes to equipment. Provide ready accessibility to equipment without moving other future or installed equipment (including light fixtures) or system components.

C. Access doors in walls, chases, or inaccessible ceilings will be provided under Division 08 - Access Doors and Frames, unless otherwise indicated. Access doors for valves, shock stops or other equipment shall provide access for servicing, repairs, and/or maintenance.

D. Provide necessary coordination and information to the Trade Contractor under Division 08 - Access Doors and Frames. This information shall include required locations, sizes, and rough-in dimensions.

E. Provide access doors in walls, chases or above inaccessible ceilings for valves, shock stops, unions or equipment/devices requiring access for servicing, repairs or maintenance, unless otherwise noted. Access frames and doors shall be as manufactured by Milcor, Incorporated, or similar, of style applicable to surface. Provide access doors used in fire rated construction with UL (FRD) Label. Provide steel, prime coated access doors unless otherwise specified. Provide stainless steel doors in ceramic tile walls, toilet rooms, locker rooms and in areas subject to excessive moisture. Provide access doors of sufficient size to allow complete maintenance. Coordinate location of access doors with General Contractor and rough-in equipment accordingly.

3.06 EQUIPMENT SUPPORTS

A. Provide supporting steel not indicated on drawings as required for installation of equipment and materials including angles, channels, beams, hangers, etc.

3.07 EQUIPMENT GUARDS

A. Provide equipment guards over belt driven assemblies, pump shafts, exposed fans, and elsewhere as indicated in this Specification or required by Code.

B. Paint equipment guards bright yellow.

C. Equipment guards shall comply with OSHA requirements.

3.08 SUPPORT PROTECTION

A. In occupied areas, mechanical rooms and areas requiring normal maintenance access, guard certain equipment to protect personnel from injury.

B. Provide minimum 1/2" thick Armstrong Armaflex insulation or similar product applied with Armstrong 520 adhesive on lower edges of equipment and mechanical supporting devices suspended less than 7 ft above floors, platforms or catwalks in these areas.

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

3.09 MECHANICAL SYSTEMS IDENTIFICATION

A. Refer to Section 23 05 53 - Mechanical Systems Identification

3.10 TEST AND BALANCING

A. Tests for equipment, ductwork and piping systems shall be performed as specified in their respective specification sections in accordance with technical requirements noted.

B. Provide equipment required for testing, including fittings for additional openings required for test apparatus.

C. All ductwork and piping inspections and testing shall be successfully completed and approved before application of covering materials.

D. When equipment or systems fail to meet minimum test requirements, replace or repair defective work or material as necessary and repeat inspection and test until equipment or systems meet test requirements. Make repairs with new materials. Caulking of holes or threaded joints is not allowed.

E. Contractor is responsible for certifying in writing equipment and system test results. Certification shall include identification of portion of system tested, date, time, test criteria, test medium and pressure used, duration of test and name and title of person signing test certification document.

F. Maintain copies of certified test results, including those for any failed tests, at project site. At completion of project, include copies of test records and certifications in O&M Manuals.

G. Balancing of various systems shall be in accordance with associated specification sections in addition to requirements noted herein.

3.11 START-UP

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

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

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

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

E. Coordinate start-up with all trades.

3.12 CLEANING

A. Clean systems after installation is complete.

B. Clean piping and ductwork both internally and externally to remove dirt, plaster dust or other foreign materials. When external surfaces of piping are rusted, clean and restore surface to original condition.

C. Clean pipeline strainers to restore them to original condition or replace with new strainer elements.

D. Clean equipment and plumbing fixtures as recommended by manufacturers.

E. Replace throwaway or replaceable media air filters used during construction period with new filters or new filter media after construction has been completed and before building is turned over to Owner. Filter replacement shall be as hereinafter specified.

F. Blow and clean dirt, plaster dust and other foreign matter from coils, terminal devices, diffusers, registers and grilles.

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

H. Provide additional cleaning of individual piping systems and apparatus as hereinafter specified.

END OF SECTION

SECTION 23 05 13
MOTORS FOR MECHANICAL EQUIPMENT

PART 1 - GENERAL

1.01 REFERENCE

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

1.02 SUBMITTALS

A. Product Data including the following:
   1. Manufacturer
   2. hp, voltage, phase, hertz, rpm
   3. Motor type
   4. Enclosure type
   5. Frame type
   6. Insulation class
   7. NEMA design designation
   8. Service factor
   9. Nominal efficiency at full load
   10. Power factor at full load
   11. Full load amperes
   12. Bearings
   13. Mountings
   14. Dimensions
   15. Weight
   16. Shaft grounding brush for motors driven by Variable Frequency Drives (VFD)

1.03 PRODUCT CRITERIA

A. Motors covered by this Specification shall conform to applicable requirements of NEMA, IEEE, ANSI, and NEC Standards and shall be UL Listed where applicable for service specified.

B. Motors shall be designed for conditions in which they will be required to perform; i.e., general purpose, splash proof, explosion proof, standard duty, high torque or other special type as required by equipment manufacturers.

C. Select motors so they do not exceed nameplate rating nor operate into service factor to meet specified duty.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials shall be new and guaranteed for service intended.

2.02 INDUCTION MOTORS

A. Voltage Ratings
   1. Refer to equipment schedules and specification sections for voltages required.
   2. Unless otherwise indicated, motors 1/3 hp and smaller shall be rated 115 V for operation on 120 V, 1 Ph, 60 Hz service.
   3. Unless otherwise indicated, motors 1/2 hp and larger shall be rated:
      a. 460 V for operation on 480 V, 3 Ph, 60 Hz service.
      b. 200 V for operation on 208 V, 3 Ph, 60 Hz service.
      c. 230 V for operation on 240 V, 3 Ph, 60 Hz service.

B. Motors shall be 4 pole (approximately 1750 rpm) unless otherwise noted.

C. Single-phase motors shall be furnished with built-in thermal overload protection.

D. Use NEMA Design B motors, normal starting torque with regreasable ball bearings, and Class B insulation unless specified otherwise or unless manufacturer of equipment on which motor is being used has more stringent requirements.
   1. Bearings shall be rated for minimum AFBMA 9, L-10 life of 26,280 hours (belted) and 200,000 hours (direct-coupled) at full-load.

E. Motors shall be rated continuous duty and have 1.15 service factor unless otherwise noted.

F. Motors Driven by Variable Frequency Drives (VFD)
   1. Motors shall comply with the latest NEMA MG 00001, Section IV, Part 31.
   2. Motors shall have service factor not less than 1.0 at rated load.
   3. Insulation shall be Class F or H.
   4. Furnish each motor with shaft grounding ring utilizing conductive microfiber similar to AEGIS SGR to protect motor bearings from electrical damage.

G. Vibration shall not exceed 0.15" per second, unfiltered peak unless otherwise noted.

H. Motors (180 frames and larger) shall have provisions for lifting eyes or lugs capable of safety factor of 5.

I. Single-phase motors for hard starting applications including outdoor applications shall be capacitor start type. Motors for fans and pumps located indoors may be split phase or permanent split-capacitor. Motors shall be equipped with permanently lubricated and sealed ball bearings and shall be selected for quiet operation. Motors 1/8 hp and below may be shaded pole type.
   1. Refer to individual equipment section for additional requirements or specific type of motors.

J. 3 Ph, 2-speed motors shall be one winding, consequent pole, variable torque type and 1 Ph, 2-speed motors shall be capacitor start capacitor run type.

K. When submersible pumps are specified, each pump shall include in addition to controls specified, all necessary controls, relays, wiring, etc. that may be required for safety features incorporated in motor design. No submersible motor shall be run or activated until all requirements of motor manufacturer's recommendations have been complied with.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install materials in accordance with drawings, approved Shop Drawings and manufacturer's recommendations.

END OF SECTION

SECTION 23 05 29
MECHANICAL PIPING AND EQUIPMENT SUPPORTING DEVICES

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 23 05 50 - Vibration Isolation

B. Section 23 31 14 - Ductwork

1.02 REFERENCE

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

1.03 DESCRIPTION

A. Provide all supporting devices not provided as part of building structure or indicated on structural drawings or structural details, as specified and as required for proper supporting, anchoring, and guiding of piping, equipment, materials and systems.

B. Support for all conditions of operation, including variations in installed and operating weight of equipment, piping and ductwork, to prevent excess stress and allow for proper expansion and contraction.

1.04 SUBMITTALS

A. Product Data for each piping system for all pipe sizes and all applicable equipment including the following:
   1. Manufacturer's name
   2. Model numbers
   3. Materials of construction and load ratings lbs.
   4. Schedule of hangers and support devices with pipe support spacing
   5. Insulated pipe supports along with application chart or table including pipe support spacing.
   6. Insulation protection saddles and weight bearing insulation table
   7. Details and calculations for sizing supplementary steel utilized for trapeze or specially designed supports
   8. Structural attachments, concrete inserts, and concrete anchors. Submit ICC-ES Evaluation Report for each type of concrete insert and anchor.
   9. Calculations and drawings for concrete inserts and anchors for each application shall be submitted when requested by Owner or Engineer.
   10. Drawings showing specific locations of any weld attachments to structure, including weight supported by such attachments

11. Drawings showing specific locations of any suspended loads which exceed 100 lbs within joist chord panel to be attached to open web steel joist structural members. Include weight supported by such attachments. (Panel is length of chord between two adjacent diagonal web members at point of connection to chord.)
12. Equipment mounting devices
13. Pipe guides and anchors
14. All other appropriate data

B. Submittals in PDF format shall be organized using PDF bookmarks per detailed instructions on assembling submittal packages identified under Submittal Requirements section of 23 00 00 - General Mechanical Requirements

1.05 DESIGN CRITERIA

A. Materials and application of pipe hangers and supports shall conform to the latest requirements of ANSI B31/ASME B31.1 Code for Pressure Piping and MSS Standard Practice SP-58-2018 (Pipe Hangers and Supports Materials, Design, Manufacture, Selection, Application, and Installation), except as supplemented or modified herein.

B. Support materials shall be steel or stainless steel unless specifically indicated.

C. Support devices shall be factory fabricated and have published load ratings.

D. Unless otherwise indicated, design supports, anchors, and related components with safety factor in accordance with AISC Manual of Steel Construction, but not less than 2.0.

E. Determine maximum deflection using the following equation.

F. Maximum deflection of support members, including trapeze supports, shall be in accordance with the following equation, but shall not exceed 0.3":

$D = L/240$

D = Max deflection in inches

L = Support member length in inches

G. Unless otherwise indicated, hangers, support devices and hardware shall be steel and shall have factory standard black, primed, galvanized or electroplated finish for indoor application, and hot-dipped galvanized finish for outdoor application and corrosive atmospheres. Coat cut edges, welds or any damaged finish with galvanized paint.

1. Corrosive atmospheres include the following locations:
   a. Exterior locations
   b. Chemical storage and hazardous waste storage rooms
   c. Food service/kitchen areas
   d. Locker/shower rooms
   e. Meter pits
   f. Utility tunnels
   g. Cage washrooms (dirty and clean)
   h. Sterilizer/autoclave rooms

H. Materials in contact with pipe shall be galvanically compatible with piping material to eliminate conductive path for galvanic corrosion. Where piping and support materials have galvanic potential, provide galvanic separation, such as nonmetallic coating or inserts between piping and metallic supports. Pipe insulation is acceptable galvanic separation. Galvanic potential shall be determined by table below:

	Galvanized Steel	**Carbon Steel**	**Stainless Steel (Type 304 or 316)**	**Copper Brass Bronze**
Copper, Brass, Bronze	Yes	Yes	No	NA
Stainless Steel (Type 304 or 316)	Yes Note (1)	Yes Note (1)	NA	
Carbon Steel	No	NA		
Galvanized Steel	NA			

(1) Required where stainless steel surface area near interface is equal or greater than steel surface area

I. Unless otherwise indicated, steel support devices exposed to ventilation air stream shall be stainless steel or steel with either galvanized finish or paint finish. Paint type shall be approved by Contracting Officer.

J. This Contractor is responsible for proper placement and sizing of supporting devices to accommodate insulation thickness and pitching of pipe. Coordinate with Contractor performing work specified in Section 22 07 00 - Plumbing Systems Insulation.

K. In addition to hangers specified in this Section, piping connected to pumps, compressors, and similar rotating or reciprocating equipment shall have vibration isolation hangers or supports for specified distance from such equipment. Refer to Section 23 05 50 - Vibration Isolation for required distance.

L. Piping connected to coils, which are in assembly mounted on vibration isolators, shall have vibration isolation hangers or supports as indicated above. Piping connected to coils, which are in equipment where fan assembly is separately isolated by vibration isolators and flexible connections, does not require additional vibration isolation hangers or supports. Refer to Section 23 05 50 - Vibration Isolation for flexible connections, vibration isolators and additional requirements.

M. Where piping can be conveniently grouped to allow trapeze type supports, supporting steel shall be by means of standard structural shapes.

N. Hangers and rods shall be plumb when pipelines are at their normal operating temperatures.

O. Unless otherwise indicated, continuous insert channels are not allowed.

P. Punching, drilling, or welding of building structural steel is not allowed unless approved by Structural Engineer.

Q. Refer to Structural Documents and ICC-ES Evaluation Report for application of concrete inserts and concrete anchors.

R. Lateral braces shall be designed and detailed to apply loads as directly as possible to structural floor slabs, roof decks, or other building lateral elements. Braces shall not be applied to bottom flanges of steel beams or bottom chords of open web steel joists.

S. Coordinate with Contractor for any proposed weld attachments to building structure. This may result in use of welding codes or standards, which may apply to "structural work". and may necessitate repair of fireproofing and/or extension of fireproofing to support members. Execution of this work may be assigned to General Trades responsible for building structural steel. Cost for this work, however, will remain the responsibility of this Contractor.

T. Top or bottom chords of open web steel joists may be used to support loads, provided total load within panel does not exceed 100 lbs and load is placed concentric to joist. (Panel is length of chord between two adjacent diagonal web members at point of connection to chord).

PART 2 - PRODUCTS

2.01 STRUCTURAL SUPPORTS

A. Unless specifically indicated on structural drawings, design and provide all supporting devices including miscellaneous steel (angles, channels, beams, etc.), required for proper support of piping, equipment and materials.

2.02 BOLTS, NUTS, STUDS AND WASHERS

A. ASTM A307, electroplated zinc finish

2.03 ROD ATTACHMENTS

A. Anvil Fig. 290 (MSS Type-17), galvanized finish

2.04 U-BOLTS

A. Anvil Fig. 137 (MSS Type-24), galvanized finish

2.05 BEAM CLAMPS

A. Beam Clamps: Anvil Fig. 133/134 (MSS Type-21), 218 (MSS Type-30), 228 (MSS Type-28 or 29) and 292 (MSS Type-28 or 29)

B. Top Beam Clamps: Anvil Fig. 227 (MSS Type-25)

C. C-Clamps: Anvil Fig. 86, 92 or 93 (MSS Type-19 or 23) with set screw and lock nut

2.06 METAL FRAMING SUPPORT SYSTEM (STRUT SYSTEM)

A. Manufacturers: Unistrut or equal.

B. Channels shall have epoxy paint or electroplated zinc finish.

C. Channels shall not be lighter than 12 ga.

2.07 EQUIPMENT RAILS

A. Manufacturers: ThyCurb equal for raised cant style for built-up roofing system. Mounting rails shall be galvanized steel with integral base plate, continuous welded corner seams, factory installed 2" x 4" wood nailer and 18 ga galvanized steel counter flashing.

B. Manufacturers: ThyCurb or equal for elastic sheet roofing system. Mounting rails shall be galvanized steel with integral base plate, continuous welded corner seams, factory installed 2" x 4" wood nailer and 18 ga galvanized steel counter flashing.

C. Mounting rail gauge shall be selected to support equipment adequately but shall be not less than 18 ga.

D. Height shall be as detailed, but not less than 8" above finished roof.

E. Equipment rails shall span minimum of 2 joists and not cantilever more than 6" where joists are used. Rails shall be level at top with pitch built in when deck slopes 1/4" per ft or greater.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install supports to allow for free expansion of piping. Support piping from building structural members using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. At no time shall hangers and supports overload building structural members. Fasten ceiling plates and wall brackets securely to structure and test to demonstrate adequacy of fastening.

B. Select and size building attachments properly in accordance with MSS Standards and manufacturer's published load rating information.

C. Piping and ductwork shall be supported independently from other piping or ductwork.

D. Do not support equipment, or piping from metal roof decking or ceiling grid.

E. Install adequate supports so as not to over stress either piping or equipment to which piping is connected.

F. Refer to Section 23 00 00 - General Mechanical Requirements for requirements of personnel injury protection guards for supporting devices.

3.02 EQUIPMENT RAILS

A. Use for all roof-mounted equipment, which is not curb mounted. Install bottom of equipment rail flat on roof deck. Insulate exterior of equipment rail.

B. Flashing will be by General Contractor. Provide counter flashing as specified and secure to wood nailer with stainless steel truss head screws.

END OF SECTION

SECTION 23 05 50
VIBRATION ISOLATION

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 23 05 29 - Mechanical Piping and Equipment Supporting Devices

B. Section 23 33 14 - Ductwork Specialties (Duct Flexible Connections)

1.02 REFERENCE

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

1.03 DESIGN CRITERIA

A. Isolate motor driven mechanical equipment, unless otherwise noted, from building structure, and from systems that they serve, to prevent equipment vibrations from being transmitted to structure. Unless specifically indicated, follow the latest edition of ASHRAE Handbook HVAC Applications - Sound and Vibration Control, or manufacturer's recommendations for isolator selection whichever is more stringent.

B. Select and locate isolators to produce uniform loading and deflection. Use minimum of 4 isolators to support each piece of equipment.

C. Select vibration isolation devices based on the lowest operating speed of equipment.

D. Vibration Criteria:

1. All rotating equipment shall operate at speeds less than 80% of their true critical speed. Unless otherwise required, equipment shall be balanced according to recommendations given in the following schedules.

Equipment Speed rpm	Maximum Allowable Vibration Displacement Peak -to-Peak (mil)
100 to 200	10
200 to 300	6
300 to 600	4
600 to 1000	3
1000 or 2000	2
over 2000	1

1.04 SUBMITTALS

A. Submit Shop Drawings and product data including the following:

1. Manufacturer's name
2. Isolator type and model number

3. Materials of construction and finish
4. Dimensional data
5. Load ratings lbs
6. Isolator free and operating heights
7. Static deflections
8. Isolation efficiency based on lowest operating speed
9. All other appropriate data

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials used shall retain their isolation characteristics for life of equipment served. Elastomeric materials shall comply with ASTM D2240 and shall be oil-resistant industrial grade neoprene.

B. Isolators shall be treated to resist corrosion.

C. Isolation devices subject to weather shall have either hot-dip or cold-dip galvanized, cadmium plated, or neoprene coated finish after fabrication and be furnished with limit stops to resist wind.

D. Vibration isolator springs shall have minimum additional travel to solid equal to 50% of rated deflection.

E. Ratio of lateral to vertical stiffness of vibration isolators shall not be less than 0.8 or greater than 2.0.

F. Coordinate selection of devices with isolator and equipment manufacturer.

2.02 TYPE 2 MOUNTS (NEOPRENE PAD)

A. Mason Type ND or rails Type RND or equal, double deflection neoprene mounts with cast-in metal inserts for bolting to equipment.

B. Both surfaces shall be rib molded for skid resistance. On equipment such as small vent sets and close coupled pumps, steel rails shall be used above mountings to compensate for overhang.

2.03 TYPE 4 MOUNTS (RESTRAINED SPRING WITH NEOPRENE)

A. Mason Type SLR or equal, combination spring and neoprene with rib molded base similar to Type 3 above, but shall have rigid housing with hold-down bolts to limit vertical as well as horizontal movement.

B. Installed and operating heights shall be the same. Maintain minimum clearance of 1/2" around restraining bolts and between housing and spring so as not to interfere with spring action. Limit stops shall be out of contact during normal operations. Use height saving brackets.

2.04 TYPE 5 HANGERS (SPRING HANGER WITH NEOPRENE)

A. Mason Type 30N or equal, vibration hangers with steel spring and neoprene element in series. Neoprene element shall be molded with rod isolation bushing that passes through hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit hanger rod to swing through 30° arc before contacting hole and short-circuiting spring.

B. Mason Type DNHS or equal may be used where load rating and specified deflection cannot be accommodated by Type 30N.

2.05 PERFORMANCE

A. Unless otherwise noted, select vibration isolation devices to achieve either minimum 95% isolation efficiency or minimum static deflection and mounting requirements listed in Table below, whichever is greater. For floor spans between increments indicated, use longer floor span indicated in table. Minimum static deflections listed below are not nominal but certifiable minimums with actual installed load. Unless otherwise indicated, apply requirements listed for floor mount for roof-mounted equipment.

Type of Equipment	Ground Supported Slab		Floor Span					
			Up to 20 ft		Up to 30 ft		Up to 40 ft	
	Type	Min Defl in	Type	Min Defl in	Type	Min Defl in	Type	Min Defl in
Condensing Units								
Air Cooled Condensers	-	-	4	0.75	4	1.5	4	1.5
Air Cooled Condensing Units	-	-	4	0.75	4	1.5	4	2.5
Axial Fans, Plenum Fans, Centrifugal Inline Fans, Cabinet Fans (Suspended)								
All Sizes	Use Type 5 hangers with deflection from blower minimum deflection guide. Use Type 5-T for over 4" static pressure.							

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install and adjust vibration isolation devices as specified, as shown on drawings and according to manufacturer's recommendations.

1. Adjust isolators after piping system is at operating weight.
2. 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.
3. Adjust active height of spring isolators.
4. Adjust restraints to permit free movement of equipment within normal mode of operation.
5. Adjust air-spring leveling mechanism.

B. In no case shall installation short circuit isolation devices.

END OF SECTION

SECTION 23 05 53
MECHANICAL SYSTEMS IDENTIFICATION

PART 1 - GENERAL

1.01 REFERENCE

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

1.02 SUBMITTALS

A. Product Data: For identification materials and devices

B. Valve Schedules: For each piping system

C. Samples: Of color, lettering style, and graphic representation required for each identification material and device.

PART 2 - PRODUCTS

2.01 IDENTIFYING DEVICES

A. Marker System:
   1. Manufacturer's standard, preprinted with color coding, lettering size and length of color field according to ASME A13.1.
   2. Use pressure-sensitive type or “snap-on” type.
   3. “Strap-on” type may be used for piping over 6” size including insulation.

B. Laminated Plastic Nameplates:
   1. Nameplates shall be approximately 1-1/2” x 4“, 1/16” thick, and have 1/2" high lettering. Face of plastic nameplates shall be black with white letters.
   2. Fasteners shall be self-tapping, stainless steel screws or contact type with permanent adhesive.

PART 3 - EXECUTION

3.01 GENERAL

A. After painting and/or covering is completed, identify equipment and piping as indicated. Locate identification as conspicuously as possible except where such would distract from finished area.

B. Where markers are used in high heat applications or exposed to harsh chemical or acid environments, specifically select marker materials for those applications.

C. Coordinate, obtain and confirm mechanical systems identification criteria and requirements from Owner.

3.02 DUCT SYSTEM IDENTIFICATION

A. Install duct identification for each supply, return and exhaust air system.

B. Identify all ductwork not less than once every 25 ft and not less than once in each room.

C. Identify duct system by stenciling exterior of duct or insulation jacket by name as either “Supply Air (AHU-x), “Return Air (RF-x)”, or “Exhaust Air (EF-x)”. “-x” shall indicate system number (e.g. AHU-1).

D. Stencils shall be 2” (min) lettering, shall include direction arrow and shall be on bottom of duct or insulation jacket such that it is visible from floor below.

E. Do not identify systems exposed in architecturally “finished” spaces.

F. Hazardous ductwork shall have appropriate warning signs posted to protect personnel from exposure.

3.03 EQUIPMENT IDENTIFICATION

A. Identify major equipment, including fans and heaters.

B. Identify equipment by stenciling equipment number and service in 2” high letters.

C. Nameplate Markings:
   1. Identify model number, size, capacity, electrical characteristics, serial number, along with other items scheduled for equipment on drawings.
   2. Indicate motor horsepower, voltage, phase, cycles, RPM, full load amps, locked motor amps, frame size, manufacturer’s name and model number, Service Factor, Power Factor, efficiency, minimum circuit amps, minimum feeder conductor size, disconnect or fuse size, refrigerant, and other pertinent information.

D. Locate motor nameplates for easy reading. Relocate or provide new nameplates on motors if original nameplates are not located for easy reading.

END OF SECTION

SECTION 23 05 95
AIR SYSTEMS TEST ADJUST BALANCE

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 23 33 14 - Ductwork Specialties

1.02 REFERENCE

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

1.03 DESCRIPTION

A. This Contractor shall be responsible for providing complete testing, adjusting and balancing (TAB) work for air systems, such as air handling units, return fans, exhaust fans, air terminal devices, diffusers, grilles and other air moving processes included in this project.

B. Work required shall consist of setting volume flow rates and adjusting speed controls, recording data, making tests, and preparing reports, as specified herein.

C. Scope of work includes TAB of new work specified herein and includes all equipment, distribution systems, and terminal units connected.

D. TAB work shall be performed by persons trained in TAB work and certified by Associated Air Balance Council (AABC), National Environmental Balancing Bureau (NEBB), or Testing, Adjusting and Balancing Bureau (TABB). Procedures shall be in accordance with the latest edition of AABC, NEBB or TABB Standards, ASHRAE (HVACA)-2015 Chapter 38, and as detailed herein.

E. Mechanical Contractors who are members of AABC or NEBB and who have qualified personnel available to perform work may submit Quality Assurance Submittal for approval. Mechanical Contractors who cannot meet these requirements shall subcontract with independent TAB Contractor who meets these requirements. TAB subcontractor shall prepare Quality Assurance Submittal for Contractor to submit for approval.

F. TAB Contractor shall perform ductwork leakage tests. Refer to Section 23 31 14 - Ductwork. Test equipment will be provided by Mechanical Contractor.

G. Upon direction of Contracting Officer/Engineer or TAB subcontractor, Mechanical Contractor shall provide at no additional cost to Owner, any additional work and/or devices necessary to properly balance system, including fan sheaves, motor sheaves and/or drive belts.

H. TAB work shall not proceed until assigned personnel have been approved by Contracting Officer /Engineer via Quality Assurance Submittal. Coordinate each phase of TAB work with overall project schedule. Each phase of TAB work shall be done in timely manner as detailed herein. Fieldwork must be completed before occupancy. Certificate of Substantial Completion shall not be issued until after Final Report is accepted by Contracting Officer /Engineer.

1.04 SUBMITTALS

A. General:
   1. Make submittals in accordance with project submittal procedure. Submittals shall be in electronic Portable Document Format (pdf) utilizing NEBB, AABC, or TABB Reporting Forms. Embed bookmarks for each system and each terminal device to assist navigation.
   2. Submit Final Report in pdf format..
      a. PDF files shall include bookmarks to facilitate navigation.

B. Quality Assurance Submittal:
   1. Within 30 days of signing contract, Contractor shall submit the following information:
      a. Firm resume
         1) AABC or NEBB active membership certificate
         2) Names of 3 recent relevant completed projects along with project address, Owner's contact person, supervising design professional
      b. Supervisor resume
      c. Balance technician(s) resume
   2. Contracting Officer/Engineer and/or Owner reserves the right to contact previous project representatives and to reject persons whom Contracting Officer/Engineer and/or Owner feel are not qualified for this project due to lack of relevant experience or problems on previous projects.

C. Planning Report:
   1. Submit Planning Report as detailed in Part 3 of this Section to demonstrate to Contracting Officer/Engineer and Owner that proper procedures are being followed. Planning Report shall be submitted after Quality Assurance submittal and 30 days before any fieldwork starts.

D. Initial Test Report:
   1. Prior to starting Final Balance Phase, submit Initial Test Report as detailed in Part 3 of this Section to indicate to Contracting Officer/Engineer and Contractor incomplete work or problem areas to be resolved before final balance is completed.

E. Final Report:
   1. Within 30 days after fieldwork is completed, submit Final Report as detailed in Part 3 of this Section to assure design objectives are met and to assist Owner in future maintenance.

1.05 REFERENCE STANDARDS

A. Refer to the latest publications of NEBB, AABC, TABB, ASHRAE, and Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) publications for establishing required procedures.

PART 2 - PRODUCTS

2.01 INSTRUMENTATION

A. Provide all required instrumentation to obtain proper measurements. Application of instruments and accuracy of instruments and measurements shall be in accordance with requirements of NEBB, AABC or TABB Standards and instrument manufacturer's specifications.

B. Instruments used for measurements shall be accurate, and calibration histories for each instrument to be available for examination by A/E upon request. Calibration and maintenance of instruments to be in accordance with requirements of NEBB, AABC or TABB Standards.

2.02 INSTRUMENT TEST HOLE PLUGS

A. Center-pull plugs similar to CPW Series by Mocap. Plug material shall be low-density polyethylene.

PART 3 - EXECUTION

3.01 GENERAL

A. TAB work shall be done in separate phases as outlined herein. TAB schedule shall allow ample time to complete TAB work before occupancy. Follow procedures outlined herein and as described in Planning Phase narratives.

B. Unless otherwise specified, maximum acceptable offset tolerance is plus or minus 10% of the design flow rates as indicated on drawings and/or as scheduled.

3.02 PLANNING PHASE

A. Procedure:
   1. Obtain the latest Contract Documents including addenda, applicable construction bulletins and change orders. Obtain product data, shop drawings and performance curves from Mechanical Contractor for fans, flow measuring devices, and all terminal devices. Prepare Planning Report as detailed herein. Make adjustments in Planning Report and/or measuring instrument calibration.

B. Planning Report:
   1. Planning Report shall contain the following minimum requirements.
      a. Samples: Provide copies of all forms to be used.
      b. General narratives: Furnish written narratives of all procedures used. Include separate narratives for each fan and air handling system. Identify flow-measuring devices to be used at each fan, air terminal device, and air outlet. Narrative shall include statement that every air outlet shall be measured and adjusted. Provide different narratives for constant and variable flow systems. Narratives shall include references to published standards of NEBB or AABC. Narratives shall include measuring instruments to be used and ranges required for each procedure. Narratives shall include specified adjustment tolerances.
      c. Air system narratives: Provide narratives for each air system which shall include procedures for measuring static pressures at each component of air handling system to generate a static pressure profile. Measurements shall be made to measure performance of system in all operating modes including economizer mode using 100% outside air where applicable. Differentiate between constant and variable flow systems.
      d. Branch duct and air outlet measurements: Indicate on preprinted forms all measurements to be taken in field. Include branch duct or air outlet identification, system, space served, location, and design flow rates (include zone and system summaries). Indicate duct or air outlet neck size, make, model number, and design velocities.
   2. Prebalance Checklist - to include:
      a. Check for completeness of work
      b. System cleaning if required

c. Check fire, smoke and balancing damper positions
d. Place system into normal operation without economizers.
e. Install test openings where required.
f. Indicate type of test holes to be used and installation procedure.
g. Provide temporary blankoffs to simulate design pressure drops of filters.
h. Chisel holes and duct tape are not allowed.
i. Fan wheels, blades, bearings, alignment, starters, vibration isolators, and rotation
j. Drive belt tension and alignment
k. Setting of automatic dampers to proper position including shutoff and bypass dampers

3. Measuring Instrument List - list what measuring instruments will be used for each procedure. Indicate ranges required for each procedure. Provide data on each measuring instrument to be used. This data shall include:
   a. Manufacturer name and model number
   b. Measurement range
   c. Pressure/temperature limits
   d. Date put into service
   e. Date of last calibration
   f. Include certificate from calibration firm
4. Contracting Officer/Engineer reserves the right to request adjustments in any procedure and/or ask for recalibration of any measuring instrument, which has not been recalibrated within past year.

3.03 SET-UP PHASE

A. Procedure:
   1. Perform prebalance checkout as per Planning Phase narrative.

B. Initial Test:
   1. Measure fan data and flows in "as found" condition after initial damper settings are made.

C. Initial Test Report:
   1. Submit report to Contracting Officer/Engineer and Mechanical Contractor indicating all measurements made and make notes of all items, which are not complete or are not within design tolerance.

3.04 FINAL BALANCE PHASE

A. Procedure:
   1. Perform all procedures as per Planning Phase narrative. Correct all deficiencies and redo procedures as required before submitting Final Report.

B. Final Report:
   1. Submit report to Contracting Officer/Engineer and Mechanical Contractor indicating all data and measurements as per requirements herein and per Planning Phase narrative. Do not submit partial or incomplete reports.

C. Final Report Adjustments:

1. Contracting Officer/Engineer reserves the right to check any measurement made and to reject any portion of work not within required tolerance of design flow. TAB Contractor shall resubmit all or portions of Final Report as directed by Contracting Officer/Engineer.

END OF SECTION

SECTION 23 09 02
CONTROL VALVES AND DAMPERS

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 23 33 14 - Ductwork Specialties

1.02 REFERENCE

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

1.03 GENERAL

A. Devices containing mercury are not allowed.

1.04 SUBMITTALS

A. Submit manufacturer's printed product data sheets for all valves, dampers, actuators and accessories included in Contractors submitted valve and damper schedules. Product data sheets shall include construction materials and assembly methods, maximum design parameters (temperature, pressure, velocity, etc.), and performance data for full range of actuator stroke. Product data sheets shall include charts, graphics or similar items used in making selections, including damper to duct area ratio and free area ratio. Damper product data sheets shall indicate certified leakage rates for given pressure differentials.

B. Damper Shop Drawing submittals will not be processed unless supporting data and sizing calculations are included.

C. Submit damper schedules with Shop Drawings, indicating unique tag numbers for each device, equipment or system served, device model numbers, duct sizes, damper sizes, flow rates, pressure differentials, calculation of actual damper pressure drops, approach velocities, leakage rates, torque requirements, actuator model number, actuator torque capacities, actuator fail positions and pilot positioner locations.

D. Select dampers to meet their intended service with respect to maximum approach velocities and maximum pressure differential. Damper materials shall match duct construction materials of systems in which they are installed (galvanized steel, aluminum, 304 or 316 stainless steel, etc.).

E. Aluminum dampers may be used in galvanized steel ductwork.

1.05 DAMPER SELECTION AND SIZING

A. Submit engineering calculations for sizing modulating control dampers including outside, return, and relief air dampers of air handling units unless dampers are scheduled.

B. Calculations for sizing dampers shall be based on actual characteristics of ductwork system being installed. Opposed blade dampers shall be sized for minimum of 10% of duct system pressure drop. Parallel blade dampers shall be sized for minimum of 30% of duct system pressure drop. Duct section is defined as ductwork containing flow control damper starting with inlet or branch tee and ending with outlet or branch tee. Calculate actual duct pressure drops for each duct section containing modulating damper using latest version of ASHRAE Handbook of Fundamentals. If control systems fixes pressure drop, use those pressure setpoints. Use balance damper to provide additional pressure drop as required for obtaining linear damper response.

C. Control Contractor is responsible for obtaining adequate system information necessary for sizing.

D. Two position dampers to be sized as close as possible to duct size, but in no case is damper size to be less than duct area.

E. Submit leakage and flow characteristic data for control dampers along with shop drawings. Leakage ratings shall be based on AMCA 500-D and dampers shall bear AMCA Air Leakage Seals.

PART 2 - PRODUCTS

2.01 CONTROL DAMPERS

A. General:

1. If control damper sizes are not shown or scheduled, refer to Part 1 of this Section for sizing criteria.
2. Unless otherwise indicated, modulating control dampers shall be opposed blade or parallel blade type and 2-position (open/close) dampers shall be parallel blade type.
3. Blade linkage hardware shall have corrosion-resistant finish and be readily accessible for maintenance.
4. AMCA Leakage Classification of Control Dampers

Class	**Static Pressure** Inches Water Column			
	1	4	8	12
	Leakage Rate L/s/m^2(cfm/ft^2)			
IA	3	NA	NA	NA
I	4	8	11	14
II	10	20	28	35
III	40	80	112	140

B. Standard Modulating and Two-Position Dampers

1. Damper frames shall be minimum of 14 ga extruded aluminum. Damper blades shall be airfoil type extruded aluminum for superior pressure drop and low noise generation. Each blade shall be maximum 6" (152) depth with integral structural reinforcing tube running full length. Minimum thickness of blade shall be .070 (1.78).
2. Bearings shall be non-corrosive molded synthetic. Axles shall be ½” (13) plated steel hexagonal shaped and to provide positive locking connection to blade (round axles are not acceptable). Linkage shall be concealed out of airstream, within frame to reduce pressure drop, noise and maintenance.

3. Furnish dampers with blade seals and stainless-steel side seals. Dampers and seals shall be suitable for maximum system temperature, pressure differential and approach velocity, but not less than temperature range of -40 to 200°F, pressure differential of 6" WC, and approach velocity of 4000 fpm based on 4 ft damper section width.
4. Leakage rate shall meet AMCA Leakage Class IA or I. Damper shall be tested and licensed in accordance with AMCA 511 for Air Performance and Air Leakage. Damper shall meet the leakage requirements of the International Energy Conservation Code by leaking less than 3 cfm/sq. ft. at 1" of static pressure and shall be AMCA licensed as Class 1A.
5. Testing and ratings shall be per AMCA 500-D.

2.02 DAMPER ACTUATORS

A. General:
1. Actuators shall have an electronic cut off or other means to provide burnout protection if stalled.
2. Provide spring return or electronic fail-safe feature for fail open or closed positions, as required by design documents. Fail-last-position actuators do not have spring return feature. Mechanical spring return shall drive the controlled device to an end position upon loss of power. Electronic fail-safe shall incorporate an active balancing circuit to maintain equal charging rates among the Super Capacitors. The electronic fail-safe shall be adjustable in 10 degree increments with a 2-second operational delay.
3. Actuators requiring 120VAC or greater control power shall be provided with a means to disconnect power at each actuator.
4. Stroke time for actuators associated with emergency generators (outside air intake, generator radiator discharge) or actuators called-out as “High Speed” shall be 5 seconds or less for 90° rotation.

B. Discrete Two-Position Electric:
1. Manufacturers: Belimo or equal.
2. Actuators shall be electric motor/gear drives for two-position control. Maximum full stroke time shall be 90 seconds or less for 90° rotation.
3. Provide spring return or electronic fail-safe feature for fail open or closed positions as required by control documents. Fail-last-position actuators do not have spring return feature.

PART 3 - EXECUTION

3.01 CONTROL DAMPERS

A. Furnish control dampers as shown on drawings and/or as required to perform control sequences specified, except those furnished with other equipment.

B. Control dampers furnished by Control Contractor shall be installed by Mechanical Contractor under coordinating control and supervision of Control Contractor.

C. Blank-off plates or transitions required to facilitate dampers shall be provided by Mechanical Contractor.

3.02 ACTUATORS AND PILOT POSITIONERS

A. Provide actuator for each automatic damper with sufficient capacity to operate damper or valve under all conditions. Select actuators to provide tight shut-off against maximum system temperatures and pressure encountered. Each actuator shall be full-modulating or two-position type as required or specified, and shall be provided with spring-return for fail open or fail closed position for fire, freeze, moisture, occupant safety, equipment protection, heating or cooling system protection on power interruption as indicated and/or as required.

B. Damper operating speeds shall be selected or adjusted so that actuators will remain in step with controllers without hunting, regardless of load variations. Actuators acting in sequence with other actuators shall have adjustment of control sequence as required by operating characteristics of system.

C. Provide proper linkage and brackets for mounting and attaching actuators to devices. Design mounting and/or support to provide no more than 5% hysteresis in either direction (actual movement of valve stem or damper shaft versus ideal movement) due to deflection of actuator mounting.

D. Provide single actuator on damper section not exceeding torque capacity of actuator.

E. Damper actuator mounting bolts/screws shall be tightened per manufacturer recommended torque requirement and provided with lock washers or blue threadlocker to ensure bolt will not loosen due to vibration.

END OF SECTION

SECTION 23 31 14
DUCTWORK

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 23 00 00 - General Mechanical Requirements (submittal requirements)

B. Section 23 05 29 - Mechanical Piping and Equipment Supporting Devices

C. Section 23 05 95 - Air Systems Test Adjust Balance

D. Section 23 09 02 - Control Valves and Dampers

E. Section 23 33 14 - Ductwork Specialties

1.02 REFERENCE

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

1.03 SUBMITTALS

A. For each duct system, submit schedule utilizing reinforcement tables from SMACNA HVAC Duct Construction Standards Metal and Flexible where applicable. Each duct system schedule shall include, but not be limited to, the following:
   1. Name of Contractor/manufacturer fabricating each duct system
   2. Material and gauge
   3. Pressure class
   4. Transverse joint type and length and reinforcement rigidity class with designated joint T number or proprietary duct connection if utilized for each system
   5. Certified test results of proprietary joint products, if used, tested in accordance with SMACNA procedures
   6. Intermediate reinforcement spacing and rigidity class with metal angle dimensions and gauge
   7. Type of longitudinal seam
   8. Fitting construction details
   9. Support methods including spacing, upper attachments, and lower attachments
   10. Sealant and gasket
   11. Sealing class
   12. Grease exhaust duct Testing Agency credentials and test procedures

B. Duct leakage testing methods, apparatus and apparatus certification signifying meter is in conformance with ASME Requirements for testing meters.

C. Submit shop drawings for manufactured duct system products

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect duct and fittings from damage due to normal handling during shipment and storage. Protection shall be applied to ends of duct to prevent dirt and moisture from entering ducts and fittings.

1.05 DESCRIPTION

A. Furnish and erect ductwork free of objectionable vibration, chatter, and pulsations. Verify dimensions at site, making field measurements and drawings necessary for fabrication and erection.

B. Duct sizes indicated are net inside dimensions.

C. Where size for a duct segment is not indicated, the duct segment size shall be equal to the largest duct segment to which it is connected. Transition to smaller size shall occur on side of fitting where smaller size is indicated.

1.06 DESIGN CRITERIA

A. All products shall conform to NFPA 90A, and shall possess flame spread rating of not over 25 and smoke developed rating no higher than 50.

B. Unless otherwise indicated, construct all ductwork of galvanized sheet metal for pressure class not less than 2" WG for positive pressure ductwork and not greater than -2" WG for negative pressure ductwork.

C. Ductwork shall comply with Local, State and Federal requirements.

D. Use material, weight, thickness, gauge, construction, and installation methods as outlined in the following SMACNA publications, unless noted otherwise:
   1. HVAC Duct Construction Standards Metal and Flexible, 3rd Edition, 2005
   2. HVAC Air Duct Leakage Test Manual, 2nd Edition, 2012
   3. Round Industrial Duct Construction Standards, 2nd Edition, 1999
   4. Rectangular Industrial Duct Construction Standards, 2nd Printing 2004
   5. Accepted Industry Practice for Industrial Duct Construction, 2nd Edition, 2008
   6. SMACNA Sheet Metal Welding Guide – 3rd Edition, 2007

E. Unless otherwise indicated, pressure class for constant air volume system ductwork shall be equal to external static pressure (fan entrance or discharge pressure minus associated unit internal component pressure drop), but not less than ± 2" WG.

F. Duct transverse joints and reinforcement material, including angle ring flanges and stiffeners, shall be of same material as duct.

G. Tie Rods
   1. Tie rods shall be 1/2" or 3/4", galvanized steel EMT/conduits with bolt assembly consisting of rubber washer and friction anchored threaded insert similar to Ductmate Easyrod or PPI Condu-Lock.

H. Adhesives and sealants used on installation of ducts shall comply with South Coast Air Quality Management District (SCAQMD) Rule #1168; Indoor Environmental Quality Section, Credit EQ-4.

PART 2 - PRODUCTS

2.01 GALVANIZED STEEL SHEET

A. Lock Former Quality (LFQ), cold rolled, open hearth soft steel sheet capable of double seaming without fracture, ASTM A924/A924M or ASTM A653/A653M. Galvanized coating shall be G90.

B. Use G90 Galvaneal or Zinc grip where painting is specified.

2.02 DUCT FLEXIBLE CONNECTORS

A. Refer to Specification Section 23 33 14 - Ductwork Specialties

2.03 DUCT SEALANTS AND GASKETS

A. Sealant:
   1. Flexible, water based, adhesive sealant compounded specifically for sealing joints and seams in ductwork. Ductmate PROseal or equal.
   2. Sealants shall be UL 723 (ASTM E84) classified, and meet NFPA 90A and 90B.
   3. Sealants shall comply with requirements of SCAQMD Rule 1168 and LEED v4 EQ-4.
   4. Select sealants as recommended by manufacturer for specific application.
   5. Submit sealant manufacturer's data sheets including performance data, pressure ratings, surface burning characteristics data, VOC compliance with LEED v4, detailed installation instructions.
      a. Sealants for exterior ductwork shall include explicit statement by manufacturer indicating suitability for application.
      b. Sealants for exposed (uninsulated) exterior ductwork shall be UV resistant and include explicit statement by manufacturer indicating suitability for exposed exterior application.
   6. Duct tapes are not allowed.

B. Gaskets:
   1. Butyl, copolymer or neoprene-based tape similar to Ductmate 440 Gasket Tape or Neoprene Gasket Tape for flanged joints.

PART 3 - EXECUTION

3.01 GENERAL

A. Unless otherwise indicated, install ductwork level, parallel, and/or perpendicular to building structure, walls, and ceilings and at such heights not to obstruct any portion of ceiling, window, doorway, stairway, or passageway. Install ductwork to allow adequate access and service space for equipment. Refer to drawings and/or manufacturer's recommendations. Install vertical ductwork plumb. Where interferences develop in field, offset or reroute ductwork as required to clear such interferences. In all cases, consult drawings for exact location of duct spaces, ceiling heights, door and window openings or other architectural details before installing ductwork.

B. Make allowances for beams, pipes or other obstructions in building construction and for work of other contractors. Check plans showing work of other trades and consult with Engineer in event of interference. Transform, divide, or offset ducts as required, in such a manner as to maintain same cross-sectional area of duct as indicated on drawings. Where it is necessary to install pipes or similar obstructions through ducts, consult with Engineer and obtain written approval from Engineer and Owner. If approved, provide streamlined encasement or collar designed in accordance with SMACNA Standards and seal to prevent air leakage.

C. Ductwork shall be free of kinks and dents.

D. Fabricate and install duct, fittings, joints, seams, reinforcement, supports, sealing, liner, etc., in sizes indicated on drawings and in accordance with manufacturer's published data and SMACNA Standards except as modified in this section of specifications or on drawings.

E. Provide transitions where different size or different shape ductwork segments are connected. Use concentric transitions unless otherwise shown. Unless otherwise indicated, make diverging transitions with maximum angle of 15° per side (30° total diverging) and converging transitions with maximum angle of 25° per side (50° total converging).

F. Provide transitions at ductwork system components and connections to equipment. Refer to Specification Section 23 37 13 - Diffusers, Registers and Grilles, for additional information regarding diffuser/register/grille connections.

G. Refer to ductwork symbols list on drawings for additional and dimensional requirements for fittings.

H. Seal duct seams and joints to meet SMACNA Seal Class A as minimum for all ductwork including low-pressure ductwork.

I. Construct ductwork so that interior surfaces are smooth. Internal duct hangers and internal bracing are not allowed. Refer to Part 1, Design Criteria for internal tie rods.

J. Install exhaust air duct to pitch down at minimum 1" per 20 ft toward exhaust louver.

K. Do not install ductwork over electrical panelboards, switchgear, switchboards or motor control centers.

L. When original galvanized finish is altered or damaged, apply field galvanizing paint as follows:
   1. Prepare surface with use of power sanders or wire brushes to remove rust, paint, etc.
   2. Apply cold galvanizing material equal to ZRC Products, Inc.

3.02 ELBOWS

A. Rectangular Duct:
   1. Use radius elbows with centerline radius to width ratio of 1.5 (SMACNA Type RE 1).
   2. Where 1.5 centerline radius elbows do not fit due to limited space, use radius elbows with centerline radius to width ratio of 1.0 (SMACNA Type RE1 or RE-3).
   3. Where 1.0 centerline radius elbows do not fit, use radius elbows with centerline radius to width ratio of 0.75 (SMACNA Type RE-1 or RE-3) or 45° throat with radius heel elbows (SMACNA Type RE 8).
   4. Use single splitter vanes for 1.0 radius elbows, 0.75 radius elbows and 45° throat with radius heel elbows for elbows width 18" and over.

5. Fabricate splitter vanes in accordance with SMACNA HVAC Duct Construction Standards, Chart 4-1, (page. 4.11) and Figure 4-9 (page. 4.13).
6. Square throat elbows with or without turning vanes are not allowed unless specifically indicated. Square throat elbows without turning vanes may be used for transfer air ducts.

B. Round and Oval Duct:
1. Unless specific type is indicated, use radius elbows with centerline radius to diameter ratio of 1.5 regardless of duct velocity. Where 1.5 radius elbows do not fit due to limited space, use 1.0 radius elbows.

3.03 LONGITUDINAL SEAM

A. Rectangular Duct:
1. Unless otherwise indicated, use Pittsburgh lock seam.
2. Seal longitudinal seams with approved sealant or pre-sealed with encapsulated mastic.
3. Button punch snap lock construction is not allowed.
4. Button punch snap lock construction is not allowed for ductwork in chases and areas above inaccessible ceiling.
5. Button punch snap lock construction is not allowed on aluminum ductwork.
6. Button punch snap lock construction (SMACNA L-2) may be used for ductwork that is both 2" WG (+ or -) and lower, and 36" and smaller in width or height. For ductwork over 24" in width or height, add screw 4" from each end.

3.04 TRANSVERSE JOINT

A. Rectangular Duct:
1. Transverse joints shall be in accordance with SMACNA HVAC Duct Construction Standards.
2. Ductmate 25/35/45 connection systems with corner clips or optional nuts and bolts may be used. Incorporate use of all Ductmate accessories to ensure integrity of transverse connection. Install joints in strict accordance with the latest edition of Ductmate 25/35/45 Assembly and Installation Instruction Manual and Duct Construction Standards. Nexus or WDCI will be acceptable.
3. Lockformers TDC or Engles TDF may be used in accordance with T-25 flanges of SMACNA HVAC Duct Construction Standards Metal and Flexible, 2005, provided that corner pieces with bolts are used. If TDF/TDC flanges are damaged, replace the damaged joint(s) by straightening and reinforcing with minimum 1-1/2" x 1-1/2" x 1/4" angle at each side of transverse joint.
4. Where any type of flanged transverse joint is used for exterior uninsulated ductwork, top flange shall have continuous sheet metal cap or continuous cleat to protect joint.

3.05 DUCT SUPPORTS

A. Unless otherwise indicated, use straps or Z bar hangers with 3/8" rods to support rectangular ducts 60" wide and smaller and trapeze hangers with rods or angles to support rectangular ducts over 60" wide.

B. For round ducts 24" diameter or smaller, use single hanger.
1. Cable Suspension System may be used up to 24" diameter at spaces higher than 8 ft above floor or platform.
2. Round Duct Strap Bracket by Ductmate Industries may be used up to 24" diameter.

C. The following upper attachments, upper attachment devices, lower hanger attachments, hanger devices, and/or hanger attachments are not allowed except where specifically indicated:

1. Hook or loop
2. Nailed pin fasteners
3. Expansion nails without washers
4. Powder actuated fasteners (forced entry anchors).
   a. Exception: Forced entry anchors may be used for upper attachments of flexible ductwork supports.
5. Beam or "C" clamps without retaining clips or friction clamps (provide retaining clips for "C" clamps)
6. Non-factory manufactured upper attachments for metal pan deck including rods, straps, or weded studs directly attached to metal deck (Items 16 through 21 shown in Fig 5-4 of SMACNA HVAC Duct Construction Standards)
7. Wire hanger shown in Fig. 5-5 of SMACNA HVAC Duct Construction Standards
8. Trapeze hangers supported by wires or straps
9. Drilled hole with attachment to structural steel
10. Lag screw expansion anchor
11. Rivets
12. Non-metallic hangers or straps

D. Supporting devices shall be standard products of manufacturers having published load ratings.

E. Refer to Section 23 05 29 - Mechanical Piping and Equipment Supporting Devices for additional support requirements including attachments to structural members, concrete inserts, and concrete anchors.

F. For welded ducts, soldered ducts or ducts with watertight joints, do not use supports utilizing screws or other penetrations into ductwork.

G. Unless Architectural Documents indicate the required framing, provide angle iron framing around roof opening where duct penetrates through roof decking, to maintain roof decking structural integrity in accordance with roof decking manufacturer's recommendations. This is not required for concrete decking. For concrete decking, consult with the project structural engineer for location and size of opening prior to execution of Work.

3.06 PROTECTION OF DUCTWORK

A. Protect ductwork during construction against entry of foreign matter and construction dirt.

B. Keep ductwork capped when work is complete for the day or when duct is not being worked on or added to. Use of polyvinyl (VISQUEEN) with duct tape wrap is an adequate measure as long as it is secure with no openings or tears in product.

C. If ductwork is not protected, remove dirt and foreign matter from the duct system and obtain inspection and approval from Engineer upon completion of cleaning before operating fans.

3.07 DUCT LEAKAGE TEST

A. Refer to Test and Balancing portion of Section 23 00 00 - General Mechanical Requirements.

B. Owner and/or Owner's representative may elect to witness leakage tests. Notify Owner and/or Owner's representative at least 3 days in advance.

C. Test supply, return, and exhaust ductwork as follows, unless otherwise indicated in this section or in schedules.
   1. Test 25% of total installed duct area for duct pressure positive or negative Class 2" wg.
   2. Test 100% of total installed duct area for ductwork located outdoors.
   3. Test 100% of total installed duct area for ductwork located in inaccessible spaces including shafts.
   4. If test results are acceptable to Engineer, remainder of ductwork is permitted to proceed without further testing. If ductwork fails test, repair all ductwork including ductwork not tested. Then repeat leakage tests for new sections of ductwork as described above.

D. Leakage test procedures shall be in accordance with test method described in Section 3 of SMACNA HVAC Air Duct Leakage Test Manual, except as modified in this Section. Test apparatus shall be in accordance with Section 5 of SMACNA HVAC Air Duct Leakage Test Manual.

E. Test pressure shall be equal to duct pressure class. Negative pressure ductwork shall be tested with negative test pressure.

F. Air leakage shall not exceed limits specified or scheduled. If leakage exceeds allowable limits, identify leaked areas, repair, seal and retest.

G. Do not insulate ductwork until it has been successfully tested.

H. Maximum permitted leakage rate in cfm per 100 ft^2 of tested duct surface area shall be calculated by:

$L = C_L \times P^{0.65}$

Where:

L (maximum permitted leakage rate) = measured leakage of test section (cfm) / area of test section (ft^2) / 100

F (leakage factor) = maximum permitted leakage rate (cfm/100 ft^2) = $C_L \times P^{0.65}$

P = test pressure (inches w.g.); typically duct pressure class.

C_L (leakage class constant) = varies with test pressure according to the relationship $C_L = F/P^{0.65}$

C_L = 2 for round/oval ducts.

C_L = 4 for rectangular ducts and flexible ducts.

3.08 LOW PRESSURE DUCT CONSTRUCTION (PRESSURE CLASS 2" WG AND UNDER)

A. Use welds, rivets or nuts, and bolts for fabricating ductwork. Fully threaded sheet metal screws may be used on duct hangers, transverse joints and other SMACNA approved locations if screw does not extend more than 1/2" into duct. Sheet metal "TEK" screws 3/4" in length may be used as fasteners in conjunction with factory made transverse joints.

B. Unless otherwise indicated, construct branch take-off fittings as follows:
   1. For branch take-offs including branch ducts serving more than one diffuser or grille, use 45° entry fittings. For supply air ducts, conical taps may be used.
   2. For take-offs serving single diffuser, register or grille, use straight spin-in collars with manual balancing dampers.

C. Splitter dampers and/or extractors are not allowed.

END OF SECTION

SECTION 23 33 14
DUCTWORK SPECIALTIES

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 23 05 95 - Air Systems Test Adjust Balance

B. Section 23 09 02 - Control Valves and Dampers (Control Dampers)

1.02 REFERENCE

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

1.03 SUBMITTALS

A. Shop Drawings including the following:
   1. Manufacturer's name and model number
   2. Capacities
   3. Temperature/pressure ratings
   4. Materials of construction
   5. Dimensions
   6. Manufacturer's installation instructions and/or detailed drawings
   7. All other appropriate data

1.04 DESIGN CRITERIA

A. Products and materials shall conform to NFPA 90A, possessing flame spread rating of not over 25 and smoke developed rating no higher than 50.

B. Ductwork specialties exposed to air stream, such as dampers, turning vanes, and access doors, shall be of same material as duct or unit within which specialties are mounted. When complying with this material requirement performance requirements (pressure, temperature, velocity limits, etc.) shall be as specified for same product constructed of the standard specified materials found in Part 2 of this Section

C. Unless otherwise noted, ductwork specialties shall be designed and constructed for pressure class of ductwork in which they are installed.

PART 2 - PRODUCTS

2.01 MANUAL BALANCING DAMPERS

A. Manufacturers: Ruskin MD25 or equal, constructed in accordance with SMACNA (HVAC DUCT CONST) Standards, except as modified below.

B. Rectangular Dampers:

1. For low pressure ductwork, for damper blade height up to 12”, use single blade type with minimum 22 ga blade with minimum 3/8" rod for blade width up to 18", and with minimum 18 ga blade with minimum 1/2" continuous rod for blade width from 19-48 inch. For damper blade height more than 12”, use multiple blade type with minimum 16 ga channel frames, opposed blade linkage operation, with blades minimum 16 ga and 6" to" maximum blade width, minimum 1/2" continuous rod and 1/2" x 1/2" angle blade stops. Bearings shall be nylon or molded synthetic. Construct dampers over 48" in width or height in multiple sections with mullions.

C. Single Blade Round Dampers:

1. For low pressure ductwork, damper shall have blade 24 ga, but not less than two gauges heavier than duct gauge. Rod shall be minimum 3/8" diameter or square continuous. Bearings shall be nylon or molded synthetic.

D. Dampers shall be properly stiffened and fabricated to prevent vibration, flutter or other noise.

E. Extend damper shafts through duct insulation or use elevated regulators for externally insulated ducts to accommodate specified insulation thickness.

2.02 BACKDRAFT DAMPERS

A. Manufacturers: Ruskin or equal.

B. Dampers shall be multi-blade, weighted type with counter-balanced blades. Blade edges to have vinyl gasket or polyurethane foam seals with ball bearings. Dampers to be suitable for flange and gasket connection to ductwork.

C. Minimum construction standards: frame shall be (specify) .125" (3.2) wall thickness with 12 gage (2.8) galvanized steel structural brace at each corner or 4” x 1” x .081” (102 x 24 x 2.1) 6063- T5 extruded aluminum. Blades shall be .070" (1.8) wall thickness 6063-T5 extruded aluminum with extruded vinyl blade edge seals mechanically locked into blade edge. Adhesive or clip-on type seals are unacceptable. Bearings shall be dustproof ball type for quiet low pressure operation. Linkage shall be 1/2" (13) wide tiebar connected to stainless steel pivot pins. Dampers shall be designed for maximum 3500 fpm spot velocities and minimum 4” w.g. backpressure, depending on damper size

2.03 DUCT FLEXIBLE CONNECTIONS

A. Manufacturers: Ductmate or equal. Material shall be glass fabric, fire retardant, waterproof, airtight and comply with NFPA 90A and 701 (formally UL 214).

B. General Supply, Return and Exhaust Ductwork:

1. Material for indoor use to be 30 oz per sq yd, double coated with neoprene, tensile strength (warp/fill) of 475/375 lbs, tear strength of 13x13 lbs, suitable for -40-200°F continuous operation.
2. Material for outdoor use shall be combination of inner layer of Duro Dyne Neoprene or similar and outer layer of 24 oz per sq yd, coated with Hypalon, UV resistant, suitable for -40-200°F, similar to Duro Dyne Durolon.

2.04 INTAKE AND RELIEF HOODS

A. Manufacturers: Greenheck Faborhoods or equal.

B. Hoods shall be low silhouette type.

C. Hoods shall be aluminum, all welded construction with mitered corner.

D. Hoods shall be removable, cross broken, undercoated with insulating mastic and fabricated of aluminum alloy 3003-H14. Louver blades and extruded members shall be aluminum alloy 6063-T5.

E. Finish shall be baked enamel; color selected by Contracting Officer. Submit color selection charts with shop drawings.

F. Intake hoods shall be furnished with 1/2", 19 ga, galvanized steel bird screen and motor operated damper except those furnished by Control Contractor.

G. Relief hoods shall be furnished with 1/2", 19 ga galvanized steel bird screen and motor operated damper except those furnished by Control Contractor.

H. Hoods shall be furnished with factory fabricated curbs and extended bases, as required for mounting with inlet/outlet minimum of 24" above roof.

I. Curbs shall be galvanized steel or extruded aluminum with continuous welded corner seams, treated wood nailer, minimum 1-1/2" thick 3 lb/ft³ density rigid mineral fiberboard insulation with metal liner.

PART 3 - EXECUTION

3.01 MANUAL BALANCING DAMPERS

A. Install manual balancing dampers in supply, return and exhaust branch ducts, as shown on drawings and as required to regulate airflow to meet air balance requirements.

B. Install manual balancing damper in branch duct to each diffuser and grille. Install dampers as close as possible to take-offs.

C. Install balancing dampers so as not to flutter or vibrate and as far as possible upstream from the air outlet.

D. Do not install balancing dampers in supply ductwork upstream of air terminal devices.

3.02 BACKDRAFT DAMPERS

A. Install backdraft dampers where indicated on drawings.

B. Where motorized dampers are shown in exhaust fan discharge duct, or in duct connecting to relief or exhaust louver, backdraft dampers are not required unless specifically indicated. Where motorized dampers are not shown, provide backdraft dampers in these locations.

3.03 DUCT FLEXIBLE CONNECTIONS

A. Connect ductwork to fans or casings containing rotating equipment or mounted on vibration isolators with duct flexible connections. Installed width shall be suitable for specific application but shall not be less than 4". Install flexible connections in accordance with SMACNA Standards with double lock or "Grip Loc" connection.

B. Duct flexible connections are not allowed for fan connection serving kitchen hood, or perchloric acid hood.

3.04 INTAKE AND RELIEF HOODS

A. Install hoods as shown on the drawings and/or as scheduled.

B. General Contractor will install curbs furnished with hoods unless otherwise indicated.

END OF SECTION

SECTION 23 34 00
FANS

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 23 05 13 - Motors for Mechanical Equipment

B. Section 23 05 50 - Vibration Isolation

1.02 REFERENCE

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

1.03 SUBMITTALS

A. Shop Drawings including the following:
   1. Manufacturer's name and model number
   2. Identification as referenced in the documents
   3. Capacities/ratings
   4. Fan curves
   5. Materials of construction
   6. Sound power levels
   7. Fan type, size, class, drive arrangement, discharge/rotation, bearings, drives
   8. Wheel type, diameter, rpm, tip speed
   9. Required fan hp including drive losses
   10. Motor data (refer to Section 23 05 13 - Motors for Mechanical Equipment)
   11. Vibration isolators furnished with fans
   12. Dimensions and weights
   13. Color selection charts where applicable
   14. Manufacturer's installation instructions
   15. All other appropriate data

B. Fan curves shall include series of curves indicating relationship of flow rate (cfm) to static or total pressure for various fan speeds, brake hp (kW) curves, and selection range (surge curves, maximum rpm, etc.).

C. Indicate performance data, based on both design air quantity and 110% of design air quantity.

D. For variable air volume application, indicate operating points at 100, 80, 60 and 40% of design capacity on fan curves including data to indicate effect of variable frequency drives on flow, pressure and hp.

1.04 DESIGN CRITERIA

A. Fan ratings shall be tested and certified in accordance with AMCA Standards 211 and 311 and fans shall bear AMCA Seal.

B. Fans shall be furnished complete with motors, wheels, drive assemblies, bearings and accessories as hereinafter specified. Motors for V-belt drives shall be furnished with adjustable rails or bases.

C. Each fan wheel shall be statically and dynamically balanced to Balance Quality Grade G6.3 per ANSI S2.19 and AMCA 204-05. Complete fan assembly shall be factory balanced statically and dynamically in accordance with Standard AMCA 204-05 for Balance Quality and Vibration Levels for Fans and meet or exceed guidelines in Application Category BV-3.

D. When fixed-pitch sheaves are furnished, system air balancing shall be accomplished by either trial of different fixed-pitch sheaves or use of temporary adjustable-pitch sheaves. This Contractor shall provide necessary trial and final sheaves and drive belts as required by TAB Contractor.

E. Select each fan to operate at single stable operating point as predicted by fan curve. Fans having 2 potential operating points on fan curves are not acceptable.

F. Provide OSHA Compliant belt and shaft guards for belt driven fans. Provide speed test openings at shaft locations. Paint guards bright yellow.

G. Sound power levels shall be based on tests performed in accordance with AMCA Standards 300 and 301.

H. Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. Motor furnished with fan shall not operate into motor service factor in any of these cases.

I. Consider drive efficiency in motor selection according to manufacturer's published recommendation, or according to AMCA Publication 203, Appendix L.

J. Where inlet and outlet ductwork at any fan is changed from that shown on drawings, submit scaled layout of change and system effect factor calculations indicating increased static pressure requirements as described in AMCA 201. This Contractor shall be responsible for costs associated with any motor, drive, and/or wiring changes required as a result of duct configuration changes at fan.

K. Exhaust fans serving fume hoods shall be marked with arrows to indicate proper direction of rotation.

PART 2 - PRODUCTS

2.01 POWER ROOF EXHAUSTERS

A. Manufacturers: Greenheck model G or equal.

B. Construct housings of spun aluminum.

C. Construct housings of galvanized steel with baked enamel finish; color to be selected by Contracting Officer.

D. Exhauster wheels shall be centrifugal, solid (single-thickness) backward inclined (BI), non-overloading type with full inlet cones to reduce air turbulence.

E. Provide units with single phase motors with factory mounted and wired NEMA standard disconnect switches.

F. Units shall be listed and bear UL 705 Label.

G. Mount units on factory installed vibration isolators.

H. Furnish units with bird screens.

I. Provide gravity backdraft dampers for fans when control dampers or motorized dampers are not scheduled or specified.

J. Units shall be furnished with factory fabricated curb and extended base, as required for mounting minimum of 18” above finished roof.

K. Curbs shall be constructed of galvanized steel or extruded aluminum with continuous welded corner seams, treated wood nailer, minimum 1-1/2” thick, 3 lb density, rigid mineral fiberboard insulation with metal liner.

L. Units shall be furnished with factory fabricated sound curb as indicated.

2.02 CEILING EXHAUST FANS

A. Manufacturers: Greenheck model CSP or equal.

B. Fans shall be complete with centrifugal blower wheel, steel housing with acoustical lining, integral exhaust grille, adjustable mounting brackets to allow for any ceiling thickness, permanently lubricated motor, integral junction box with motor factory wired and motor overload protection.

C. Provide unit discharge outlet as indicated on plans.

D. Provide units with appropriate roof discharge assembly, as indicated, complete with bird screen and gravity backdraft damper.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install units as shown on drawings, and according to manufacturer's installation instructions. On units provided with drain connection, install drain valve and cap discharge of drain.

B. Verify lubrication of motor and fan bearings and lubricate properly in accordance with manufacturer’s recommendation and Section 23 00 00 - General Mechanical Requirements, Part 3 under LUBRICATION.

C. General Contractor will install curbs furnished with fans unless otherwise indicated.

D. Perform field mechanical balancing, if necessary, to meet vibration tolerance specified in Part 1 of this Section.

END OF SECTION

SECTION 23 37 13
DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

1.01 REFERENCE

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

1.02 SUBMITTALS

A. Shop Drawings including the following:
   1. Manufacturer's name and model number
   2. Identification as referenced in the Documents
   3. Capacities/ratings
   4. Materials of construction
   5. Sound ratings
   6. Dimensions
   7. Finish
   8. Color selection charts where applicable
   9. Manufacturer's installation instructions
   10. All other appropriate data

1.03 DESIGN CRITERIA

A. Performance data shall be based on tests conducted in accordance with ASHRAE Std 70-2006.

B. Screw holes on surface shall be counter sunk to accept recessed type screws.

PART 2 - PRODUCTS

2.01 REGISTERS AND GRILLES

A. Registers and grilles shall be aluminum as scheduled unless otherwise indicated and furnished with frame type appropriate to installation.

B. Return and exhaust registers and grilles shall have fixed blade core.

C. Register and grille models, sizes and finishes shall be as shown on drawings and/or as scheduled. Unless otherwise noted, registers and grilles shall have baked enamel finish with color selected by Contracting Officer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install grilles, registers and diffusers as shown on drawings and according to manufacturer's instructions.

B. Unless otherwise indicated, size ductwork drops to diffusers or grilles to match unit collar sizes.

C. Seal connections between ductwork drops and diffusers/registers/grilles airtight.

D. Unless otherwise shown, provide wire mesh screen at end of each open-ended duct (OED) that is exposed in occupied spaces.

E. Protect diffusers, registers and grilles from construction dirt. Clean or replace those soiled or stained prior to turnover to Client.

END OF SECTION

SECTION 23 82 14
HEATING AND COOLING TERMINAL DEVICES

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 23 05 13 - Motors for Mechanical Equipment

1.02 REFERENCE

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

1.03 SUBMITTALS

A. Shop Drawings for all items in this Section including the following:
   1. Manufacturer's name and model number
   2. Identification as referenced in the documents
   3. Capacities/ratings
   4. Materials of construction
   5. Dimensions and weights
   6. Color selection chart where applicable
   7. Wiring diagrams
   8. Motor data (refer to Section 23 05 13 - Motors for Mechanical Equipment)
   9. All other appropriate data

1.04 REFERENCE STANDARDS AND DESIGN CRITERIA

A. Units including electrical work shall be UL Listed.

B. Electric Heaters: Shall be listed by UL, bear appropriate UL Label, contain the latest devices for protection of installation, and shall be installed in strict accordance with the latest revision of National Electric Code and other applicable State and Local Codes. Provide grounding lugs on all apparatus.

PART 2 - PRODUCTS

2.01 UNIT HEATERS

A. Heating elements shall be constructed copper clad steel sheath element with continuously brazed steel fins formed to allow side draw through air flow.

B. Units shall be equipped with automatic reset type limit controls to de-energize the heater should an over-temperature situation occur.

C. Casings shall be minimum 18 ga steel with epoxy or polyester powder coat finish, or baked enamel finish

D. Furnish adjustable horizontal and vertical discharge louvers for horizontal units and adjustable cone diffuser for projection units.

E. Fans shall have aluminum blades, factory balanced and quiet in operation and furnished with standard safety guard.

F. Fans shall be totally enclosed, 1-speed, 1-phase, permanently lubricated, thermally protected motors with unit bearings on 3 KW - 20 KW models. All motors mounted with rubber insulators to minimize vibration & noise. Fan over-ride purges unit of residual heat at shutdown.

G. Louvers shall be individually adjustable for directional control of air flow up to 15° from straight horizontal.

H. Electrical
   1. Unit shall have junction box for motor terminals factory mounted on unit or integral to motor.
   2. Provide unit mounted non-fused electrical disconnect switch.
   3. Provide line voltage thermostats with an adjustable temperature range of 40°F to 110°F.

I. Motors:
   1. Motors shall be TEFC with characteristics as scheduled.
   2. Single phase motors shall be permanently lubricated and have built-in thermal overload.

2.02 ELECTRIC WALL HEATERS

A. The heating element shall be of the non-glowing design consisting of a special resistance wire enclosed in a steel sheath to which steel plate fins are copper brazed.

B. Fan shall be five-bladed aluminum. Fan motor shall be totally enclosed.

C. Units shall be furnished with factory mounted necessary over-heat protection, reset devices, contactors, transformers and control as required. Provide adjustable thermostatic control for operation of fan and heater.

D. Fans shall be statically and dynamically balanced. Fans and motors shall be mounted for vibration free operation.

E. Cabinets shall be 20 ga galvanized steel. Exposed cabinets shall have baked enamel finish in one of manufacturer's standard colors, selected by Architect.

F. Non-fused disconnect switches shall be factory mounted at units.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install units as indicated on drawings, and according to manufacturer's installation instructions.

B. Install branch piping to each unit with minimum of 3 elbows to allow for expansion and contraction.

C. Protect units during construction against entry of foreign matter and construction dirt.

D. Unless otherwise shown on drawings, mount vertical type wall mounted heating units 10'-0” above finished floor.

3.02 ELECTRIC HEATERS

A. Units shall be provided by Mechanical Contractor and wired by Electrical Contractor.

END OF SECTION

DIVISION 26 -- ELECTRICAL

SECTION 26 00 00
GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 REFERENCE

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

1.02 DESCRIPTION

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

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

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

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

E. Included in this Contract are electrical connections to equipment provided by others. Refer to drawings, specifications, and final shop drawings prepared for/by other trades for equipment being furnished under other sections for exact locations of equipment and various connections required.

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

G. Where architectural and/or civil features govern location of work, refer to Architectural and/or Civil Drawings.

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

1.03 RELATED WORK

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

B. Temporary Services:
   1. Refer to Division 01- Section 01 50 00 temporary Facilities and Controls.

C. Continuity of Service:
   1. No service shall be interrupted or changed without permission from Contracting Officer. Obtain written permission before work is started.
   2. When interruption of services is required, Contracting Officer, and other concerned parties shall be notified and shall determine a time.

D. Demolition:
   1. Refer to Division 02 - Selective Demolition
   2. Perform required demolition to accomplish new work.
      a. Remove abandoned wiring to source of supply.
      b. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
      c. Disconnect abandoned outlets and remove devices.
      d. Remove abandoned outlets if conduit servicing them is abandoned and removed.
      e. Provide blank cover for abandoned outlets that are not removed.
      f. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
      g. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
      h. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
   3. Accomplish work in neat workmanlike manner to minimize interference; annoyance or inconvenience such work might impose on Owner or other Contractors.
   4. Unless otherwise noted, remove from premises materials and equipment removed in demolition work.
   5. Equipment noted to be removed and turned over to Owner, shall be delivered to Owner at place and time Owner designates.
   6. Where materials are to be turned over to Owner or reused and installed by Contractor, it shall be Contractor's responsibility to maintain condition of materials and equipment equal to that existing before work began. Repair or replace damaged materials or equipment at no additional cost.
   7. Where demolition work interferes with Owner's use of premises, schedule work through Owner to minimize inconvenience to Owner. Contracting Officer must approve schedule before Contractor begins such work.

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

b. Use mild detergent to clean exterior and interior surfaces; rinse with clean water and wipe dry.

c. Replace lamps, ballasts, drivers, and broken electrical parts.

F. Concrete Work:

1. Provide cast-in-place concrete as required by Contract Documents unless otherwise noted.
2. Concrete shall comply with Division 03 - Concrete.
3. Provide anchor bolts, metal shapes and templates to be cast in concrete or used to form concrete as required for anchoring and supporting electrical equipment.

G. Painting:

1. Furnish equipment with factory-applied finish coats or paint equipment per Division 09 – Finishes unless specified otherwise.
2. Furnish equipment with factory applied prime finish unless otherwise specified.
3. If factory finish on equipment furnished by Contractor is damaged in shipment or during construction, refinish equipment to satisfaction of Contracting Officer.
4. Furnish one can of touch up paint for each final factory-applied finish coat of product.

1.04 REQUIREMENTS OF REGULATORY AGENCIES

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

1.05 REFERENCE STANDARDS

A. Agencies or publications referenced herein refer to the following:

1. Association of Edison Illuminating Companies
2. American National Standards Institute
3. American Society for Testing and Materials
4. Insulated Cable Engineers Association
5. Institute of Electrical & Electronics Engineers
6. Illuminating Engineering Society of North America
7. National Electrical Code
8. National Electrical Contractors Association
9. National Electrical Manufacturers Association
10. National Electrical Safety Code
11. National Electrical Testing Association
12. National Fire Protection Association
13. National Institute of Standards & Technology
14. Occupational Safety and Health Administration
15. Underwriters Laboratories, Inc.

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

1.06 LISTING

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

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

1.07 ENCLOSURES

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

1.08 SUBMITTALS

A. Shop Drawings (Product Data):
   1. Refer to Division 01, Section 01 3323 - Submittal Procedures.
   2. Note that for satisfying submittal requirements for Division 26, “Product Data” is usually more appropriate than true “Shop Drawings” as defined in Division 01. However, the expression “Shop Drawings” is generally used throughout Specification.
   3. Submit shop drawings for equipment and systems as requested in respective specification sections. Submittals which are not requested may not be reviewed.
   4. Specifically mark general catalog sheets and drawings to indicate specific items submitted and its correlation to specific designation for product in drawings.

5. Specifically indicate proper identification of equipment by name and/or number, as indicated in specification and shown on drawings.
6. When manufacturer's reference numbers are different from those specified, provide correct cross-reference number for each item. Clearly mark and note submittal accordingly.
7. Submit complete record of required components when luminaires, equipment and items specified include accessories, parts and additional items under one designation.
8. Include wiring diagrams for electrically powered or controlled equipment.
9. Submit electrical equipment room layouts drawn to scale, including equipment, raceways, accessories and required working clearances. Submit electrical equipment room layouts concurrently with electrical distribution equipment submittals.
10. Where submittals cover products containing non-metallic materials, include “Safety Data Sheet” (MSDS) from manufacturer stating physical and chemical properties of components and precautionary considerations required.
11. Submit shop drawings or product data as soon as practicable after signing contracts. Submittals must be approved before installation of materials and equipment.
12. Submittals that are not complete, not permanent, or not properly checked by Contractor, will be returned without review.
13. Bidders shall provide a full compliance review of specifications. Compliance review shall accompany submittals. Compliance review shall include paragraph-by-paragraph review of specifications with the following information “C”, “D”, “E” marked in the margin of the specification section. Unless a deviation or exception is specifically noted in the compliance review, it is assumed that Bidder is in complete compliance with plans and specifications. Lack of these requirements in the submittal shall result in rejection of submittal. Text shall be provided accompanying compliance review as follows:
    a. “C” – Comply with no exceptions
    b. “D” – Comply with deviations. For each of the deviations, provide numbered footnote with reasons for proposed deviation
    c. “E” – Exceptions; do not comply

B. Bookmarks:
1. Submitted documents greater than 50 pages in length shall include electronic bookmarks setup to quickly navigate and easily locate submitted information. Each major series of equipment shall have a bookmark.
2. Hyperlinks can be used to enhance bookmark tools but are not an acceptable substitute for electronic bookmarks. If hyperlinks are used, they should be clearly identifiable as a hyperlink by using a different color text similar to how MS Office identifies hyperlinks.

C. Certificates and Inspections:
1. Obtain and pay for inspections required by authorities having jurisdiction and deliver certificates approving installations to Owner unless otherwise directed.

D. Operation and Maintenance Manuals:
1. Refer to Division 01, Section 01 3323 - Submittal Procedures.
2. Upon completion of work but before final acceptance of system, submit electronic copy to Contracting Officer for approval. After securing approval, submit 3 copies to Owner.
3. Organize manuals by specification section number and furnish table of contents and electronic hyper-linked tabs for each piece of equipment or system.

4. Manuals shall include the following:
    a. Copies of shop drawings
    b. Manufacturer's operating and maintenance instructions. Include parts lists of items or equipment, with component exploded views and part numbers. Where manufacturer's data includes several types or models, designate applicable type or model.
    c. Phone numbers and addresses of local parts suppliers and service companies
    d. Internet/WEB page addresses where applicable
    e. Wiring diagrams
    f. Start up and shut down procedure
    g. Factory and field test records
    h. Additional information, diagrams or explanations as designated under respective equipment or systems specification section
5. Instruct Owner in operation and maintenance of equipment. Instruction shall include complete operating cycle on all apparatus.
6. Furnish O&M manuals and instructions to Owner prior to request for final payment.
7. Include bookmarks as indicated above.

1.09 JOB CONDITIONS

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

B. Coordination:
1. Equipment provided under other Divisions of these specifications.
    a. Motors
    b. Electrically powered equipment
    c. Electrically controlled equipment
    d. Control devices, where specified
    e. Temperature Control wiring
2. Provide the following devices required for control of motors or electrical equipment, unless otherwise noted:
    a. Disconnect devices
    b. Control devices:
        1) Pushbuttons
        2) Pilot lights
        3) Contacts
    c. Conduit, boxes and wiring for Power wiring
    d. Conduit, boxes and wiring for control wiring.
3. Connect and wire equipment complete and ready to operate according to wiring diagrams furnished by various trades.
4. Wire starters or other similar control devices furnished by others.

5. This Contractor's drawings and/or specifications show number and hp rating of motors furnished by others, together with their actuating devices. Should any change in size, hp rating, voltage, or means of control be made to any motor or other electrical equipment after Contracts are awarded, Contractor responsible for change shall immediately notify the Owner.
6. Equipment and wiring shall be selected and installed for conditions in which it will be required to perform. (i.e., general purpose, weatherproof, rain tight, explosion proof, dust tight, or any other special type as required.)
7. Comply with local utility motor starting requirements and provide starters for motors furnished by others as specified herein or under various trade sections of those specifications.

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

D. Housekeeping and Cleanup:
1. As work progresses or as directed by Contracting Officer, periodically remove waste materials from building and leave area of work broom clean. Upon completion of work, remove tools, scaffolding, broken and waste materials, etc. from site.

1.10 WARRANTY

A. Refer to technical sections for warranty requirement for each system.
1. Where no warranty requirements are called out, warrant for 1 year after acceptance by Contracting Officer equipment, materials, and workmanship to be free from defect.

B. Repair, replace, or alter systems or parts of systems found defective at no extra cost.

C. In any case, wherein fulfilling requirements of any guarantee, if this Contractor disturbs any work guaranteed under another contract, this Contractor shall restore such disturbed work to condition satisfactory to Contracting Officer and guarantee such restored work to same extent as it was guaranteed under such other contract.

D. Warranty shall include labor, material, and travel time.

PART 2 - PRODUCTS

2.01 PRODUCT SUBSTITUTIONS

A. Refer to Division 01, Section 01 6700 - Product Requirements.

PART 3 - EXECUTION

3.01 GENERAL

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

B. Where conduits are shown on plans, they are shown for reference only. Conduit routes shown on plans may not show all required junction boxes, pull boxes, control conduits, or coordination with other trades. Contractor is responsible for coordination of all conduit routes with other trades, and providing junction boxes and pull boxes as required by code.

3.02 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site under provisions of Division 01.

B. Store and protect products under provisions of Division 01.

C. Store in clean, dry space.

D. Maintain factory wrapping or provide cover to protect units from dirt, water, construction debris, and traffic.

E. Handle in accordance with manufacturer's written instructions.

F. Handle carefully to avoid damage to components, enclosure, and finish. Lift only with lugs provided for the purpose.

G. Provide supplemental heat if required to prevent moisture contamination. Provide temporary circuits as required.

3.03 FLOOR, WALL, ROOF AND CEILING OPENINGS

A. Coordinate location of openings, chases, furred spaces, etc. with appropriate Contractors. Provide sleeves and inserts that are to be built into structure during progress of construction.

B. Provide Schedule 40 carbon steel pipe with integral water stop for steel sleeves required below grade or to exterior.

C. Submit to Contracting Officer for review and approval size and location of core-drilled holes prior to execution.

D. Submit product data and installation details for penetrations of building structure. Include schedule indicating penetrating materials, (steel conduit, PVC conduit, cables, cable tray, etc.), sizes of each, opening sizes and sealant products intended for use.

E. Where penetrations of fire-rated assemblies are involved, seal penetrations with appropriate firestopping systems as specified in 26 05 93 - Electrical Systems Firestopping.

F. Provide 2" clearance around penetration openings intended for raceways and cables. Where fire resistant penetrations are required, size openings in accordance with written recommendations of firestopping systems manufacturer.

G. Seal non-fire-rated floor penetrations with non-shrink grout, or urethane caulk, as appropriate.

H. Seal non-rated wall openings with urethane caulk.

I. Where penetrations occur through exterior walls into building spaces, use steel sleeves with integral water stop Seal annular space between sleeves and pipe with modular wall and casing seals. Sealing system shall utilize Type 316 stainless steel bolts, washers and nuts.

J. Finish and trim penetrations as shown on details and as specified.

3.04 EQUIPMENT ACCESS

A. Install raceways, cable tray, junction and pull boxes, and accessories to permit access to equipment for maintenance. Relocate raceways or accessories to provide maintenance access at no additional cost.

B. Install equipment with sufficient maintenance space for removal, repair or changes to equipment. Provide ready accessibility to equipment and wiring without moving other future or installed equipment.

C. Access doors in walls, chases, or inaccessible ceilings will be provided under Division 08 - Access Doors and Frames, unless otherwise indicated. Access doors for equipment shall provide access for servicing, repairs and/or maintenance.

D. Provide necessary coordination and information to the Trade Contractor under Division 08 - Access Doors and Frames. This information shall include required locations, sizes and rough-in dimensions.

E. Locate electrical outlets and equipment to fit details, panels, decorating or finish at space. Contracting Officer and/or Architect reserves right to make minor position changes of outlet locations before work has been installed.

F. Verify door swings before installing room light switch boxes. Install boxes on latch side of door unless otherwise noted

3.05 EQUIPMENT SUPPORTS

A. Provide supporting steel not indicated on drawings as required for installation of equipment and materials including angles, channels, beams, hangers, etc.

B. Provide steel shell with plug type concrete anchors for attaching equipment to concrete. Plastic, rawhide or anchors using lead are not allowed.

C. Do not support equipment or luminaires from metal roof decking.

3.06 SUPPORT PROTECTION

A. In occupied areas, mechanical and electrical rooms and areas requiring normal maintenance access, guard certain equipment to protect personnel from injury.

B. Provide minimum 1/2” thick closed cell fiber-free, non-particulating foam insulation applied with compatible adhesive by the foam insulation manufacturer on lower edges of equipment, including bus duct, cable tray, pull boxes and electrical supporting devices suspended less than 7 ft above floors, platforms or catwalks in these areas.

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

3.07 ELECTRICAL SYSTEMS IDENTIFICATION

A. Refer to Section 26 05 53 - Electrical Systems Identification

3.08 ACCEPTANCE TESTING

A. Contractor shall perform acceptance testing. Equipment to be tested is noted as "Testing by Electrical Contractor" in technical specification sections. Perform in accordance with Section 26 08 12 - Power Distribution Acceptance Tests and Section 26 08 13 - Power Distribution Acceptance Test Tables.

B. Contractor is responsible for all costs associated with 3rd party testing and inspections.

C. When testing is to be witnessed by Contracting Officer or Inspector, notify them at least 10 days prior to testing date.

D. When equipment or systems fail to meet minimum test requirements, replace or repair defective work or materials as necessary and repeat inspection and test until equipment or systems meet test requirements. Make repairs with new materials.

E. Contractor is responsible for certifying in writing equipment and system test results. Certification shall include identification of portion of system tested, date, time, test criteria and name and title of person signing test certification documents.

F. Submit test results to Contracting Officer for approval prior to start-up of equipment.

G. Maintain copies of certified test results, including those for any failed tests, at project site. At completion of project, include copies of test records and certifications in O&M Manuals.

3.09 START-UP

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

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

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

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

E. Coordinate start-up with all trades.

3.10 CLEANING

A. Clean systems after installation is complete.

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

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

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

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

END OF SECTION

SECTION 26 05 13.16
MEDIUM-VOLTAGE, SINGLE- AND MULTI-CONDUCTOR CABLES

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 05 43 - Underground Ducts And Raceways For Electrical Systems

B. Section 26 05 53 - Electrical Systems Identification

C. Section 26 08 12 - Power Distribution Acceptance Tests

D. Section 26 08 13 - Power Distribution Acceptance Test Tables

1.02 REFERENCE

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

1.03 DESCRIPTION

A. Section includes cables and related splices, terminations, and accessories for medium-voltage electrical distribution systems.

B. Cables are for use in underground duct applications.

C. Conductors shall be rated to operate at conductor temperature of 105°C for continuous normal operation, 130°C for emergency overload conditions, and 250°C for short circuit conditions, based on 40°C maximum ambient temperature.

D. Conductor sizes in Section are based on copper wire, and only copper wire shall be used.

E. Conductor sizes in Section are based on copper wire.

1.04 REFERENCE STANDARDS

A. AEIC CS8 – Specification for Extruded Dielectric Shielded Power Cables Rated 5 through 46kV.

B. IEEE 48 – Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5kV through 765kV.

C. IEEE 386 – Standard for Separable Insulated Connector Systems for Power Distribution Systems above 600 V (ANSI).

D. IEEE 404 – Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 – 500000 V (ANSI)

E. IEEE 576 – Recommended Practice for Installation, Termination, and Testing of Insulated Power Cable as Used in Industrial and Commercial Applications (ANSI)

F. ICEA S-93-639 – 5-46kV Shielded Power Cables for the Distribution and Transmission of Electrical Energy

G. ICEA S-94-649 – 5-46kV Concentric Neutral Cables Rated 5000 to 46000 Volts

H. ICEA S-97-682 – Utility Shielded Power Cables Rated 5000 to 46000 Volts

I. NFPA 70 – National Electrical Code

J. UL 1072 – Medium-Voltage Power Cable

1.05 SUBMITTALS

A. Product Data: For each type of cable indicated. Include splices and terminations for cable and cable accessories.
   1. Include cable drawings with the following data:
      a. Longitudinal cutback and cross-sectional view of cable.
      b. Identification and structure of cable components.
      c. Dimensions of cable components in English and SI units.

B. Material Certificates: For each cable and accessory type, signed by manufacturer.

C. Manufacturer Testing Certificate: For each type and voltage class of cable indicated.

D. Certified Field Quality Control Test Reports per requirements in Section 26 08 12 - Power Distribution Acceptance Tests and Section 26 08 13 - Power Distribution Acceptance Test Tables for each type and voltage class of cable indicated. Indicate applicable standards compliance. Interpret test results and corrective action taken for compliance with specification requirements.

E. Qualification Data: For 5 KV.

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

G. Installation Guide: Include the following:
   1. Maximum allowable pulling tension (in pounds and newtons)
   2. Minimum allowable bending radius
   3. Recommended pulling compounds
   4. Splicing and termination instructions with diagrams, dimensions, and material lists
   5. Weight per 1,000 ft
   6. Standard "packaging" of reels (i.e., lengths, lagging, banding, etc.)
   7. Reactance and AC resistance (ohms to neutral) of each size and voltage class of cable, both in magnetic and non-magnetic duct, based on 3-1/C cables or 1-3/C cable in one duct.

H. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual locations of cables, splices, and terminations.

2. Operation and Maintenance Data:
    a. Include manufacturer's recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.

1.06 QUALITY ASSURANCE

A. Installer: Engage cable splicer, trained and certified by splice material manufacturer, to install, splice, and terminate medium-voltage cable, having not less than 3 yrs experience as licensed electrician.

B. Regulatory Requirements:
1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
2. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

C. Source Limitations: Obtain cables and accessories through one source from single manufacturer.

D. All cables shall be of a single type and configuration. Date of manufacture shall not precede contract date by more than one year.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Coordinate with manufacturer to provide protective covering over cable and reel to prevent damage during shipping, storage, or handling.

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

1.08 WARRANTY

A. Refer to Division 01 and Section 26 00 00 - General Electrical Requirements for general warranty requirements.

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

PART 2 - PRODUCTS

2.01 MEDIUM VOLTAGE CABLES

A. Manufacturers:
1. Cable Type: MV105
    a. General Cable / Prysmian Group, or Equal
2. Cable Splicing and Terminating Products and Accessories:
    a. Prysmian Group, or Equal

B. Salient Characteristics:
1. Physical
    a. Conductor: Copper
    b. Conductor Stranding: Compact round, concentric lay, Class B

c. Strand Filling: Conductor interstices are filled with impermeable compound
d. Conductor Insulation: Ethylene-propylene-rubber

2. Functional
a. Comply with UL 1072, AEIC CS8, ICEA S-93-639 and ICEA S-97-682

C. Comply with UL 1072, AEIC CS8, ICEA S-93-639 and ICEA S-97-682

D. Conductor: Copper

E. Conductor Stranding: Compact round, concentric lay, Class B

F. Strand Filling: Conductor interstices are filled with impermeable compound

G. Conductor Insulation: Ethylene-propylene-rubber

H. Voltage Rating: 5 kV

I. Insulation Thickness: 133 percent insulation level

J. Shielding: Copper tape, helically applied over semiconducting insulation shield. 12.5% overlap for 15 KV and less, 25% over 15 KV.

K. Cable Jacket: sunlight-resistant PVC. Color: black, unless otherwise designated

L. Cables utilizing combination insulation shield and jacket are acceptable.

M. Cable lengths shall be supplied with factory-installed, moisture-proof end seals on conductors on each end. Cable seals shall be rubber or plastic caps, and shall prevent moisture from seeping into cable ends.

N. Each cable reel shall be tagged with the following:
1. Manufacturer
2. Cable Size
3. Cable Type
4. Voltage Class
5. Manufacture Date
6. Cable Length
7. Tolerances
8. Reel Number
9. Customer Order No.
10. Customer Name

O. Surface Marking:
1. Cables shall be permanently printed (or imprinted) on jacket surface at regular intervals over entire length of cable with the following:
a. Manufacturer’s name
b. Conductor size
c. Voltage class
d. Insulation type

e. UL designation

P. Cables shall be constructed and rated for continuous and intermittent submersion in water and shall be suitable for installation in conduit and underground duct.

Q. Cable shield shall be capable of withstanding fault current indicated on drawings for 1/10 second.

2.02 SPLICE KITS

A. Connectors and Splice Kits: Comply with IEEE 404; type as recommended by cable or splicing kit manufacturer for application.

B. Splicing Products: As recommended, in writing, by splicing kit manufacturer for specific sizes, ratings, and configurations of cable conductors. Include components required for complete splice, with detailed instructions.

1. Combination tape and cold-shrink-rubber sleeve kit with rejacketing by cast-epoxy-resin encasement or other waterproof, abrasion-resistant material.
2. Heat-shrink splicing kit of uniform, cross-section, polymeric construction with outer heat-shrink jacket.
3. Premolded, cold-shrink-rubber, in-line splicing kit.
4. Premolded EPDM splicing body kit with cable joint sealed by interference fit of mating parts and cable.

2.03 SOLID TERMINATIONS

A. Multi-conductor Cable Sheath Seals: Type recommended by seal manufacturer for type of cable and installation conditions, including orientation.

1. Cold-shrink sheath seal kit with preformed sleeve openings sized for cable and insulated conductors.
2. Heat-shrink sheath seal kit with phase- and ground-conductor rejacketing tubes, cable-end sealing boot, and sealing plugs for unused ground-wire openings in boot.
3. Cast-epoxy-resin sheath seal kit with wraparound mold and packaged, two-part, epoxy-resin casting material.

B. Shielded-Cable Terminations: Comply with the following classes of IEEE 48. Insulation class is equivalent to that of cable. Include shield ground strap for shielded cable terminations.

1. Class 1 Terminations: Modular type, furnished as kit, with stress-relief tube; multiple, molded-silicone rubber, insulator modules; shield ground strap; and compression-type connector.
2. Class 1 Terminations: Heat-shrink type with heat-shrink inner stress control and outer nontracking tubes; multiple, molded, nontracking skirt modules; and compression-type connector.
3. Class 1 Terminations: Modular type, furnished as kit, with stress-relief shield terminator; multiple-wet-process, porcelain, insulator modules, shield ground strap; and compression-type connector.
4. Class 1 Terminations, Indoors: Kit with stress-relief tube, nontracking insulator tube, shield ground strap, compression-type connector, and end seal.
5. Class 2 Terminations, Indoors: Kit with stress-relief tube, nontracking insulator tube, shield ground strap, and compression-type connector. Include silicone-rubber tape, cold-shrink-rubber sleeve, or heat-shrink plastic-sleeve moisture seal for end of insulation whether or not supplied with kits.
6. Class 3 Terminations: Kit with stress cone and compression-type connector.

C. Cable Terminations:

1. Product of one manufacturer and furnished in kit form compatible with insulation and conductor material for cable terminated.

D. Connecting Lugs:

1. Connectors and terminals: Copper with uniform compression over entire contact surface.
2. Terminals on conductors: Solderless terminal lugs.

2.04 SEPARABLE INSULATED CONNECTORS

A. Description: Modular system, complying with IEEE 386, with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.

B. Terminations at Distribution Points: Modular type, consisting of terminators installed on cables and modular, dead-front, terminal junctions for interconnecting cables.

C. Dead-Break Cable Terminators: Elbow-type unit with 600A continuous-current rating; designed for de-energized disconnecting and connecting; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.

D. Dead-Front Terminal Junctions: 600A, 5KV class, modular bracket-mounted groups of dead-front stationary terminals that mate and match with above cable terminators. Two-, three-, or four-terminal units as indicated, with fully rated, insulated, watertight conductor connection between terminals and complete with grounding lug, manufacturer's standard accessory stands, stainless-steel mounting brackets, and attaching hardware.

1. Protective Cap: Insulating, electrostatic-shielding, water-sealing cap with drain wire.
2. Portable Feed-Through Accessory: Two-terminal, dead-front junction arranged for removable mounting on accessory stand of stationary terminal junction.
3. Grounding Kit: Jumpered elbows, portable feed-through accessory units, protective caps, test rods suitable for concurrently grounding three phases of feeders, and carrying case.
4. Standoff Insulator: Portable, single dead-front terminal for removable mounting on accessory stand of stationary terminal junction. Insulators suitable for fully insulated isolation of energized cable-elbow terminator.

E. Test-Pont Fault Indicators: Applicable current-trip ratings and arranged for installation in test points of load-break separable connectors, and complete with self-resetting indicators capable of being installed with shotgun hot stick and tested with test tool.

F. Tool Set: Shotgun hot stick with energized terminal indicator, fault-indicator test tool, and carrying case.

2.05 ARC-PROOFING MATERIALS

A. Tape for First course on Metal Objects: 10 mil-thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape.

B. Arc-Proofing Tape: Fireproof tape, flexible, conformable, intumescent to 0.3" thick, compatible with cable jacket.

C. Glass-Cloth Tape: Pressure-sensitive adhesive tape, 1/2" wide.

2.06 FAULT INDICATORS

A. Indicators: Automatic reset fault indicator with inrush restraint feature, arranged to clamp to cable sheath and provide a display after fault has occurred in cable. Instrument shall not be affected by heat, moisture, and corrosive conditions and shall be recommended by manufacturer for installation conditions.

2.07 SOURCE QUALITY CONTROL

A. Test and inspect cables according to Section 26 08 12 - Power Distribution Acceptance Tests and Section 26 08 13 - Power Distribution Acceptance Test Tables.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install cables according to IEEE 576.

B. Pull Conductors: Do not exceed manufacturer's recommended minimum installation temperature, maximum pulling tensions, and sidewall pressure values.
   1. Where necessary, use manufacturer-approved pulling compound or lubricant that will not deteriorate conductor or insulation.
   2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips that will not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.
   3. Cut off cable damaged by cable grips or pulling make-ups so as to provide clean, undamaged cable for termination. Continuously record pulling tension during installation.
   4. Make attachment to cable by compression or epoxy filled pulling eye and provide break away (clutch) tension device.

C. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
   1. Support cables and conductors in vertical raceways per requirements in Section 26 05 29 - Hangers and Supports for Electrical Systems.

D. Support cables in handholes and manholes from walls on heavy-duty, non-metallic cable rack arms, at least 3" above the floor. Support cables with reinforced nylon cradles. Anchor to wall with stainless steel anchor bolts.
   1. Install compression connectors with hydraulic compression tool on 600V neutral/ground conductor.

E. Install direct-buried cables on leveled and tamped bed of 3" thick, clean sand. Separate cables crossing other cables or piping by a minimum of 4" of tamped earth. Install permanent markers at ends of cable runs, changes in direction, and buried splices.

F. Install "buried-cable" warning tape per requirements in Section 26 05 53 - Electrical Systems Identification.

G. In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by longest route from entry to exit and support cables at intervals adequate to prevent sag. Fill lowest ducts first, avoid covering or blocking duct entrances and allow space for future cable installation.

H. Provide at least one 360-degree loop around first and last manhole for each cable run and every third manhole in between (if applicable).

I. Cut cable in clean, dry environment. Seal cut ends with waterproof seal immediately after cutting. Maintain a seal during and after pulling.

J. Install cable splices at pull points (accessible locations) and elsewhere as indicated; use standard kits.

K. Install terminations at ends of conductors and seal multi-conductor cable ends with standard kits. Do not install exterior terminations during inclement weather or damp atmospheric conditions.

L. Install stress cones at cable splices and terminations, grounded per cable and connector manufacturer recommendations.

M. Check phase rotation before connections are made to existing circuits. Clearly letter cable terminations. Identify phases with phase designations lettered on terminal boxes and other terminations throughout the system.

N. Install separable insulated-connector components as follows:
   1. Protective Cap: At each terminal junction, with one on each terminal to which no feeder is indicated to be connected
   2. Portable Feed-Through Accessory: Three
   3. Standoff Insulator: Three

O. Arc Proofing: Unless otherwise indicated, arc proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial, or termination materials. In addition to arc-proofing tape and/or manufacturer’s written instructions, apply arc proofing as follows:
   1. Clean cable sheath.
   2. Wrap metallic cable components with 10 mil pipe-wrapping tape.
   3. Smooth surface contours with electrical insulation putty.
   4. Apply arc-proofing tape in one half-lapped layer with coated side toward cable.
   5. Band arc-proofing tape with 1”-wide bands of half-lapped, adhesive, glass-cloth tape 2" o.c.

P. Seal around cables passing through fire-rated elements according to Section 26 05 93 - Electrical Systems Firestopping.

Q. Install fault indicators on each phase where indicated.

R. Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Shields shall be grounded at both ends of cable run. Single point grounding will not be accepted. Ground metal bodies of terminators, splices, cable and separable insulated-connector fittings, and hardware. For grounding requirements, refer to Section 26 05 26 - Grounding and Bonding for Electrical Systems.

S. Identify cables according to Section 26 05 53 - Electrical Systems Identification.

3.02 FIELD QUALITY CONTROL

A. Perform cable acceptance tests on cable circuits after installing cables and before electrical circuitry has been energized. Splices and terminations required as part of this project are to be completed and acceptance tested as part of cable tests. For cables not spliced or terminated as part of project, ends should be clean, dry and long enough to eliminate leakage from conductor to ground along outer surface of cable.

B. Perform acceptance tests and damage investigations under constant supervision of Owner's representative. Contractor shall coordinate and provide labor, material, equipment, and services necessary to test each completed cable circuit.

C. Remove and replace defective cables and retest as required.

D. Refer to Section 26 08 12 - Power Distribution Acceptance Tests and Section 26 08 13 - Power Distribution Acceptance Test Tables for visual and mechanical inspection and electrical tests. Certify compliance with test parameters.

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 05 29 - Hangers and Supports for Electrical Systems

B. Section 26 05 33 - Raceway and Boxes for Electrical Systems

C. Section 26 05 53 - Electrical Systems Identification

D. Section 26 08 12 - Power Distribution Acceptance Tests

E. Section 26 08 13 - Power Distribution Acceptance Test Tables

1.02 REFERENCE

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

1.03 DESCRIPTION

A. Section includes conductors and cables rated 600 V and less, connectors, splices, and terminations rated 600 V and less, sleeves and sleeve seals for cables.

B. Conductor and conduit sizes in these contract documents are based on copper wire, and only copper wire shall be used.

1.04 REFERENCE STANDARDS

A. ASTM B1 – Standard Specification for Hand-Drawn Copper Wire.

B. ASTM B8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

C. NEMA WC 70 – Non-Shielded Power Cable 2000 V or less for the Distribution of Electrical Energy (ICEA S-95-658).

D. NFPA 70 – National Electrical Code.

E. UL 44 – Thermoset-Insulated Wires and Cables.

F. UL 83 – Thermoplastic-Insulated Wires and Cables.

G. UL 486A-486B – Wire Connectors.

H. UL 486C – Splicing Wire Connectors.

I. UL 486D – Standard for Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations.

J. UL 486E – Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.

1.05 SUBMITTALS

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

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

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

D. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual locations of components and circuits.
   2. Operation and Maintenance Data:
      a. Include manufacturer's recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.

1.06 QUALITY ASSURANCE

A. Refer to Division 01, Section 01 4000 - Quality Requirements

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

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

1.07 DELIVERY, STORAGE, AND HANDLING

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

1.08 WARRANTY

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

PART 2 - PRODUCTS

2.01 SINGLE CONDUCTOR INSULATED WIRE

A. Salient Characteristics
   1. Physical:
      a. Conductor: Copper Wire

b. Insulation: Type THWN-2 Thermoplastic-insulated wires and cables; Type XHHW-2 Thermoset-insulated wires and cables

2. Functional:
   a. THWN-2: NEMA WC-70, UL83
   b. XHHW-2: NEMA WC-70, UL44
3. Performance:
   a. 600V rated insulation class
   b. 90°C maximum operating temperature for dry and wet or damp locations

2.02 REMOTE CONTROL AND SIGNAL CIRCUITS

A. Class 1: Salient Characteristics
1. Physical:
   a. Conductor: Copper
   b. Insulation: Type THHN-2 Thermoplastic insulated wires and cable; Type XHHW Thermoplastic insulated wires and cables for ambient temperature less than 32°F
2. Functional:
   a. UL 83 listed, ASTM B 1 for solid conductors; ASTM B 8 for stranded conductors
3. Performance:
   a. 600V rated insulation class
   b. 90°C maximum operating temperature for dry and wet or damp locations

B. Class 2 and 3: Salient Characteristics
1. Physical:
   a. Conductor: Multiple twisted copper wires covered with an overall non-metallic jacket.
   b. Insulation: type XLPE
2. Functional:
   a. UL listed for use in space in which circuits will be installed
3. Performance:
   a. 300V rated insulation class
   b. 105°C maximum operation temperature

2.03 CONNECTORS, SPLICES, AND TERMINALS

A. Salient Characteristics
1. Physical:
   a. Factory-fabricated connectors, splices, and terminals of size, ampacity rating, material, type, and class for application and service indicated
2. Functional:
   a. UL 486A-486B, UL 486C, UL 486D, UL 486E
3. Performance: None

2.04 TERMINATIONS

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

2.05 PLASTIC CABLE TIES

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

PART 3 - EXECUTION

3.01 INSTALLATION OF CONDUCTORS AND CABLES

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

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

C. Pull conductors into raceway at same time.

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

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

F. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

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

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

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

J. Support cables and conductors in vertical raceways per requirements in Section 26 05 29 - Hangers and Supports for Electrical Systems.

K. Identify and color-code conductors and cables according to Section 26 05 53 - Electrical Systems Identification.

L. Wiring at Outlets: Install conductor at each outlet, with minimum 6" of slack.

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

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

O. Install control wiring in their own separate conduit systems.

P. Neutral conductors shall not be used for more than one branch circuit, for more than one multiwire branch circuit, or for more than one set of ungrounded feeder conductors unless otherwise noted on drawings.

3.02 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid or stranded for #10 AWG and smaller; stranded for #8 AWG and larger.

B. Branch Circuits: Copper Solid or stranded for #10 AWG and smaller; stranded for #8 AWG and larger.

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

D. Branch wiring length limitations:
   1. Where wire sizes are shown on project drawings and do not indicate they have been adjusted for voltage drop based on circuit length, they shall be increased as noted below depending on Contractor routing.
   2. 208Y/120 V circuits over 75 ft in length: Increase wire size one size for each 75 ft in length. Increase conduit size as required.
   3. 480Y/277 V circuits over 150 ft in length: Increase wire size one size for each 150 ft of length. Increase conduit size as required.

3.03 CONDUCTOR INSULATIONS AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, rated 90°C for wet locations, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, rated 90°C for wet locations, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, rated 90°C for wet locations, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, rated 90°C for wet locations, single conductors in raceway.

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

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN, rated 90°C for dry and wet or damp locations, single conductors in raceway.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, rated 90°C for dry and wet or damp locations, single conductors in raceway.

H. Motor Circuit Branch Wiring and Associated Control Wiring: Type THHN, rated 90°C for dry and wet or damp locations, single conductors in raceway, stranded.

I. Wiring in Light Fixture Channels: Type THHN/THWN-2, rated 90°C for dry and damp locations, single conductors.

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

K. Circuits 100A and less, utilize 60°C for ampacity (unless both sides of the circuit are listed for 75°C). Circuits 100A and overuse 75°C for ampacity. If the wire insulation ratings are higher, they may be utilized for de-rating purposes only and wire size shall be increased if the de-rated insulation rating is less than the required load current.

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

3.04 REMOTE CONTROL AND SIGNAL CIRCUITS

A. Sizing – #16 AWG minimum.

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

3.05 CONNECTORS, SPLICES, AND TERMINALS

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

B. Splices:
   1. Splice wires and cable only in accessible locations such as within junction boxes.
   2. Make splices to carry full capacity of conductors with no perceptible temperature rise.
   3. Make below-grade splices in manholes and handholes watertight with pre-stretched or heat-shrinkable insulating tubing, or resin-filled insulator.
   4. Use electrical tape to build up insulation level equivalent to cable insulation and cover with not less than two half-lapped layers of plastic electrical tape, for joints, taps, and splices of #1 AWG conductors and larger.
   5. Plastic snap-on splice insulators are not allowed.
   6. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Terminals:

1. Insulate ends of spare conductors with electrical tape and identify spare circuit number where appropriate.
2. Eye type crimped terminal for removable screw type terminal. Forked torque terminal when screw terminal cannot be removed.
3. Train wires to eliminate fanning of stands, crimp with proper tool and die.
4. Torque screw termination per manufacturer's recommended values.

3.06 CABLE TIES

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

3.07 FIELD QUALITY CONTROL

A. Test 600 volt conductors and cables per requirements in Sections 26 08 12 - Power Distribution Acceptance Tests and 26 08 13 - Power Distribution Acceptance Test Tables.

B. Interpret test results in writing and submit to Contracting Officer.

C. Replace conductors and cables that are found defective, at no expense.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 05 13.16 - Medium-Voltage, Single- and Multi-Conductor Cables

B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables

C. Section 26 05 33 - Raceway and Boxes for Electrical Systems

D. Section 26 05 43 - Underground Ducts And Raceways For Electrical Systems

E. Section 26 05 43.23 - Underground Electrical Service

F. Section 26 08 12 - Power Distribution Acceptance Tests

G. Section 26 08 13 - Power Distribution Acceptance Test Tables

H. Section 26 09 23 - Lighting Control Devices

I. Section 26 22 00 - Low-Voltage Transformers

J. Section 26 24 13 - Switchboards

K. Section 26 24 16.13 - Lighting and Appliance Panelboards

L. Section 26 27 26 - Wiring Devices

M. Section 26 28 16 - Enclosed Switches and Circuit Breakers

N. Section 26 43 00 - Surge Protective Devices (SPD)

O. Section 26 50 00 - Lighting

1.02 REFERENCE

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

1.03 DESCRIPTION

A. Section includes methods and materials for grounding systems and equipment, as required by State Codes, NFPA 70, applicable portions of other NFPA codes, as indicated herein, plus the following special applications:
   1. Overhead-lines grounding.
   2. Underground distribution grounding.
   3. Common ground bonding with lightning protection system.

B. Maximum resistance to ground shall be less than 25 ohms.

C. Refer to Grounding Riser Diagram.

1.04 REFERENCE STANDARDS

A. ASTM B3 – Specification for Soft or Annealed Copper Wire

B. ASTM B8 – Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft

C. ASTM B33 – Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes

D. IEEE C2 – National Electrical Safety Code (ANSI)

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

F. NETA MTS – Maintenance Testing Specifications

G. NFPA 70 – National Electrical Code

H. NFPA 70B – Recommended Practice for Electrical Equipment Maintenance

I. NFPA 780 – Lightning Protection Systems

J. UL 467 – Grounding and Bonding Equipment

1.05 TELECOMMUNICATIONS GROUNDING SYSTEM DEFINITIONS

A. Grounding Equalizer (GE): Conductor that interconnects elements of telecommunications grounding infrastructure.

B. Telecommunications Bonding Backbone (TBB): Conductor that interconnects telecommunications main grounding busbar (TMGB) to telecommunications grounding busbar (TGB).

C. Telecommunications Bonding Conductor: Conductor that interconnects telecommunications bonding infrastructure to building's service equipment (power) ground.

D. Telecommunications Grounding Busbar (TGB): Interface to building telecommunications grounding system, common point of connection for telecommunications system and equipment to ground, and located in telecommunications room or equipment room.

E. Telecommunications Main Grounding Busbar (TMGB): Busbar placed in convenient and accessible location and bonded by means of bonding conductor for telecommunications to building service equipment (power) ground.

1.06 SUBMITTALS

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

B. Other Informational Submittals:
   1. Plans showing dimensioned as-built locations of grounding features, including the following:
      a. Test wells

b. Ground rods
c. Ground rings
d. Grounding arrangements and connections for separately derived systems
e. Grounding for sensitive electronic equipment
f. Photos of underground grounding and bonding

C. Field Quality-Control Test Reports:
1. Indicate field test and inspection procedures and interpret test results and corrective action taken for compliance with specification requirements.
2. Test reports of resistance to earth. Each test report shall include:
a. Date of test, soil moisture content, and soil temperature
b. Test operator
c. Instrument or other test equipment used
d. Electrode designation or location
e. Ground impedance in ohms
f. Assumptions made - if required

D. Closeout Submittals:
1. Operation and Maintenance Manuals: Include the following:
a. Instructions for periodic testing and inspection of grounding features at insert locations based on NFPA 70B.
1) Instructions to perform tests to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
2) Include recommended testing intervals.

1.07 QUALITY ASSURANCE

A. Refer to Division 01, Section 01 4000 - Quality Requirements

B. Regulatory Requirements:
1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70.
2. Comply with UL 467 for grounding and bonding materials and equipment.

1.08 DELIVERY, STORAGE, AND HANDLING

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

1.09 WARRANTY

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

PART 2 - PRODUCTS

2.01 CONDUCTORS

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

B. Bare Copper Conductors:
   1. Solid Conductors: ASTM B3.
   2. Stranded Conductors: ASTM B8.
   3. Tinned Conductors: ASTM B33.
   4. Bonding Cable: 28 kcmil, 14 strands of #17 AWG conductor, 1/4” in diameter.
   5. Bonding Conductor: #4 AWG or #6 AWG, stranded conductor.
   6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8” wide and 1/16" thick.
   7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8” wide and 1/16" thick.

C. Grounding Bus: Horizontal rectangular bars of annealed copper, 1/4” by 2” in cross section; with insulators.

2.02 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Electro-tin-plated copper or copper alloy, bolted pressure-type, with at least two bolts.
   1. Pipe connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Compression Connectors: Irreversible type.

2.03 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel, sectional type; 3/4" in diameter by 10' in length.

2.04 TELECOMMUNICATIONS BUSBARS

A. Material: Copper
   1. 1/4” thick

B. Pre-drilled
   1. 7/16” diameter
   2. Hole spacing per ANSI Joint Standard TIA-607-B
   3. Hole pattern shall accommodate two-hole lugs

C. Insulators and stand-off brackets shall electrically isolate busbar from wall or other mounting surface.

D. Provide busbars listed by nationally recognized testing laboratory.

PART 3 - EXECUTION

3.01 APPLICATIONS

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

B. Underground Grounding Conductors: Install bare copper conductor. Sized as indicated on drawings.
   1. Bury at least 24” below grade.
   2. Ductbank Grounding Conductor: Bury 12” above ductbank when indicated as part of ductbank installation.

C. Grounding Bus: Install in electrical and communications rooms, in rooms housing service equipment.
   1. Install bus as indicated on drawings.

D. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors
   2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated
   3. Connections to Ground Rods at Test Wells: Bolted connectors
   4. Connections to Structural Steel: Welded connectors

3.02 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4” will extend above finished floor. If necessary, install ground rod before manhole is placed and provide #1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof PVC sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2" above to 6" below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, catch basins, metallic cover frame and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with #4 AWG minimum, stranded, copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers, Unit Substations, and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with transformer and switches by connecting them to underground cable and grounding electrodes. Install copper conductor not less than #2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 24” from the foundation. Install as indicated on drawings.

3.03 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with feeders and branch circuits.
   1. Install a single insulated equipment ground conductor for each branch circuit conduit originating from panelboards.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Feeders and branch circuits
   2. Lighting circuits
   3. Receptacle circuits
   4. Single-phase motor and appliance branch circuits
   5. Three-phase motor and appliance branch circuits
   6. Flexible raceway runs
   7. Armored cable runs

C. Air-Duct Equipment Circuits: Install a separate insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping. Ground ductwork of fans serving flammable liquid storage rooms or fume hoods. Install continuous ground around any flexible connections in this ductwork system. Bond lower end of exhaust ducts, vent stacks, etc., which pass through roof.

D. Uninterruptible Power Supply (UPS) Battery Cabinets: Dedicated #4/0 from UPS ground bus to each associated battery cabinet ground bus.

E. Metallic Sleeves: Minimum #6 AWG

F. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

G. Duplex receptacles and light switches of any amperage: Install separate jumper between grounding terminal on device and metallic box.

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

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

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

K. Install grounding for service entrance equipment room consisting of ground bus, ground conductors, and grounding rods arranged as indicated on drawings.
   1. Ground bus shall be horizontal as indicated on drawings, copper bar. Bolt to wall at 3 ft intervals with 1" stand-offs at each bus support.
   2. Install ground bus per details on drawings.

L. Install grounding conductor to luminaires hanging from conduit swivel hangers.

3.04 SEQUENCING, SCHEDULING

A. Permanently attach service grounds before permanent building service is energized.

B. Permanently attach equipment grounds prior to energizing equipment.

3.05 INSTALLATION

A. Contractor shall take photographs of all underground grounding and bonding connections prior to covering. Furthermore, Contractor shall coordinate with the Owner and Authority Having Jurisdiction to confirm approval of installation prior to covering.

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

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

D. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

E. Ground Rods: Install ground rods with the top 1' minimum below finished grade
   1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
   2. For grounding electrode system, install at least 3 rods spaced at least one rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

F. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

G. Grounding and Bonding for Piping:
   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Water pipe, by itself, is not an adequate grounding electrode and must be supplemented by another electrode system. Bond system together.
   2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
    a. Confirm application with local gas and electric utility ordinances and notify the contracting officer if restrictions do not allow bonding as required by the project documents.

H. Grounding Electrode Conductor installed in metal conduit or sleeves, shall be bonded at each end using grounding hubs. The bonding conductor shall be the same size as the grounding electrode conductor. Conduits terminated to grounding enclosures, shall be secured to enclosure using grounding locknuts.

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

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

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

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

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

3.06 FIELD QUALITY CONTROL

A. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
    1. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal and at individual ground rods. Make tests at ground rods before any conductors are connected.

B. Test grounding systems per requirements in Section 26 08 12 - Power Distribution Acceptance Tests and 26 08 13 - Power Distribution Acceptance Test Tables.

C. Interpret test results in writing and submit to Contracting Officer.

D. Inspect completed system by commissioning authority, prior to backfilling.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 05 33 - Raceway and Boxes for Electrical Systems

B. Section 26 22 00 - Low-Voltage Transformers

C. Section 26 24 13 - Switchboards

D. Section 26 24 16.13 - Lighting and Appliance Panelboards

E. Section 26 28 16 - Enclosed Switches and Circuit Breakers

F. Section 26 50 00 - Lighting

1.02 REFERENCE

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

1.03 DESCRIPTION

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

1.04 REFERENCE STANDARDS

A. AWS D1.1/D1.1M – Structural Welding Code-Steel.

B. ASTM A36/A36M – Carbon Structural Steel.

C. 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.

D. ASTM A780/A780M – Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

E. MSS SP-58 – Pipe Hangers and Supports - Materials, Design and Manufacture.

F. MSS SP-69 – Pipe Hangers and Supports - Selection and Application.

G. MFMA-4 – Metal Framing Standards Publication.

H. NECA 1 – Standard Practices for Good Workmanship in Electrical Construction.

I. NECA 101 – Standard for Installing Steel Conduits (Rigid, IMC, EMT).

J. NFPA 70 – National Electrical Code.

K. SSPC-PA 1 – Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel.

1.05 SUBMITTALS

A. Product Data: For the following:
   1. Steel slotted support systems.
   2. Nonmetallic slotted support systems.
   3. Raceway and cable supports.
   4. Support for conductors in vertical raceway.
   5. Structural steel for fabricated supports and restraints.
   6. Mounting, anchoring, and attachment components:
      a. Powder-actuated fasteners.
      b. Mechanical-expansion anchors.
      c. Concrete inserts.
      d. Clamps for attachment to structural steel.
      e. Through bolts.
      f. Toggle bolts.
      g. Hanger rods.

B. Shop Drawings: Signed and sealed by an Engineer registered and licensed in the State of New York. Include concrete anchors application, size, and placement. Include concrete inserts application, size, loading, and placement. Show fabrications and installation details and include calculations for the following:
   1. Trapeze hangers. Include product data for components.
   2. Steel slotted channel systems. Include product data for components.
   3. Nonmetallic slotted channel systems. Include product data for components.
   4. Fabricated metal equipment support assemblies.

C. Drawings showing specific locations of any suspended loads which exceed 100 lbs within joist chord panel, to be attached to open web steel joist structural members. Include weight supported by such attachments. (Panel is length of chord between two adjacent diagonal web members at points of connection to chord.)

D. Schedule of hangers and support devices with support spacing.

1.06 QUALITY ASSURANCE

A. Refer to Division 01, Section 01 4000 - Quality Requirements

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, “Structural Welding Code – Steel.”

C. Comply with NFPA 70.

D. Certification:
   1. Installer of PVC-coated hangers and supports shall be certified by a PVC conduit manufacturer.

PART 2 - PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of 5 times the applied force.

B. Steel Slotted Support Systems:
   1. Type: Power-Stut Unit
   2. Salient Characteristics
      a. Physical:
         1) Metallic Coatings:
            a) Factory standard electroplated finish and applied according to MFMA-4, for indoor applications.
      b. Functional: Comply with MFMA-4, factor-fabricated components for field assembly
      c. Performance: Channel dimensions selected for applicable load criteria.

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

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

E. Support for 600V and under Conductors in Vertical Raceway:
   1. Salient Characteristics
      a. Physical:
         1) Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs
         2) Body shall be malleable iron.
      b. Functional:
         1) UL E-11853, CSA 11584
         2) Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported.
         3) For use with all types of insulations at voltages to and including 600V.
      c. Performance:
         1) For supporting non-armored electrical conductors or cables in riser conduits.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Concrete Anchors
      a. Salient Characteristics
         1) Physical:
            a) Anchors shall be zinc plated in accordance with ASTM B633.

2) Functional:
   a) Anchors shall be selected, sized, and detailed by Contractor's structural engineer registered in project's jurisdiction, based on project conditions and in accordance with project building code. Calculations and drawings shall be submitted.
   b) Anchors shall meet ICC Acceptance Criteria, and ICC-ES Evaluation Reports (ESRs) shall specifically list the current applicable codes.
   c) Anchors installed in hardened concrete for purpose of transmitting structural loads from one connected element to another, or for safety related elements such as sprinkler pipes, heavy suspended pipes, and barrier rails shall have ICC-ES report demonstrating anchors have met requirements of AC 193 for mechanical anchors in concrete elements.
   d) Post-installed expansion anchors and undercut anchors installed in hardened concrete shall be qualified for strength design and tested according to ACI 355.2. Designs shall be per the requirements of ACI 318, Appendix D.
3) Performance: Load ratings based on cracked concrete conditions.

2. Mechanical-Expansion Anchors
   a. Salient Characteristics
      1) Physical:
         a) Insert-wedge type, zinc-coated steel
      2) Functional:
         a) For use in hardened Portland cement concrete.
      3) Performance:
         a) Tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element

G. Beam Clamps: C-clamps are allowed 3/8" or smaller and only for static loading such conduits. Provide locknut for hanging rod at clamp. C-clamps are not allowed for open web steel joist applications nor seismic applications.

H. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

I. Toggle Bolts: All-steel springhead type.

J. Hanger Rods:
   1. MSS SP-58; threaded steel, with adjusting and lock nuts; electroplated zinc finish.

PART 3 - EXECUTION

3.01 APPLICATION

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

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70.

1. Size steel hanger rods for individual hangers and trapeze supports as indicated in the following schedule. Total weight of equipment shall not exceed limits indicated.

Maximum Loads (lbs(kg))	**Rod Diameter ("(mm))**	**Maximum Pipe Size With Single Rod**
730lbs	3/8"	2"
1130lbs	1/2"	3"
1818lbs	5/8"	5"

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25% in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with 2-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 3/4” and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

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

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.

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

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor application size and placement shall be reviewed and approved by Structural Engineer prior to installation. Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4” thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4” thick.
6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
7. To Light Steel: Sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

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

F. Do not support raceway by other raceway.

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

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

I. Top or bottom chords of open web steel joists may be used to support loads provided total load within panel does not exceed 100 lbs and load is placed concentric to joist (panel is length of chord between two adjacent diagonal web members at point of connection to chord).
   1. C-clamps are not permitted for use in open web steel joist applications.

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

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

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

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

N. Use tools approved for use with PVC-coated conduits and fittings.

3.03 CONCRETE HOUSEKEEPING PADS

A. Construct concrete housekeeping pads for all floor-mounted electrical equipment.

B. Dimensions: 3.5" high and not less than 2" larger in both directions than supported equipment, so anchors will be a minimum of 10 bolt diameters from edge of the base.

C. Use 3000psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section “Cast-in-Place Concrete.”

D. Anchor equipment to concrete housekeeping pad.
   1. Place and secure anchorage devices. Use supported equipment manufacturer’s setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor bolts to elevations required for proper attachment to supported equipment.
   3. Install anchor bolts according to anchor-bolt manufacturer’s written instructions.

E. Coordinate with Contracting Officer installation of housekeeping pads on roof and utility yards.

3.04 PAINTING

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

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

B. Touchup: Comply with requirements in Division 09 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

END OF SECTION

SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems

C. Section 26 05 29 - Hangers and Supports for Electrical Systems

D. Section 26 05 53 - Electrical Systems Identification

E. Section 26 05 93 - Electrical Systems Firestopping

1.02 REFERENCE

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

1.03 DESCRIPTION

A. Section includes raceways, fittings, wireways, pull and junction boxes, tap boxes and raceway seals.

1.04 REFERENCE STANDARDS

A. ANSI/NECA 1 – Standard Practices for Good Workmanship in Electrical Contracting

B. ANSI C80-1 – Rigid Steel Conduit-Zinc Coated (GRS)

C. ANSI C80-3 – Electrical Metallic Tubing-Zinc Coated (EMT)

D. ASTM A 53/A 53M – Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

E. BICSI TDMM – Telecommunications Distribution Methods Manual, Latest Edition

F. NEMA 250 – Enclosures for Electrical Equipment (1000 V Maximum)

G. NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

H. NEMA OS 1 – Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports

I. NEMA TC 2 – Electrical Polyvinyl Chloride (PVC) Conduit

J. NEMA TC 3 – PVC Fittings for Use with Rigid PVC Conduit and Tubing

K. NFPA 70 – National Electrical Code

L. TIA-569-B – Commercial Building Standard for Telecommunications Pathways and Spaces

M. UL 1 – Flexible Metal Conduit

N. UL 6 – Electrical Rigid Metallic Conduit-Steel

O. UL 360 – Liquid-Tight Flexible Steel Conduit

P. UL 514A – Metallic Outlet Boxes

Q. UL 514B – Conduit, Tubing, and Cable Fittings

R. UL 651 – Schedule 40 and 80 Rigid PVC Conduit and Fittings

S. UL 797 – Electrical Metallic Tubing-Steel

T. UL 2024 – Optical Fiber and Communication Cable Raceway

1.05 SUBMITTALS

A. Product Data:
   1. Raceways
   2. Fittings
   3. Wireways
   4. Pull and junction boxes
   5. Tap boxes
   6. Raceway seals

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

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

1.06 QUALITY ASSURANCE

A. Refer to Division 01, Section 01 4000 – Quality Requirements.

B. Regulatory Requirements:
   1. Comply with NFPA 70.

2. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

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

B. Comply with manufacturer's written instructions.

1.08 WARRANTY

A. Refer to Division 01, Section 01 33 23 Submittal Procedures/Closeout and O&M Requirements and Section 26 00 00 - General Electrical Requirements for general warranty requirements.

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

PART 2 - PRODUCTS

2.01 RIGID METAL CONDUIT (RMC)

A. Salient Characteristics
   1. Physical:
      a. Rigid Steel Conduit (RSC): Heavy wall galvanized steel
      b. Rigid Aluminum Conduit (RAC): Heavy wall aluminum
      c. Fittings (couplings, connectors and bushings): Steel (concrete-tight where applicable); threaded; connectors with double locknuts and steel insulating bushings, thermoplastic insulating bushings for conduits 2" and smaller.
      d. Fittings (conduit bodies): Aluminum die-cast; cover: cast, with stainless steel screws and neoprene gaskets.
   2. Functional:
      a. Rigid Steel Conduit (RSC): ANSI C80.1, UL 6
         1) NEMA RN 1, ANSI C80.1, UL 6, ETL PVC-001
      b. Fittings (couplings, connectors and bushings): NEMA FB 1, UL 514B
      c. Fittings (conduit bodies): NEMA FB 1, UL 514B
   3. Performance:
      a. None

2.02 ELECTRICAL METALLIC TUBING (EMT)

A. Salient Characteristics
   1. Physical:
      a. Galvanized steel tubing

b. Fittings (couplings and connectors):
   1) Steel gland compression type or steel concrete-tight set-screw type connectors with double locknuts and insulated throat in dry locations.
   2) Indentor, drive-on, zinc die-cast or pressure cast not permitted.
   3) Watertight gland compression type fittings shall be used in damp and wet locations.
c. Fittings (conduit bodies): Aluminum die-cast; cover: stamped, with stainless steel screws and neoprene gaskets.

2. Functional:
   a. ANSI C80.3, UL 797
   b. Fittings (couplings and connectors): NEMA FB I, UL 514B
   c. Fittings (conduit bodies): NEMA FB 1, UL 514B
3. Performance:
   a. None

2.03 FLEXIBLE METAL CONDUIT (FMC)

A. Salient Characteristics
1. Physical:
   a. Conduit: Interlocked steel
   b. Fittings: Steel. Die-cast fittings not permitted.
2. Functional:
   a. Conduit: UL 1
   b. Fittings: NEMA FB I, UL 514B
3. Performance:
   a. None

2.04 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Salient Characteristics
1. Physical:
   a. Conduit: Interlocked steel, with PVC jacket
   b. Fittings: Steel. Die-cast fittings not permitted.
2. Functional:
   a. Conduit: UL 360
   b. Fittings: NEMA FB I, UL 514B
3. Performance:
   a. None

2.05 RIGID NONMETALLIC CONDUIT (RNC)

A. Salient Characteristics
1. Physical:
   a. Conduit: Schedule 40 or 80 PVC
   b. Fittings: Schedule 40 or 80 PVC

2. Functional:
    a. Conduit: B. NEMA TC 2, UL 651
    b. Fittings: NEMA TC 3, UL 651
3. Performance:
    a. None

2.06 PULL AND JUNCTION BOXES

A. Salient Characteristics
1. Physical:
    a. Small Sheet Metal Pull and Junction Boxes: Galvanized steel
        1) Sheet metal boxes larger than 12” in any direction: Hinged cover or a chain installed between box and cover
        2) Field-fabricated boxes not allowed without prior approval of local authority having jurisdiction.
    b. Cast-Metal, Pull, and Junction Boxes: Cast aluminum with ground flange, gasketed cover and stainless-steel cover screws
    c. Minimum size: 4” square by 2-1/8” deep for use with 1” conduit and smaller; 4-11/16” square by 2-1/8” deep for use with 1-1/4” conduit and larger
2. Functional:
    a. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1
    b. Cast-Metal, Pull, and Junction Boxes: NEMA FB 1
3. Performance:
    a. None

2.07 EXPANSION FITTINGS

A. Salient Characteristics
1. Physical:
    a. Malleable iron
    b. Hot dip galvanized
        1) Functional:
    c. NEC 2023, Section 352.44
        1) Performance:
    d. Allowing 4” (±2”) raceway movement.

2.08 RACEWAY PENETRATION SEALS

A. Sealing Assembly Description:
1. Sealing assembly shall consist of pipe sleeve, rubber seal, pressure plates and connecting hardware (bolts, washers and nuts).
2. Provide chrome or nickel-plated escutcheons where raceways pass through walls or ceilings and are exposed in finished areas. Size escutcheons to fit raceways for finished appearance. Finished areas shall not include mechanical/electrical rooms, storage rooms, etc., unless suspended ceilings are specified.

B. Manufacturer
   1. Wall sleeves: Thunderline Corporation, Type “WS”; or Equal
   2. Sealing System: Link Seal by GPT; or Equal

C. Salient Characteristics
   1. Physical:
      a. Sleeve: High density polyethylene (HDPE)
      b. Rubber Seal Element: EDPM
      c. Pressure Plate Material: Reinforced nylon polymer
      d. Hardware material: 316 stainless steel bolts
   2. Functional:
      a. Temperature Range: -40°F to 250°F
      b. Pressure resistant to 20 psig
   3. Performance:
      a. U.L. listed modular elastomer sealing assembly creating a permanent hydrostatic watertight seal around conduit penetrations in exterior wall system.

2.09 RACEWAY SEALING FITTINGS

A. Salient Characteristics
   1. Physical:
      a. Material: Malleable Iron
      b. Finish: Triple coat zinc electroplate, or chromate, or epoxy powder coat
      c. Threaded for Rigid Conduit or IMC
      d. Female/Female and/or Male/Female
      e. Tapered threads (NPT)
         1) Functional:
      f. Conductor fill: 25 - 40%, Unless noted otherwise
      g. Explosionproof, dust-ignition proof, raintight
      h. UL Standard 886
      i. UL Listed E34997, E10444
         1) Performance:
            a) Prevent passage of gases, vapors or flames from one portion of conduit system to another. Restrict any explosion to the sealed off enclosure. Prevent pressure piling within conduit system.
            b) Class 1, Division 1 and 2

PART 3 - EXECUTION

3.01 COORDINATION

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

B. Coordinate with Contracting Officer cutting, removing, or piercing general or mechanical insulation, fire-rated walls, ceilings or steelwork.

C. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 26 05 93 - Electrical Systems Firestopping.

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

E. Verify with manufacturer that "touch-up" paint kit and PVC-coating kit are available for use.

3.02 EXAMINATION

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

3.03 INSTALLATION

A. Raceways:

1. Comply with ANSI/NECA 1 and NFPA 70 for installation requirements applicable to products specified in Part 2 except where requirements on drawings or in this Section are stricter.
2. Arrange raceways to maintain headroom and present neat appearance.
3. Raceway routing is shown in approximate locations, unless dimensioned. Route to complete raceway installation before starting conductor installation.
4. Keep raceways at least 6" away from parallel runs of flues, steam, hot-water pipes or ductwork. Install horizontal raceway runs above water and steam piping. Install raceways level and square and at proper elevations: 6'-6" minimum headroom, except in exit pathways 7'-0" minimum headroom. Do not block access to junction boxes, mechanical equipment or prevent removal of ceiling panels, etc.
5. Run raceways concealed in construction to avoid adverse conditions such as heat and moisture, to permit drainage, and to avoid materials and equipment of other trades, except where noted otherwise.
6. Avoid exposed raceway runs. Run raceways exposed where impractical or impossible to conceal or where specific approval is obtained. Run exposed raceways grouped and parallel or perpendicular to construction. Do not route exposed raceways over boilers or other high-temperature machinery or in contact with such equipment. Offset exposed raceways at boxes.
7. Route raceways installed above accessible ceilings parallel or perpendicular to construction.
8. Cut raceways square using saw or pipecutter.
9. Use hydraulic one-shot raceway bender or factory elbows for bends in raceway larger than 2", unless sweep elbows required. Bend raceways according to manufacturer's recommendations. Do not use torches or open flame to aid in bend of PVC conduit.
10. Use raceway fittings compatible with raceways and suitable for use and environment.
11. Provide bushings on all raceways.
12. Raceways minimum sizes:
    a. Minimum raceway size 3/4", except as noted on drawings.
    b. Minimum home run size: 3/4", except as noted on drawings.
    c. Minimum size for flexible metal conduit is 1/2" except 3/8" for luminaires.

d. Minimum size for liquid-tight flexible metal conduit is 1/2”

13. Install empty raceways 2-1/2” and larger with 10 ga galvanized fishwire; install 200 lb nylon pull cord in raceways smaller than 2-1/2”; leave at least 12” of slack at each end of pull wire. Cap raceways at both ends.
14. Feed devices on same wall vertically from above or junction box in suspended ceiling.
    a. Do not install horizontal bends in conduit around corners.
    b. Feed devices in exterior or load-bearing walls by horizontal conduit runs.
    c. Where horizontal conduit runs are required or allowed, install conduits from device to device on same wall.
15. Raceways Supports:
    a. Independently support or attach raceway system to structural parts of construction. Suspended ceiling systems shall not be considered as structural parts of construction for raceway support. Do not attach raceways to piping system.
    b. Raceway supports for horizontal or vertical single runs:
        1) Hot dipped galvanized heavy-duty sheet steel straps, mineralac clamps or steel slotted support channel system with appropriate components.
        2) Spring steel type pressure clamps for raceways 3/4” and smaller.
    c. Raceway supports for horizontal and vertical multiple runs:
        1) Trapeze-type supports fabricated with steel slotted channel systems with appropriate components.
        2) Support horizontal runs with appropriately sized rods.
        3) Anchor vertical runs to structure.
        4) Spring-steel type pressure clamps for raceways 3/4” and smaller.
    d. Vertical raceway runs 1-1/4” and larger passing through floors: Support at each floor with pipe riser clamps.
    e. Do not support raceways with wire, perforated pipe straps or plastic tie-wrap. Remove wires used for temporary support.
    f. Secure raceways in metal stud walls to prevent rattling.
    g. Arrange raceway supports to prevent misalignment during wiring installation.
    h. Do not fasten raceways to corrugated metal roof deck.
    i. For fasteners and supports, including steel slotted support systems, support devices, support spacing, support of conductors in vertical raceways, and hanger rod size, refer to Section 26 0529 – Hangers and Supports for Electrical Systems and NFPA 70.
16. Identify raceways per requirements in Section 26 0553 – Electrical Systems Identification.
17. Ground raceways per requirements in Section 26 0526 – Grounding and Bonding for Electrical Systems.
18. Flexible Conduit Connections: Use maximum of 72” of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for motors.
    a. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
19. Power and low-voltage raceways: Minimum 12” separation when run parallel, cross perpendicular.

B. Boxes:
1. Install boxes to accommodate device indicated by symbol, in conformance with code requirements, number and size of conductors and splices and consistent with type of construction.

2. Install the appropriate cover on surface-mounted boxes:
   a. Raised device covers on 4” square and 4-11/16” boxes and handy box covers on handy boxes, etc.
   b. Device covers that are square drawn or square cut on boxes in block.
   c. Tile covers on boxes in tile.
   d. Round drawn device covers on boxes in lath and plaster walls or dry wall only.
   e. Set front edge of device boxes flush with finished wall surfaces except on walls of non-combustible materials where boxes may have maximum set back of 1/4”. Secure flush-mounted box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
3. Set outlet boxes parallel to construction and independently attached to same.
4. Do not install back-to-back and through-the-wall boxes. Install with minimum 6” horizontal separation between closest edges of the boxes. Install with minimum 24” separation in acoustic-rated walls and fire-rated walls.
5. Install multi-ganged boxes where 2 or more devices are in same location, unless otherwise noted.
6. Box Support:
   a. Mount boxes straight.
   b. Install horizontal bracing at top or bottom of box for 3 or more gang device boxes in stud walls.
   c. Install stud support one side, with short piece of stud, for up to 2 gang device boxes.
   d. Do not support boxes with tie-wire.
   e. For one and two gang box support, manufactured bracket supports shall be accepted alternate.
   f. Support boxes independently of raceways.
   g. Install adjustable steel channel fasteners for hung ceiling outlet box.
   h. Install stamped steel bridges to fasten flush-mounted outlet box between studs.
   i. Do not install boxes to ceiling support wires or piping systems.
7. Install partitions in multi-ganged boxes where different types of devices are installed, or devices installed operate at different voltages.
8. Mount boxes in block walls at block joint nearest to indicated height.
9. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
10. When boxes are installed in fire-resistive walls and partitions, provide 24” horizontal separation between boxes on opposite sides of a wall. In addition, limit penetrations to 16 sq inch per penetration and not to exceed a total of 100 sq inch per 100 sq ft of wall area. Apply fire stop putty pads acceptable to the fire marshal.
11. Pull and junction boxes: Install as shown, or as necessary to facilitate pulling of wire and to limit number of bends within code requirements. Install above accessible ceilings and in unfinished areas.
12. Install boxes to be permanently accessible.
13. Do not intermix conductors from more than one system in same junction box or pull box, unless shown or specifically authorized otherwise.
14. Adjust box location up to 10’ prior to rough-in to accommodate intended purpose.
15. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6” from ceiling access panel or from removable recessed luminaire.
16. The drawings do not necessarily show every outlet, pull or junction box required. Add all required boxes as necessary.

C. Expansion Fittings:

1. Install raceway expansion and deflection fittings in all raceway runs embedded in or penetrating concrete where movement perpendicular to axis of the raceway may be encountered.
2. Install raceway expansion fittings complete with bonding jumpers in raceway runs that cross expansion joints in structure and raceway runs mechanically attached to 2 separate structures.
3. Use couplings and flexible connection made up of 24" length of flexible metal conduit, where EMT runs across expansion joints in ceiling spaces.
4. Install fitting(s) that provide expansion and contraction for at least 0.0004" per ft of length of straight run per °F of temperature change.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation.

D. Raceway Penetration Seals:

1. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
2. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint.
3. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Section 26 05 93 - Electrical Systems Firestopping.
4. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
5. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1" annual clear space between pipe and sleeve for installing mechanical sleeve seals.
6. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1" annual clear space between raceway and sleeve for installing mechanical sleeve seals.
7. Sleeve-Seal Installation: Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
8. Provide chrome- or nickel-plated escutcheons where raceways pass through walls, floors or ceilings and are exposed in finished areas. Size escutcheons to fit raceways for finished appearance. Finished areas shall not include mechanical/electrical rooms, janitor's closets, storage rooms, etc., unless suspended ceilings are specified.
9. Remove temporary sleeves, if used for form wall openings, prior to installation of permanent materials.

E. Raceway Sealing Fittings:

1. Install listed watertight seals to prevent the passage of moisture and water vapor through raceway, where raceway passes from interior to exterior of the building, where raceway passes between areas of different temperatures such as into or out of cold rooms or freezers, where raceway enters room which at any time is subject to low or high temperatures and where raceway enters a room which at any time is subject to internal air pressures above or below normal.

2. Install watertight seals in interior of all raceways passing through building roof, ground floor slab (when the raceway does not extend beyond building footprint), or through outside walls of building above or below grade. Seal on the end inside building, using raceway sealing fittings manufactured for the purpose. Locate fittings at suitable accessible locations. For concealed raceways install each fitting in flush steel box with blank coverplate to match finish of adjacent plates or surfaces.
3. Seal raceways entering or passing through "hazardous (classified) areas" as defined in NFPA 70.

F. Sleeve Installation for Electrical Penetrations:
1. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 26 05 93 - Electrical Systems Firestopping.
2. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
3. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
4. Rectangular Sleeve Minimum Metal Thickness:
   a. For sleeve cross-section rectangle perimeter less than 50" and no side greater than 16", thickness shall be 0.052".
   b. For sleeve cross-section rectangle perimeter equal to, or greater than, 50" and 1 or more sides equal to, or greater than, 16", thickness shall be 0.138".
5. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies, unless openings compatible with firestop system used are fabricated during construction of floor or wall.
6. Cut sleeves to length for mounting flush with both surfaces of walls.
7. Extend sleeves installed in floors 2" above finished floor level.
8. Size pipe sleeves to provide 1/4" annular clear space between sleeve and raceway, unless sleeve seal is to be installed.

3.04 APPLICATION

A. Provide raceways and boxes in accordance with the following table:

APPLICATION	APPROVED RACEWAYS	APPROVED BOXES	APPLICATION NOTES
Underground More Than 5 Ft Outside Foundation Wall	Schedule 80 PVC – Direct Buried Schedule 40 PVC – Concrete Encased	Cast Metal Boxes or Nonmetallic Handholes	
Underground Within 5 Ft from Foundation Wall	Rigid Steel Conduit, PVC-Coated Schedule 40 PVC – Concrete Encased	Cast Metal Boxes or Nonmetallic Handholes	

APPLICATION	APPROVED RACEWAYS	APPROVED BOXES	APPLICATION NOTES
In or Under Slab on Grade	Rigid Steel Conduit, PVC-Coated Schedule 40 PVC – Concrete Encased	Cast Or Nonmetallic Boxes	Use Steel Elbows with RNC when Encased in Concrete
Outdoor Locations, Above Grade	Rigid	Cast Metal or Nonmetallic	
Wet And Damp Locations	Rigid Steel Conduit	Cast Metal. Install Flush Mounting Outlet Boxes in Finished Areas	
Concealed Dry Locations	Rigid Steel Conduit	Sheet Metal Boxes; Install Flush Mounting Outlet Boxes in Finished Areas; Install Hinged Enclosure for Large Pull Boxes.	
Exposed Dry Locations	Rigid Steel Conduit	Sheet Metal Boxes; Install Flush Mounting Outlet Boxes in Finished Areas; Install Hinged Enclosure for Large Pull Boxes.	
Exposed Subject to Damage	Rigid Steel Conduit	Cast Metal	
Locations Requiring Mechanical Protection	Rigid Steel Conduit	Cast Metal	
Vibrating Equipment (Including Transformers & Hydraulic, Pneumatic,		Sheet Metal – Dry Locations Only	Lengths For FMC & LFMC May Range Between 2 Ft To 4 Ft

APPLICATION	APPROVED RACEWAYS	APPROVED BOXES	APPLICATION NOTES
Electric Solenoid or Motor-Driven Equipment)	Flexible Metal Conduits (FMC) – Dry Locations Only Liquid Tight Flexible Metal Conduits (LFMC) – Wet Locations	Cast Metal, Wet Locations and Mechanical Rooms	
Instruments & Control Devices	Liquid Tight Flexible Metal Conduits	Cast Metal	Lengths For LFMC May Range Between 2 Ft To 4 Ft

3.01 FIELD QUALITY CONTROL

A. Inspect raceway and boxes for physical damage, proper alignment, and supports, where applicable.

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

C. Inspect components, wiring, connections and grounding.

3.02 REPAINTING

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

3.03 ADJUSTING

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

B. Install knockout closures in unused openings in boxes.

3.04 CLEANING

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

END OF SECTION

SECTION 26 05 43.13
EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 05 43 - Underground Ducts And Raceways For Electrical Systems

1.02 REFERENCE

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

1.03 DESCRIPTION

A. Section lists methods and materials for trench excavation and backfill for electrical and communications conduits in duct banks. Refer to Section 26 05 43 - Underground Ducts And Raceways For Electrical Systems.

1.04 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

B. Excavation: Removal of material encountered above sub-grade elevations and to lines and dimensions indicated.

C. Duct: A single underground conduit encased in concrete or direct buried.

D. Duct Bank: Two or more ducts run together.

E. Fill: Soil materials used to raise existing grades.

F. Sub-grade: Surface or elevation remaining after completing excavation, or top surface of fill or backfill immediately below subbase, drainage fill, or topsoil materials.

G. Utilities: On-site underground ducts and duct banks as well as underground services within buildings.

1.05 SUBMITTALS

A. Submit list of materials to be used for backfill.

1.06 QUALITY ASSURANCE

A. Refer to Division 01, Section 01 4000 - Quality Requirements

B. Pre-excavation Conference: Conduct conference at project site to comply with requirements in Division 01, Section 01 31 00 - Project Management and Coordination

PART 2 - PRODUCTS

2.01 FILL MATERIAL

A. Type 1 Fill:
   1. Material from excavation separated from materials, which do not compact by tamping and rolling. No stones larger than 3” and no building, organic, corrosive or frozen materials and no lumps larger than 6".

B. Type 2 Fill:
   1. Sand or gravel materials with none larger than 2” and of that portion passing the #4 (4.75 mm) sieve less the 5% to pass #200 sieve.

C. Type 3 Fill:
   1. Gravel of rounded to sub-angular shape, screened, which will pass 3/4” sieve and retained on #4 (4.75 mm) sieve.

D. Type 4 Fill:
   1. Pit run rock or gravel with maximum stone size of 1”.

E. Type 5 Fill:
   1. Pea gravel, screened, which will pass 3/8” sieve and retained on #4 (4.75 mm) sieve.

2.02 CRUSHED ROCK

A. Crushed Rock: 1-1/4” minus, unless smaller is required for bedding material.

2.03 SAND

A. Sand: Clean and washed building sand.

2.04 TOPSOIL

A. Topsoil: Equal in quality to that removed.

2.05 SOD

A. New Sod: Mature, densely rooted grass free of weeds and objectionable grasses.

2.06 PLANTS

A. Plants: Obtained from a commercial nursery and be similar to those replaced.

PART 3 - EXECUTION

3.01 PREPARATION

A. Establish grade lines and locations of roadways and sidewalks, grade beams, and pill caps. Provide necessary stakes and batter boards.

B. Verify elevations of existing utilities prior to excavation for new ducts.

C. Verify locations of manholes with civil drawings

D. Verify footings and foundations with structural drawings

E. Verify underground sanitary and sewer with plumbing and civil drawings.

3.02 EXCAVATION

A. Provide excavation for underground work, including ducts, vaults, manholes, handholes, and pull boxes, unless otherwise shown or specified. Lay duct in open trench, except when Contracting Officer gives written permission for tunneling.

B. Excavate trench to 24” wider than duct or duct bank dimensions and minimum of 3" below bottom of duct.

C. Include clearing, tree removal, grubbing, pavement removal, substructure removal such as walls, footings, and piers, and all incidental work such as tunneling, sheet piling, shoring, underpinning, pumping, bailing, and transportation. Coordinate excavation extending beyond construction limits with Owner.

D. Do not provide blasting on this project without written permission of Contracting Officer Architect.

E. Remove all excess excavation material from site, unless directed otherwise.

F. Over excavate 3” and fill with 3" of sand, where trench bottom is rock, or rocky, or contains debris larger than 1", or material with sharp edges.

G. Perform all crossings of concrete or asphalt after surface material has been saw cut to required width and removed.

H. Conform to utility company requirements for excavation and vault installation in addition to contract document requirements where excavations are for installing utility company’s ducts and vaults.

3.03 ROCK EXCAVATION

A. Use mechanical methods to remove rock in trenches for underground ducts.

B. Refer to Geotechnical Report available from Contracting Officer for data on rock.

C. Include rock excavation in the Bid, unless otherwise indicated.

3.04 INSTALLATION

A. Keep underground ducts to proper line and grade and sealed to prevent entrance of animals or foreign matter.

B. Provide bracing and sheet piling as necessary to support trenches. Comply with Local Regulations, applicable provisions of OSHA Regulations on trenching, or with provisions of “Manual of Accident Prevention in Construction” published by Associated General Contractors of America.

C. Do not lay duct in water.

D. Review project drawings for underground duct bank details.

E. Keep trench free from water until duct joint material has hardened and concrete encasement is in place.

F. Do not increase the contract cost due to presence of ground water in soil or necessity of sheet piling or bracing trenches. Adjust contract cost when sheet piling is left in place, on written order of Contracting Officer.

G. Do not remove sheet piling until trench is substantially backfilled. Cut off sheet piling left in place not less than 2 ft below new, finished grade.

H. Place underground ducts on 3" compacted bedding of sand. Shape bedding for clearance for joints and fittings, tamped in place and graded evenly to ensure uniform bearing for the full length of duct. Do not support duct by blocking, planking or mounding of bedding material.

I. Install lines passing under foundations with minimum of 3" clearance to concrete and ensure there is no disturbance of bearing soil.

3.05 BACKFILL

A. Backfill around ducts by hand to depth of 12” above top of duct with Type 3 or 5 fill in 6"layers. Compact backfill thoroughly with compactor of suitable weight or with approved mechanical tamper. Do not use flooding or jetting with water.

B. In unpaved areas, place backfill from 12” above duct to elevation of subgrade in layers not exceeding 8" in depth with Type 3, 4 or 5 fill.

C. Backfill from 12” above duct to sub-grade with Type 2, 3, or 4 fill, when excavating through areas which are to become walks, roads, driveways or parking areas of concrete, bituminous or exposed gravel surfacing or such areas are existing to remain. Backfill in 12" layers and compact with mechanical means to density 95% modified proctor.

D. Conform excavation, duct laying, backfilling, grading and surfacing, as herein specified, when excavation occurs on public property or areas beyond the property line. Comply with additional requirements for public utility or other authorities. Check with each utility and incorporate cost of any additional requirements in base bid.

E. Backfill around vaults and handholes to be free of debris larger than 1-3/4” in all directions to 1 ft from vault.

F. Provide 6” of pea gravel or sand bedding for vaults and handholes larger than 3x3 FT. For handholes smaller than 3x3 ft, provide 3" pea gravel or sand.

G. Other backfill shall be free of debris larger than 6” in diameter.

H. Place backfill material so as to obtain a minimum degree of compaction of 95% of maximum density at optimum moisture content. Moisten backfill material as required to obtain proper compaction.

I. Broken pavement, concrete, sod, roots, and debris shall not be used for backfill.

3.06 DEWATERING

A. Provide, operate, and maintain all pumps or other dewatering equipment required for control of water in trenches and excavations for electrical and communications site work during the entire construction period.

3.07 SHORING

A. Provide as required by trenching and excavating to secure site work. Comply with applicable safety regulations.

3.08 FINISHING

A. On completion of trenching and backfilling operations, restore grades to original elevation or to new sub-grade elevation.

B. Replace surfaces to existing conditions when trenching is through existing areas or beyond construction limits.

C. Use 6” of topsoil and sod to match existing elevations in landscaped areas or as otherwise approved by Contracting Officer.

3.09 SURFACE FINISHING

A. Refinish every disturbed surface to its original condition.

B. Replace planted materials not surviving 90 days after contract acceptance at Contractor’s own expense.

C. Return after 1 year and re-fill, compact and refinish settled areas to grade.

3.10 CARE OF PLANTS AND TREES

A. Remove and safely store plants and trees with trunks smaller than 6” diameter prior to commencing site work. Avoid trees larger than 6" diameter when so indicated on drawings. Replace plants and trees upon completion of site work.

END OF SECTION

SECTION 26 05 43.23
UNDERGROUND ELECTRICAL SERVICE

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 00 00 - General Electrical Requirements

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems

C. Section 26 05 43 - Underground Ducts And Raceways For Electrical Systems

1.02 REFERENCE

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

1.03 DESCRIPTION

A. Utility Company is Consolidated Edison (ConEd).

B. Secondary Service Characteristics
   1. Secondary service will be 480Y/277 V, 4-wire, 3-phase for combined lighting and power.

C. Provide electrical service system except for the following which will be provided by Utility Company:
   1. Protective device at transformer
   2. Transformer
   3. Metering at transformer
   4. Cable from terminal pole to transformer
   5. Cable from terminal pole to building
   6. Cable from transformer to building
   7. Primary cable as shown
   8. Secondary cable as shown

1.04 SEQUENCING, SCHEDULING

A. Coordinate electrical service with Utility.

B. Utility costs shall be included in Base Bid.

PART 2 - PRODUCTS

2.01 NOT APPLICABLE

PART 3 - EXECUTION

3.01 INSTALLATION

A. Provide duct banks as specified in Specification Section 26 05 43 - Underground Ducts And Raceways For Electrical Systems.

END OF SECTION

SECTION 26 05 43
UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 03 3053 - Miscellaneous Cast-In-Place Concrete

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems

C. Section 26 05 33 - Raceway and Boxes for Electrical Systems

D. Section 26 05 43.13 - Excavation and Backfill

E. Section 26 05 53 - Electrical Systems Identification

1.02 REFERENCE

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

1.03 DESCRIPTION

A. Section includes conduits, ducts, and duct accessories for concrete encased for underground distribution for electrical power and communications.

B. The terms duct and duct bank, as used in this Section, are defined as follows:
   1. Duct: A single underground conduit, encased in concrete or direct buried.
   2. Duct Bank: Two or more ducts run together.

1.04 REFERENCE STANDARDS

A. ANSI C2 – National Electrical Safety Code

B. ANSI C80.1 – Rigid Steel Conduit-Zinc Coated (GRC)

C. ASTM F512 – Specification for Smooth-Wall Poly (Vinyl Chloride) (PVC) Conduits and Fittings for Underground Installation

D. NEMA TC 2 – Electrical Polyvinylchloride (PVC) Conduit

E. NEMA TC 3 – PVC Fittings for Use with Rigid PVC Conduit and Tubing

F. NEMA BI 50063 – PVC Plastic Utilities Duct for Underground Installation

G. NEMA TC 9 – Fittings for PVC Plastic Utility Duct for Underground Installation

H. NFPA 70 – National Electrical Code

I. UL 651 – Schedule 40 and 80 Rigid PVC Conduit

J. UL 651A – Type EB and A Rigid PVC Conduit and HDPE Conduit

K. UL E53373 – Underground Fiber Reinforced Epoxy Conduit (FRE)

L. UL 6 – Electrical Rigid Metallic Conduit-Steel

1.05 SUBMITTALS

A. Product data for the following:
   1. Duct bank materials, including spacers and miscellaneous components
   2. Ducts and conduits and their accessories, including elbows, end bells, bushings, seals, bends, fittings, plugs, pull tape, and solvent cement
   3. Warning tape
   4. Warning plank

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

C. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual routing of conduits and duct banks.
   2. Operation and Maintenance Data:
      a. Include manufacturer's recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.
      b. Include spare parts data listing, source, and current prices of replacement parts and supplies.

1.06 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with NFPA 70
   2. Comply with ANSI C2
   3. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

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

B. Deliver ducts to project site with end capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

1.08 WARRANTY

A. Refer to Division 01 and Section 26 00 00 - General Electrical Requirements for general warranty requirements.

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

PART 2 - PRODUCTS

2.01 CONDUITS

A. Rigid Steel Conduit (RSC): NEMA RN 1, ANSI C80.1, UL 6, heavy wall, hot dipped, galvanized steel .

B. Rigid Nonmetallic Conduit (RNC): NEMA TC 2 Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer, complying with NEMA TC 3 and UL 651, listed for underground use, concrete encased.

C. Size:
   1. 4” nominal for voltages below 600 V and communications
   2. 5” nominal for voltages above 600 V

2.02 DUCT ACCESSORIES

A. Duct Spacers:
   1. Rigid PVC interlocking spacers.
   2. Factory-fabricated, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling. Horizontal and vertical locking separation of 3" between ducts.

B. Elbows: Material to match conduit; minimum bend radius of 36".

C. Bell Ends: Manufactured bell ends of appropriate sizes at each end of conduit; pre-manufactured system for PVC with conduit seals, provisions for roughing into the concrete pour and waste stops, when entering a new building or a new manhole.

D. Bushings: Groundable steel bushings of appropriate sizes on all metal conduits where bell ends are not used; pre-manufactured system for PVC with conduit seals, provisions for roughing into concrete pour and water stops, when entering a new or existing building or a new or existing manhole.

E. Seals: Mechanical interlocking assembly seal of modular synthetic rubber links properly sized to fit the pipe and tightened in place, in accordance with manufacturer’s instructions, when entering an existing building or manhole below grade and concrete shall be core drilled for the appropriate size conduit and seal.

F. Plugs: Closure plugs or caps of same material as conduit at ends of unused sections.

G. Pull Tape: Nylon pull tape with measurement markings in uniform lengths in each empty duct.

H. Grounding:
   1. Steel grounding bushings, where bell ends are not used.
   2. Bonding fitting with bonding strap on steel conduit with end bells.

I. Warning Tape: Underground line warning tape specified in Section 26 05 53 - Electrical Systems Identification.

J. Concrete Dye Color: Red dye for electrical duct bank and orange dye for communications duct bank added to concrete during batching.

K. Solvent Cement: Recommended by conduit manufacturer.

PART 3 - EXECUTION

3.01 COORDINATION

A. Coordinate layout and installation of ducts with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct bank entrances into manholes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Contracting Officer.

C. Adjust the depth of electrical utilities to avoid existing utilities with no change to contract price.

D. Utility Coordination: When duct lines are being constructed for use by a utility serving the project, consult with them for duct size and quantity, minimum bending radii, maximum distance between pulling points, grounding details, termination arrangement, and other criteria.

E. Duct Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
   1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
   2. Drawings shall be signed and sealed by a qualified professional engineer.

3.02 EXISTING UTILITIES

A. The existing utilities shown on contract drawings have been plotted from available records. No guarantee is made as to accuracy of locations indicated, and is shown for the benefit of Contractor.

B. Contact all serving utility companies and have them locate their lines prior to commencing work. Telephone “Call Before You Dig” 811, 2 to 10 days prior to commencing work. Coordinate with Owner all existing utility lines prior to commencing work.

C. Protect shown, visible and located utilities from damage. Promptly repair all active shown, visible and located utilities damaged by construction. This repair shall be made solely at the expense of the Contractor.

D. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

3.03 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Contracting Officer no fewer than 10 days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without written permission from the Contracting Officer.

3.04 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends, both horizontally and vertically, at other locations, unless otherwise indicated. All 90-degree sweeps with radius 10 ft or less shall be rigid steel conduit.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer’s written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane. Do not use conduit that requires the use of couplings for straight runs. Use acceptable PVC terminal adapters when joining PVC conduit to metallic fittings or rigid metal conduit.

D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10” o.c. for 5" ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 ft from the end bell without reducing duct line slope and without forming a trap in the line.
2. Direct Buried Duct Banks: Install an expansion and deflection fitting in each conduit in area of disturbed earth adjacent to manhole or handhole.
3. Concrete Enclosed Duct Banks: Install watertight expansion fitting in each conduit, with internal bonding jumper to allow for 3/4” movement in any direction.
4. Grout end bells into structure walls from both sides to provide watertight entrances.

E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 5 ft outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Section 26 05 33 - Raceway and Boxes for Electrical Systems.

F. Expansion Fittings: Provide suitable expansion fittings or other suitable means to compensate for expansion and contraction for raceways crossing expansion joints in structures or concrete slabs between two adjacent structures and between a duct bank and structure. Provide for the high rate of thermal expansion and contraction of PVC conduit by providing PVC expansion joints as recommended by manufacturer and as required. Refer to structural drawings for location of expansion joints in structures.

G. Sealing: Provide temporary closure at termination of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand minimum of 15 psig hydrostatic pressure. Provide watertight entrance sealing device where an underground conduit enters a structure through a concrete roof or membrane waterproofed wall or floor.

H. Fire Stops: Provide fire stop openings around electrical penetrations to maintain fire-resistance rating, where underground raceways penetrate fire-rated walls or floors.

I. Pulling Cord: Install 100 lb test nylon cord in ducts, including spares. Identify with tags at each end and at any intermediate pull point the origin and destination of each spare duct. Provide a removable permanent cap over each end of each spare duct.

J. Concrete Encased Ducts: Support ducts on duct spacers.

1. Spacer Installation:
   a. Provide spacers close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 ft of duct. Secure spacers to earth and to ducts to prevent floating during concreting. Stagger spacers approximately 6" between tiers. Tie entire assembly together using tie wires and reinforcing steel. Install base and intermediate spacers at every coupling point of each duct line for a separation horizontally and vertically per NEC.
2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
   a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
   b. Terminate each pour in a vertical plane if more than one pour is necessary, and install 3/4" reinforcing rod dowels extending 18" into concrete on both sides of joint near corners of envelope. Obtain Architect's approval for the number and location of dowels.
3. Pouring Concrete: Space concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct bank application.
4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing bars and ties without forming conductive or magnetic loops around ducts or duct groups. Size reinforcing bars and wire ties as indicated on drawings. Provide rebars with minimum of 2" of concrete on sides, top and bottom. Reinforcing bars shown in sections are required throughout.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms of materials and in a manner acceptable to Architect.
6. Minimum Space between Ducts: 3" between ducts and exterior envelope wall, 2" between ducts for like services, and 4"between power and signal ducts.
7. Depth: Install top of duct bank at least 24" below finished grade in areas not subject to deliberate traffic, and at least 30" below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.
8. Maintain a grade of at least 4" per 100 ft, either from one manhole or pull box to the next, or from a high point between them, depending on surface contour.
9. Warning Tape: Bury warning tape approximately 12" above all concrete-encased ducts and duct banks. Align tape parallel to and within 3" of the centerline of duct bank. Provide an additional warning tape for each 12" increment of duct bank width over a nominal 18". Space additional tapes 12" apart, horizontally.

10. Place duct banks on an undisturbed soil base if possible. Where concrete encased duct bank is installed over an extensive area of disturbed earth such that within the periphery of a building, provide a separate concrete base under the duct bank to ensure stability of raceways during installation. Allow this base to set before duct bank is installed.

K. Direct Buried Duct Banks:
1. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
2. Space spacers close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 ft of duct. Secure spacers to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6" between tiers.
3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Section 26 05 43.13 - Excavation and Backfill.
4. Install backfill as specified in Section 26 05 43.13 - Excavation and Backfill.
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4” over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Section 26 05 43.13 - Excavation and Backfill.
6. Install ducts with a minimum of 3” between ducts for like services and 6" between power and signal ducts.
7. Depth: Install top of duct bank at least 36” below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Warning Plank: Bury warning plank approximately 12” above direct buried ducts and duct banks, placing them 24" o.c. Align plank along the width and along the centerline of duct bank. Provide an additional plank for each 12" increment of duct bank width over a nominal 18". Space additional planks 12" apart, horizontally.

L. Stub-Ups:
1. Use manufactured PVC duct elbows for stub-ups at poles and equipment and at building entrances through floor, unless otherwise indicated. Extend concrete encasement throughout length of the elbow. Concrete encasement applies to concreted encased ducts.
2. Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase couplings with 3” of concrete. Concrete encasement applies to concrete encased ducts.
   b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete pads, extend steel conduit horizontally a minimum of 5 ft from edge of equipment pad or foundation. Encase in concrete for concrete encased ducts. Install insulated grounding bushings on terminations at equipment.

M. Arrangement and Routing:
1. Arrange multiple duct runs substantially in accordance with details shown on drawings. Locate underground ducts where indicated on drawings and grade to the elevations shown on civil drawings.

2. Make minor changes in location or cross-section as necessary to avoid obstructions or conflicts. Where duct runs cannot be installed substantially as shown because of conditions not discoverable prior to digging of trenches, refer the condition to the Contracting Officer for written instructions before further work is done.
3. Maintain a 12” minimum vertical separation between ducts and other systems at crossings where other utility piping systems are encountered or being installed along a raceway route. Maintain a 12" minimum separation between ducts and other systems in parallel runs. Do not place ducts over valves or couplings in other piping systems. Refer conflicts with these requirements to the Contracting Officer for written instructions before further work is done.
4. Provide markers at grade to indicate direction of underground conduits provided under this contract. Provide markers consisting of double-ended arrows, straight for straight runs and bent at locations where runs change direction. Provide markers at all bends and at intervals not exceeding 100 ft in straight runs. Use markers made of sheet bronze not less than 1/4" thick embedded in and secured to the top of concrete posts. User markers not less than 10" long and 3/4" wide and marked ELECTRIC CABLES in letters 1/4" high incised into the bronze to a depth of 3/32".
5. Enter manholes and structures with ducts at right angles.

3.05 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Feeders 600V and Less: RNC, NEMA Type EPC-40-PVC, in concrete encased duct bank, unless otherwise indicated.

B. Ducts for Electrical Feeders 600V and Less: RNC, NEMA Type EPC-40-PVC, in direct buried duct bank, unless otherwise indicated.

C. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-80-PVC, in direct buried duct bank, unless otherwise indicated.

D. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, in concrete encased duct bank, unless otherwise indicated.

E. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, installed in concrete encased duct bank, unless otherwise indicated.

F. Underground Ducts for Telephone, Communications, or Data Circuits: RNC, NEMA Type EB-2--PVC, in concrete encased duct bank, unless otherwise indicated.

G. Underground Ducts Crossing Paved Paths, Walks, Driveways, Roadways, and Railroads: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.06 EARTHWORK

A. Excavation and Backfill: Comply with Section 26 05 43.13 - Excavation and Backfill, do not use heavy-duty, hydraulic-operated compaction equipment.

3.07 CONCRETE

A. Concrete: 3000 psi, 28-day strength, complying with Division 03 – Concrete, where concrete encased.

3.08 GROUNDING

A. Ground underground ducts according to Section 26 05 26 - Grounding and Bonding for Electrical Systems.

3.09 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts.
   2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80% fill of duct. If obstructions are indicated, remove obstructions and retest.

B. Preparation for pulling in conductors:
   1. Do not install crushed or deformed raceways. Avoid traps in raceways where possible. Take care to prevent the lodging of plaster, concrete, dirt, or trash in raceways, boxes, fittings, and equipment during the course of construction. Make raceways entirely free of obstructions or replace them. Ream all raceways, remove burrs, and clean raceway interior before introducing conductors or pull wires.
   2. Immediately after installation, plug or cap all raceway ends with watertight and dust-tight seals until the time for pulling in conductors.

C. Do not backfill underground direct buried and concrete encased ducts until the Architect has inspected them. Notify Architect 24 h in advance of duct concrete pour, or backfill of direct buried ducts.

3.10 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

END OF SECTION

SECTION 26 05 48
VIBRATION CONTROLS FOR ELECTRICAL SYSTEMS

PART 1- GENERAL

1.01 RELATED WORK

A. Section 26 05 29 - Hangers and Supports for Electrical Systems

B. Section 26 05 33 - Raceway and Boxes for Electrical Systems

C. Section 26 22 00 - Low-Voltage Transformers

D. Section 26 24 13 - Switchboards

E. Section 26 24 16.13 - Lighting and Appliance Panelboards

F. Section 26 28 16 - Enclosed Switches and Circuit Breakers

G. Section 26 50 00 - Lighting

1.02 REFERENCE

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

1.03 DESCRIPTION

A. Section includes requirements for vibration control and anchorage to building structure of electrical systems, including equipment specified in paragraph “Related Work”, raceways, and lighting fixtures:

B. Obtain services of Engineer registered and licensed in the State of New York to design vibration control and methods of anchorage of electrical systems to building structure.

1.04 REFERENCE STANDARDS

A. ASTM E488/E488M – Specification for Test Methods for Strength of Anchors in Concrete and Masonry Elements

B. IBC – International Building Code

C. ICC-ES – International Code Council Evaluation Service

D. NFPA 70 – National Electrical Code

E. NFPA 5000 – Building Construction and Safety Code

F. SEI/ASCE 7 – Structural Engineering Institute/American Society of Civil Engineers - Minimum Design Loads for Buildings and Other Structures

1.05 PERFORMANCE REQUIREMENTS

A. Governing Codes:
   1. 2021 IBC, Section 1613, which references and modifies SEI/AASCE 7-05, Chapter 13

1.06 SUBMITTALS

A. Product Data: For the following:
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
   2. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:
   1. Submit vibration isolation details:
      a. Indicate fabrication and arrangement.
      b. Detail attachments of restraints to the restrained items and to the structure.
      c. Show attachment locations, methods, and spacings.
      d. Indicate association with vibration isolation devices.
   2. Submit design analysis to support selection and arrangement of vibration isolation. Include calculations of combined tensile and shear loads.
   3. Shop drawings, including calculations, shall be signed and sealed by an Engineer registered and licensed in the State of New York.

1.07 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATORS

A. Pads: Arrange 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.

B. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
   1. Outside Spring Diameter: Not less than 80% of the compressed height of the spring at rated load.
   2. Minimum Additional Travel: 50% of the required deflection at rated load.
   3. Lateral Stiffness: More than 80% of rated vertical stiffness.
   4. Overload Capacity: Support 200% of rated load, fully compressed, without deformation or failure.
   5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4” thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
   6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

C. 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” thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
   2. Outside Spring Diameter: Not less than 80% of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50% of the required deflection at rated load.
   4. Lateral Stiffness: More than 80% of rated vertical stiffness.
   5. Overload Capacity: Support 200% of rated load, fully compressed, without deformation or failure.

2.02 FACTORY FINISHES

A. Finish: Manufacturer’s standard prime-coat finish ready for field painting.

B. Finish: Manufacturer’s standard paint applied to factory-assembled and -tested equipment before shipping.
   1. Powder coating on springs and housings.
   2. Hardware shall be galvanized. Hot-dip galvanized metal components for exterior use.
   3. Baked enamel or powder coat for metal components on isolators for interior use.
   4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation after unsatisfactory conditions have been corrected.

3.02 APPLICATION

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to Authorities Having Jurisdiction.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits.

3.03 METHODS AND MATERIALS

A. Vibration control methods and materials shall be supplementary to supporting devices and together shall serve as equipment support criteria. Provide hangers and supports in accordance with Section 26 05 29 - Hangers and Supports for Electrical Systems.

3.04 ADJUSTING

A. Adjust isolators after isolated equipment 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.

END OF SECTION

SECTION 26 05 53
ELECTRICAL SYSTEMS IDENTIFICATION

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 05 13.16 - Medium-Voltage, Single- and Multi-Conductor Cables

B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables

C. Section 26 05 33 - Raceway and Boxes for Electrical Systems

D. Section 26 05 43 - Underground Ducts And Raceways For Electrical Systems

E. Section 26 05 73 - Power System Studies

F. Section 26 09 23 - Lighting Control Devices

G. Section 26 22 00 - Low-Voltage Transformers

H. Section 26 24 13 - Switchboards

I. Section 26 24 16.13 - Lighting and Appliance Panelboards

J. Section 26 27 13 - Electrical Metering

K. Section 26 27 26 - Wiring Devices

L. Section 26 28 16 - Enclosed Switches and Circuit Breakers

M. Section 26 43 00 - Surge Protective Devices

1.02 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including sections under Division 01 - General Requirements.

1.03 DESCRIPTION

A. Section includes the following:
   1. Identification for raceway
   2. Identification for conductors and communication and control cable
   3. Underground-line warning tape
   4. Warning labels and signs
   5. Instruction signs and posted drawings
   6. Equipment identification nameplates
   7. Wiring devices identification
   8. Miscellaneous identification products

B. Refer to the respective Division 26 Sections, and Sections in other Divisions that specify electrical components, for additional electrical identification requirements.

1.04 REFERENCE STANDARDS

A. ANSI A13.1 – Scheme for the Identification of Piping Systems

B. ANSI C2 – National Electrical Safety Code

C. ANSI Z535.4 – National Standards for Product Safety Signs and Labels

D. 29 CFR 1910 – Labor, Part 1910 – Occupational Safety and Health Standards, Section 1910.145 – Specifications for Accident Prevention Signs and Tags

E. NFPA 70 – National Electrical Code

1.05 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Torque log for all terminations 100A and over. Log shall identify target torque values, as they are found via manufacturer documentation and individual locations.

C. Nameplate Schedule: Prior to making nameplates, submit a complete schedule to Contracting Officer for approval indicating nameplate size, lettering size, color and actual nameplate information.

D. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.06 QUALITY ASSURANCE

A. Refer to Division 01, Section 01 4000 - Quality Requirements

B. Comply with ANSI A13.1 and ANSI C2.

C. Comply with NFPA 70.

D. Comply with 29 CFR 1910.145.

1.07 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 RACEWAY IDENTIFICATION MATERIALS

A. Salient Characteristics
   1. Physical:
      a. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
      b. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action when placed in position.
      c. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2” long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action when placed in position.
      d. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2” wide; compounded for outdoor use.
   2. Functional:
      a. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size
      b. Color for Printed Legend:
      c. Power Circuits: Black letters on an orange field
         1) Legend: Indicate system or service and voltage, if applicable.

B. Performance: None

2.02 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Salient Characteristics
   1. Physical:
   2. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2" wide.
      a. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
      b. Aluminum Wraparound Marker Labels: Cut from 0.014” thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.
      c. Metal Tags: Brass or aluminum, 2” x 2” x 0.05”, with stamped legend, punched for use with self-locking nylon tie fastener.
      d. Write-On Tags: Polyester tag, 0.015" thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.
      e. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
      f. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, unless otherwise indicated, with eyelet for fastener.
   3. Functional: Comply with ANSI A13.1 for minimum size of letters for legend.

4. Performance: None

2.03 UNDERGROUND-LINE WARNING TAPE

A. Salient Characteristics
   1. Physical:
      a. Permanent, bright-colored, continuous-printed, polyethylene tape.
      b. Not less than 6” wide by 4 mils thick.
      c. Embedded continuous metallic strip.
   2. Functional:
      a. Printed legend shall indicate type of underground line.
      b. Red tape for electrical and orange tape for communications / controls installations.
   3. Performance: None

2.04 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Salient Characteristics
   1. Physical:
      a. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
      b. Self-Adhesive Arc Flash Warning Labels: Industrial grade, made of durable polyester with over-laminate to withstand harsh environments (UV rays, scratches and most chemicals).
      c. Engraved Plastic Signs: Engraving stock, melamine plastic laminate, minimum 1/16” thick for signs up to 20 sq inch and 1/8" thick for larger sizes.
         1) Engraved legend with black letters on white face.
         2) Punched or drilled for mechanical fasteners.
      d. Baked-Enamel Warning Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4” grommets in corners for mounting. Nominal size, 7x10".
   2. Functional:
      a. Comply with NFPA 70 and 29 CFR 1910.145.
      b. Warning label and sign shall include, but are not limited to, the following legends:
         1) Multiple Power Source Warning: “DANGER – ELECTRICAL SHOCK HAZARD – EQUIPMENT HAS MULTIPLE POWER SOURCES.”
         2) Workspace Clearance Warning: “WARNING – OSHA REGULATION – AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36".”
         3) Battery Room Warning: “DANGER – THIS ROOMS CONTAINS LEAD ACID BATTERY SYSTEMS, CORROSIVE ELECTROLYTE LIQUIDS, ENERGIZED ELECTRICAL CIRCUITS AND HYDROGEN GAS – AUTHORIZED PERSONNEL ONLY”.
         4) Battery Room Warning: “DANGER – THIS ROOMS CONTAINS LITHIUM-ION BATTERY SYSTEMS – AUTHORIZED PERSONNEL ONLY”

5) Arc Flash Labels: Per ANSI Z535.4, the signal word WARNING appearing in black letters on an orange background, with second line below (Arc Flash and Shock Hazard) in black letters on white background and third line below (Appropriate PPE Required) in black letters on white background. Include the following information on the label:
   a) Equipment name
   b) Available bolted current
   c) Flash protection boundary distance
   d) Incident energy level at 18” expressed in cal/cm2
   e) Personnel protective equipment (PPE) class
   f) Voltage shock hazard Limited shock approach boundary Restricted shock approach boundary
   g) Limited shock approach boundary
   h) Restricted shock approach boundary
6) Insert names and wording of additional warning signs or labels.

3. Performance: None

2.05 TORQUE MARKING

A. Contractor shall keep a log of torque values used for project. This record shall incorporate name of installer for each specific location with date/time.

B. Torque marks shall be made on nut side and extend to a non-rotating surface. Torque marks shall be made at time of torqueing – placing torque marks after the fact is not permitted, but instead must be re-torqued and marked.

C. Torque seal: (Blue) Cross-Check or similar manufacturer shall be used for terminations 100A and over. Use of permanent black marker is not acceptable.

D. Salient Characteristics
   1. Physical:
      a. Highly Visible multiple color options
      b. Liquid paste
   2. Functional:
      a. BMS8-45 Type II
      b. Tamper proof
      c. Dry to touch in 30-40 minutes
      d. Cured in 7-10 days
   3. Performance:
      a. Fluorescent
      b. Visually detects loose nuts and bolts

2.06 INSTRUCTION SIGNS AND POSTED DRAWINGS

A. Instruction Signs: Engraved, laminated acrylic or melamine plastic, minimum 1/16” thick for signs up to 20 sq inch and 1/8" thick for larger sizes.
   1. Engraved legend with white letters on black face.

2. Punched or drilled for mechanical fasteners.
3. Mounting Frames: Extruded aluminum, 4-point screw mount with 1/8” clear plexiglass cover.

B. Posted Drawings: Print electrical riser diagrams on 20 lb bond paper. (Blueprint paper is not acceptable.) Reduce drawings to approximately 1/2 size using Xerox reduction process. Contact Engineer to obtain updated original plans for printing.

2.07 EQUIPMENT IDENTIFICATION NAMEPLATES

A. Engraved, Three-layer, Laminated Acrylic or Melamine Nameplate: Punched or drilled for screw mounting. White letters on a black background, except emergency power equipment nameplates are to have white letters on a red background. Minimum letter height shall be 3/8” unless otherwise noted.

2.08 WIRING DEVICES IDENTIFICATION

A. Refer to Section 26 27 26 - Wiring Devices for requirements.

2.09 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, type 6/6 nylon cable ties.
1. Minimum Width: 3/16”
2. Tensile Strength: 50 lb minimum
3. Temperature Range: -40°F to 185°F
4. Color: Black, except where used for color-coding

B. Paint: Paint materials and application requirements are specified in Division 09 – Finishes painting Sections.

C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.01 APPLICATION

A. Raceway and Ductbanks More Than 600 V Concealed within Buildings: 4” wide black stripes on 10" centers over orange background that extends full length of raceway or duct and is 12" wide. Stencil legend “DANGER CONCEALED HIGH-VOLTAGE WIRING” with 3" high black letters on 20" centers. Stop stripes at legends. Apply to the following finished surfaces:
1. Floor surface directly above conduits running beneath and within 12” of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Accessible Raceways, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30A: Identify with orange snap-around labels.

1. Identify 4” round, 4" square and 4-11/16" junction boxes concealed above ceiling or exposed with neat lettering on cover with permanent black marking pen. Identify source, circuit number, phase, and control circuit number.

C. Accessible Raceways and Cables of Auxiliary Electrical Systems: Identify the following systems with color-coded, snap-around, color-coding bands:
   1. Fire Alarm System (including covers of pull and junction boxes): Red
   2. Fire-Suppression Supervisory and Control System: Red and yellow
   3. Combined Fire Alarm and Security System: Red and blue
   4. Security System: Blue and yellow
   5. Mechanical and Electrical Supervisory System: Green and blue
   6. Telecommunication System: Green and yellow

D. Power-Circuit Conductor Identification: For secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape. Identify source and circuit number of each set of conductors or other appropriate number or letter to expedite future tracing and troubleshooting. For single conductor cables, identify phase in addition to the above. Phase identification shall be consistent throughout the system.

E. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.

F. Conductors to Be Extended in the Future and Spare Conductors: Attach color-coded conductor tape and write-on tags to conductors and list source and circuit number.

G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
   3. Coordinate identification with project drawings, manufacturer’s wiring diagrams, and Operation and Maintenance Manual.

H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access to equipment.
   1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, the following:
      a. Power transfer switches
      b. Controls with external control power connections

2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
3. Arc Flash Warning Labels: install per NFPA 70 for each switchgear, switchboard, panelboard, motor control center, industrial control panel (every enclosure that may contain energized conductors or components). Locate labels so they are visible to the personnel before examination, adjustment, servicing, or maintenance of the equipment.
4. Available Fault Current Labels: install per NFPA 70 for each piece of service entrance equipment. Locate labels so they are visible to the personnel before examination, adjustment, servicing or maintenance of the equipment.

J. Warning Labels for central inverter equipment rooms: Comply with International Fire Code (IFC) requirements for UPS and apply baked-enamel warning signs. Identify word 'DANGER' with white letters on red background. Identify other explanatory text describing the danger condition with black text on white background. Apply to exterior of inverter equipment room door.

K. Instruction Signs and Posted Drawings:
1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend printed in all capital letters of 12 pt size minimum where instructions are needed for system or equipment operation.

L. Equipment Identification Nameplates: On each unit of equipment, install unique designation nameplate that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply nameplates to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Nameplate Instructions:
   a. Indoor Equipment: Engraved, laminated acrylic or melamine nameplate. Unless otherwise indicated, provide a single line of text with 1/2" high letters 1/4" where space is limited) on 1-12" high nameplate; where 2 lines of text are required, use nameplates sized 2" high.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine nameplates sized similar to indoor equipment nameplates.
   c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
2. Install nameplates for equipment including the following:
   a. Panelboards, electrical cabinets, and enclosures
   b. Access doors and panels for concealed electrical items
   c. Electrical switchgear, switchboards, and distribution panelboards including each feeder device within the equipment enclosures.
   d. Transformers
   e. Disconnect switches
   f. Enclosed circuit breakers
   g. Motor controllers
   h. Pushbutton stations
   i. Contactors

j. Remote-controlled switches, dimmer modules, and control devices
k. Battery inverter units
l. Battery racks
m. Power-generating units
n. Voice and data cable terminal equipment
o. Fire alarm control panel and annunciators
p. Monitoring and control equipment
q. Central Battery Inverter power supply equipment
r. Terminals, racks, and patch panels for voice and data communication and for signal and control functions
s. Non-concealed junction box covers of auxiliary electrical systems

3. Provide the following information on each nameplate:
   a. Equipment name/tag:
      1) Matching the designation from the contract documents, or identifying the load controlled or function of the equipment where no specific tag is shown on the contract documents.
      2) For disconnect switches, use the prefix "SW-" followed by the name of the equipment served, example: "SW-PMP-201."
   b. Equipment operating voltage, phase, wiring configuration, and ampacity:
      1) Example: "208V/3PH/4W/225A"
   c. Source of power supply, including circuit number:
      1) Example: "FED FROM LP-2/45"

M. For switchgear, switchboards, and panelboards, provide a nameplate identifying the color code of wiring within the panel, including the following information:
   1. Heading "PANEL VOLTAGE CONDUCTOR COLOR CODING"
   2. PHASE A: (COLOR OF INSTALLED CONDUCTORS)
   3. PHASE B: (COLOR OF INSTALLED CONDUCTORS)
   4. PHASE C: (COLOR OF INSTALLED CONDUCTORS)
   5. NEUTRAL: (COLOR OF INSTALLED CONDUCTORS)
   6. GROUND: GREEN

N. For service entrance equipment, provide a nameplate identifying the maximum available fault current and "as of" effective date.
   1. Example: "MAXIMUM AVAILABLE FAULT CURRENT 33,500A AS OF 2017/06/15."

O. Access Panel Identification: Furnish typewritten charts with identification and location of access panels serving equipment and incorporate in O&M Manuals.

3.02 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Install non-adhesive signs and plastic nameplates parallel to equipment lines; attach with screws and auxiliary hardware appropriate to the location and substrate. Secure to inside surface of door or panelboard that is recessed in finished locations.

F. Posted Drawings and Operating Instructions: Mount drawings and operating procedures on the wall immediately adjacent to the piece of equipment for which the instructions apply. If sufficient wall space is available, mount directly to one of the sheet metal panels of the equipment.

G. Warning Signs: Install warning signs where there is hazardous exposure or danger associated with access to or operation of electrical facilities. Provide text of sufficient clarity and lettering of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with ANSI A13.1 standard color and design.

1. Operational Tags: Where needed for proper and adequate information on operation and maintenance of electrical systems, provide tags of plasticized card stock, either preprinted or hand printed to convey the message; example: “DO NOT OPEN THIS SWITCH WHEN BREAKER IS CLOSED.”

H. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.

I. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied, or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
2. Colors for 208/120 V Circuits:
   a. Phase A (left bus in panelboard): Black
   b. Phase B (center bus in panelboard): Red
   c. Phase C (right bus in panelboard): Blue
   d. Neutral: White
   e. Equipment Ground: Green
3. Colors for 480/277 V Circuits:
   a. Phase A (left bus in panelboard): Brown
   b. Phase B (center bus in panelboard): Orange
   c. Phase C (right bus in panelboard): Yellow
   d. Neutral: Gray
   e. Equipment Ground: Green
4. Field-applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6” from terminal points and in boxes where splices or taps are made. Apply last two runs of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6” to 8” below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16" overall.

K. Painted Identification: Prepare surface and apply paint according to Division 09 – Finishes painting Sections.

END OF SECTION

SECTION 26 05 73
POWER SYSTEM STUDIES

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 05 53 - Electrical Systems Identification

B. Section 26 08 12 - Power Distribution Acceptance Tests

C. Section 26 08 13 - Power Distribution Acceptance Test Tables

D. Section 26 22 00 - Low-Voltage Transformers

E. Section 26 24 13 - Switchboards

F. Section 26 24 16.13 - Lighting and Appliance Panelboards

G. Section 26 28 13 - Fuses

H. Section 26 28 16 - Enclosed Switches and Circuit Breakers

1.02 REFERENCE

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

1.03 DESCRIPTION

A. Section includes computer based, fault current, arc flash, and overcurrent protective device coordination studies for an electrical distribution system, based on actual equipment supplied. Set protective devices based on results of the protective device coordination study.

1. Coordination of fully-rated devices is required. Coordination of series-rated devices is permitted only where indicated on drawings.

B. Furnish field information and data needed for the studies.

C. Available fault current and electrical equipment interrupting capacity indicated on drawings are based on the short circuit study performed during design as part of the construction documents.

D. Provide studies and reports prior to manufacture of the electrical distribution equipment.

E. Equipment submittal will not be approved until the coordination study is complete and the equipment submittals indicate compliance with the study recommendations.

1.04 REFERENCE STANDARDS

A. IEEE C57.12.10 – American National Standard for Transformers-230 kV and Below 833/958-8333/10 417 kVA, Single-Phase, and 750/862-60 000/80 000/100 000 kVA, Three-Phase, w/o Load Tap Changing; and 3750/4687-60 000/80 000 kVA with Load Tap Changing-Safety Requirements

B. IEEE C57.96 – Distribution and Power Transformers, Guide for Loading Dry-Type (Appendix to ANSI C57.12 Standards)

C. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings

D. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

E. IEEE 399 – Recommended Practice for Power System Analysis

F. IEEE 620 – Guide for the Presentation of Thermal Limit Curves for Squirrel Cage Induction Machines

G. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems

H. IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations

I. IEEE C57.96 – IEEE Guide for Loading Dry-Type Distribution and Power Transformers

J. ICICEA P-32-382 – Short-Circuit Characteristics of Insulated Cable

K. ICEA P-45-482 – Short-Circuit Performance of Metallic Shielding and Sheaths of Insulated Cable

L. NEMA MG 00001 – Motors and Generators

M. NFPA 70 – National Electrical Code (NEC)

N. NFPA 70B – Recommended Practice for Electrical Equipment Maintenance

O. NFPA 70E – Standard for Electrical Safety in Workplace

1.05 SUBMITTALS

A. Product Data: Computer software program to be used for studies. Include specific software version for owner record.

B. Product Certificates:
   1. Coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.
   2. Arc flash calculations computer software programs, certifying compliance with IEEE 1584.

C. Qualification Data: For coordination study specialist.
   1. Submit qualifications of the organization proposed for performing the study. Include description of the equipment and computer-based computation methods or programs used and the names and experience histories of the personnel who will perform the study.

D. Other Action Submittals: Subsequent to having approval for system protective devices submit the following in digital format:
   1. Electrical one-line drawing drafted in computer software program with component names.
      a. Drawing minimum text height of 3/32”. Maximum paper size 30”x42”. Provide multiple drawing sheets as required.

2. Fault current study report
3. Equipment evaluation report
4. Coordination study input data, including completed computer program input data sheets
5. Coordination Study Report
6. Arc Flash Study and Report
7. Arc Flash labels
8. Serving utility information with utility letterhead, including:
    a. Protective device part numbers/settings
    b. Maximum available 1P and 3P fault
    c. Line conductor sizes/lengths
    d. Transformer impedance
    e. Serving voltage
9. Provide copy of Owner's electrical safety program if site specific standards vary from instructions noted in this project specification. All software files, including report documents and system study native files (including relevant library files), to allow review and future use of files
10. Sample energized work permit form

1.06 QUALITY ASSURANCE

A. Perform studies using computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination Study Specialist Qualifications: An organization experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
    1. Perform study under the direct supervision and control of a Registered Professional Electrical Engineer licensed in the State of New York, with a minimum of 5 years recent experience in performing protective device coordination studies, arc flash calculations, and electrical system analysis. Final report shall be signed and sealed by said engineer.

C. Comply with IEEE 242 for short circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

E. Comply with IEEE 1584 for arc flash calculations.

PART 2 - PRODUCTS

2.01 COMPUTER SOFTWARE DEVELOPERS

A. Computer Software Developers: Subject to compliance with requirements, provide products by one of the following:

2.02 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399 and IEEE 1584.

B. Analytical features of fault current study computer software program shall include “mandatory,” “very desirable,” and “desirable” features as listed in IEEE 399 Table 7-4.

C. Computer software program shall be capable of plotting and diagramming time-current characteristic curves as part of its output. Computer software program reports device settings and ratings of all overcurrent protective devices and demonstrates selective coordination by computer-generated, time-current coordination plots.

D. Arc Flash Calculations: Software program capable of calculating Arc Flash Incident Energy (AFIE) levels and flash protection boundary distances.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices for coordination are indicated on drawings.

B. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

C. Provide the study based on the actual electrical equipment supplied for the project.

3.02 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:
   1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with power riser diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Impedance of utility service entrance(s).
   3. Power Riser Diagrams: In hard copy and electronic copy formats, showing the following:
      a. Circuit breaker and fuse-current ratings and types
      b. Relays and associated power and current transformer ratings and ratios
      c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios
      d. Generator kilovolt amperes, size, voltage, and source impedance
      e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length
         1) Prior to equipment purchase, utilize conservative lengths (up/down included) based on planned conduit routing to validate equipment ratings. Final study to utilize contractor provided as-built lengths to confirm equipment ratings.
      f. Busway ampacity and impedance
      g. Motor horsepower and code letter designation according to NEMA MG 00001
      h. Load current that is the basis for sizing continuous ratings of circuits for cables and equipment

4. Data sheets to supplement power riser diagrams, cross-referenced with tag numbers on diagrams, showing the following:
    a. Special load considerations, including starting inrush currents and frequent starting and stopping
    b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability
    c. Motor full-load current, locked-rotor current, service factor, starting time, type of start, and thermal-damage curve
    d. Generator thermal-damage curve
    e. Ratings, types, and settings of utility company's overcurrent protective devices
    f. Special overcurrent protective device settings or types stipulated by utility company
    g. Time-current characteristic curves of devices indicated to be coordinated
    h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers
    i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays
    j. Panelboards, switchboards ampacity, and interrupting rating in amperes rms symmetrical

3.03 FAULT CURRENT STUDY

A. Calculate maximum available short circuit current in amperes rms symmetrical at circuit breaker positions of electrical power distribution system. Provide calculation for a current immediately after initiation and for a three-phase bolted short circuit at the following:
    1. Switchboard bus
    2. Distribution panelboard
    3. Branch circuit panelboard
    4. Disconnect switches
    5. Equipment fed by Variable Frequency Drive (VFD)
    6. Industrial control panels including air handling equipment, elevator controllers, etc.

B. For standard non-bypass Pulse Width Modulation VFDs, a line short circuit condition may be ignored.

C. Verify mechanical equipment served meets or exceeds maximum short circuit available.

D. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for project. Include studies of system switching configurations and alternate operations that could result in maximum fault conditions.
    1. Model the entire electrical distribution system from utility company point of connection to circuit breakers in 208 V distribution panels at secondary side of distribution transformers. Include mechanical HVAC equipment, motor driven equipment feeder circuits, and elevator feeder circuits.
    2. Model shall include components of the distribution system which would be exposed to fault current levels of 10,000 A symmetrical on a calculated basis.

E. Calculate momentary and interrupting duties on basis of maximum available fault current.

F. Perform calculations to verify interrupting ratings of overcurrent protective devices in compliance with IEEE 241 and IEEE 242.
   1. Transformers:
      a. IEEE C57.12.10
      b. IEEE C57.12.00
      c. IEEE C57.96
   2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1
   3. Low-Voltage Fuses: ANSI C37.46

G. Study Report:
   1. Show calculated X/R ratios and equipment interrupting rating (5-cycle) fault currents on power riser diagrams in report. List other output values from computer analyses, including momentary (1/2-cycle), interrupting (5-cycle), and 30-cycle fault current values for 3-phase, 2-phase, and phase-to-ground faults.
   2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium- and high voltage circuit breakers to set relays and assess the sensitivity of overcurrent relays.

H. Equipment Evaluation Report:
   1. Prepare report on adequacy of overcurrent protective devices and conductors by comparing fault current ratings of devices with calculated fault current momentary and interrupting duties.
   2. For 600V overcurrent protective devices, ensure interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
   3. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
   4. Verify adequacy of phase conductors at maximum 3-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure short circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
   5. Notify Owner promptly of discrepancies, problem areas, or inadequacies and provide recommendations for problem resolution.

3.04 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 maximum and minimum 1/2-cycle short circuit currents.
   2. Calculate maximum and minimum interrupting duty (5 cycles to 2 seconds) short circuit currents.
   3. Calculate maximum and minimum ground-fault currents.

B. Comply with NFPA 70 for overcurrent protection of circuit elements and devices.

C. Comply with IEEE 241 recommendations for fault currents and time intervals.

D. Transformer Primary Overcurrent Protective Devices:
   1. Devices non-operational 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. Protect transformers according to IEEE C57.12.00, for fault currents by device settings.

E. Protect motors served by voltages more than 600 V according to IEEE 620.

F. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate equipment withstands the maximum short circuit current for a time equivalent to tripping time of primary relay protection or total clearing time of fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short circuit current. Verify adequacy of phase conductors at maximum three-phase bolted fault currents, equipment grounding conductors, and grounding electrode conductors at maximum ground-fault currents.

G. Include voltage classes of equipment from utility's incoming line protective device down to and including each panelboard. The phase and ground overcurrent protection shall be included as well as settings for other adjustable protective devices.

H. Selective Coordination: Overcurrent devices installed upstream and downstream of automatic transfer switches and/or associated with NEC Article 700 Emergency and 701 Legally Required loads shall be selectively coordinated from source of supply (both normal and emergency sources) through final device. Change specific circuit breakers (type, frame, trip-unit, etc.) and equipment bus rating as necessary to meet this requirement. Selective coordination of the system indicated on the one-line diagram is based on (list manufacturer) equipment.

1. Additionally, provide selective coordination for ground fault through-out.

I. Coordination Study Report: Prepare a written report indicating results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:

a. Device tag

b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values

c. Circuit breaker sensor rating; and long-time, short-time, and instantaneous settings

d. Fuse-current rating and type

e. Ground-fault relay-pickup and time-delay settings

f. Manufacturer and type of device

g. Range of adjustments and recommended settings

2. Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate adequate time separation exists between devices installed in series, drawn to show the boundaries of device operation on log-log scale graphs, including power utility company's upstream devices. Where time current curves do not explicitly illustrate selective coordination but breakers have been tested and documented as being selectively coordinated, submit manufacturer's literature to substantiate device coordination. Include on curve sheet a title and legend identifying portion of the system covered. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. 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, full-load amps, and damage curves
g. Maximum fault current cutoff point
h. Generator decrement curve and full-load amps

3. Plot characteristics where applicable:
   a. Low-voltage fuses including minimum melt, total clearing and damage bands
   b. Low-voltage circuit breaker trip devices
   c. Transformer full-load current, magnetizing inrush current, and ANSI transformer withstand parameters
   d. Ground-fault protective devices
   e. Motor starting characteristics and motor damage points
   f. Generator short circuit decrement curve and generator damage point
   g. Conductor damage curves
   h. Electric utility's protective devices
   i. Medium-voltage equipment relays
4. Notify Contracting Officer promptly of discrepancies, problem areas, or inadequacies and provide recommendations for problem resolution. Propose approaches to effectively protect the underrated equipment. Present technical evaluation with discussion of logical compromises for best coordination.

J. Completed data sheets for setting of overcurrent protective devices.

3.05 ARC FLASH STUDY

A. Perform arc flash calculations for Arc Flash Incident Energy (AFIE) levels and flash protection boundary distances. Utilize short circuit rating of equipment identified in fault current study – note infinite bus fault current alone is not acceptable.

B. Model worst-case arc flash conditions .
   1. Equipment with PPE rating greater than 2 shall be investigated. Investigation shall include adjustment of upstream overcurrent device settings to determine if PPE rating can be reduced with minimal compromise to coordination with other overcurrent devices.
   2. Systems or portions thereof 240 V and less and on the secondary side of 112.5kVA or smaller transformer report calculated values from NFPA 70E equations.
   3. Study shall include investigation for "Maintenance Settings" scenario(s). Adjustable breakers shall be set to lowest instantaneous setting available.

C. Arc Flash Study Report: Provide study results in tabular form and include:
   1. Device or bus name
   2. Bolted fault and arcing fault current levels
   3. Arc Flash Incident Energy (AFIE) level at 455 mm expressed in cal/cm2
   4. Flash protection boundary distances including:
      a. Limited shock approach boundary

b. Restricted shock approach boundary

5. Trip/Delay time
6. Breaker opening time
7. Working distance
8. Equipment class and bus gap
9. Personal protective equipment class (PPE)

D. Provide recommendation for reducing AFIE levels and enhancing worker safety.

3.06 FIELD QUALITY CONTROL

A. Inspect, set, test, and calibrate the protective relays, circuit breakers, fuses, and other applicable devices per requirements in Section 26 08 12 - Power Distribution Acceptance Tests and Section 26 08 13 - Power Distribution Acceptance Test Tables.

B. Upon final approval of study, provide weatherproof vinyl or polyester arc flash label for all electrical equipment defined above. Label shall include calculated flash protection boundary, incident energy in cal/cm2 at working distance (mm working distance based on equipment class, per IEEE 1584), required PPE level, limited approach, restricted approach, equipment name, company name/logo who performed the study, available fault current, overcurrent device settings if applicable, and date label was produced.

1. Label to comply with ANSI Z535. Use “WARNING” (ANSI safety orange background with an orange exclamation point safety symbol) for all arc flash levels.
2. Per NFPA 70E 130.5(C), due to use of incident energy analysis method, PPE categories shall not be provided on labels unless site specific standard PPE categories differ from incident energy levels noted in NNFPA 70E Table 130.7(C)(16).
3. Include verbiage on label noting study should be re-examined once every (5) years or upon modifications to electrical system.

3.07 ADJUSTING

A. Make modifications to equipment, as required, to accomplish conformance with equipment evaluation study.

B. Adjust relay and overcurrent protective device settings according to recommended settings table provided by overcurrent protective device coordination study.

C. Notify Contracting Officer in writing of any required major modifications.

3.08 INSTALLATION

A. Install PPE labels on each piece of equipment prior to energizing equipment.

B. PPE labels shall be protected by clear plastic cover, weatherproof type material, or laminated and mounted on front of equipment. Taping of PPE label to front of equipment is unacceptable.

C. PPE label shall be clearly visible upon approach to equipment.

D. For large pieces of equipment, label shall be placed near main overcurrent device or incoming feeder to equipment. For equipment such as switchboards, UPS, or switchgear, with multiple vertical sections, provide (1) label per vertical section.

E. Contractor to provide one-line diagrams (meet IEEE/ANSI standard 141), mounted on 24”x36” (minimum) Styrofoam backboard. These one-line diagrams shall be mounted in each electrical room.

F. Label shall be mounted at a minimum of 42” to bottom and maximum 66" to top above finished floor.

END OF SECTION

SECTION 26 05 93
ELECTRICAL SYSTEMS FIRESTOPPING

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 05 33 - Raceway and Boxes for Electrical Systems

1.02 REFERENCE

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

1.03 DESCRIPTION

A. Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions (walls, partitions, floors, and ceilings) including both empty openings and openings containing electrical penetrating items, including raceways, cables, cable trays, busways, and wireways.

1.04 REFERENCE STANDARDS

A. ASTM E814 – Standard Test Method for Fire Tests of Through-Penetration Firestops

B. UL 1479 - Fire Tests of Through-Penetration Firestops

1.05 PERFORMANCE REQUIREMENTS

A. Provide firestop system to resist spread of fire, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

B. Firestop systems shall be UL Classified for the application and correspond to those indicated by reference to designations listed by UL Fire Resistance Directory.

C. Conform to applicable Code requirements of Authority Having Jurisdiction.

1.06 SUBMITTALS

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

B. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetration items, including documentation of UL certification for firestop systems.

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

D. Material Safety Data Sheets provided with product delivered to job site.

E. Certification of compliance with Building Codes of the State of Project location.

F. Inspection reports

G. Onsite Training Letter: Firestop manufacturer to provide and contractor to submit letter stating the names(s) of the companies, person(s) in attendance and date of onsite training as required in section 1.7.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance.

B. Firestopping tests shall be performed by a qualified testing and inspecting agency, or another agency performing testing and follow-up inspection services for firestop systems acceptable to Authorities Having Jurisdiction.

C. Manufacturer's representative shall be on-site during initial installation of firestop systems to train appropriate Contractor personnel in proper selection and installation procedures.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product, type and manufacturer, and UL Label where applicable.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

C. Handle in accordance with recommended procedures, precautions, or remedies described in material safety data sheets as applicable.

1.09 PROJECT CONDITIONS

A. Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop systems' manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturers' written instructions by natural means or, where this is inadequate, forced-air circulation.

1.10 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Notify Owner's inspecting agency at least 7 days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by Authorities Having Jurisdiction.

1.11 SEQUENCING

A. Sequence work to avoid interferences with building finishes and installation of other products.

1.12 WARRANTY

A. Refer to Division 01 and Section 26 00 00 - General Electrical Requirements for general warranty requirements.

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

PART 2 - PRODUCTS

2.01 MATERIALS

A. Firestop Products: UL 1479, ASTM E814 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements and fire-rating involved for each separate instance; materials shall not contain flammable solvents.

B. Firestop Systems: Produced by the same manufacturer.

C. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Sealants: 250 g/L
   2. Sealant Primers for Nonporous Substrates: 250 g/L
   3. Sealant Primers for Porous Substrates: 775 g/L

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions for compliance with requirements for opening configurations, penetrating items and other conditions affecting performance of firestopping.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean out openings immediately prior to installing through-penetration firestop system to comply with firestop system manufacturer's written instructions.

B. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.

C. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.

3.03 INSTALLATION

A. Comply with "System Performance Requirements" Article in Part 1 and with firestop system manufacturer's written installation instructions and drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during application as required. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Each conduit penetration through a fire rated assembly is to be dedicated to a single conduit. Multiple conduits penetrating a single opening is not acceptable unless a UL listed, multi-conduit assembly is used.

3.04 IDENTIFICATION

A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include label(s) complying with 1 or 2 below.

1. Custom label with the following information:
   a. The words: "Warning—Through-Penetration Firestop System—Do Not Disturb. Notify Building Management of Any Damage."
   b. Contractor's name, address, and phone number
   c. Through-penetration firestop system designation of applicable testing and inspecting agency
   d. Date of installation
   e. Through-penetration firestop system manufacturer's name
   f. Installer's name
2. Manufacturer's preprinted labels with similar information per 1 above.

3.05 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified independent inspecting agency to inspect through-penetration firestop systems and to prepare test reports.

1. Inspecting agency will state in each report whether inspected through-penetration firestop systems comply with or deviate from requirements.

B. Provide certification by Installer that all through-penetration firestop systems have been firestopped in accordance with applicable Building Codes of the State of Project location.

C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

D. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with specifications.

3.06 CLEANING

A. Clean surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

END OF SECTION

SECTION 26 08 12
POWER DISTRIBUTION ACCEPTANCE TESTS

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems

C. Section 26 05 73 - Power System Studies

D. Section 26 08 13 - Power Distribution Acceptance Test Tables

E. Section 26 22 00 - Low-Voltage Transformers

F. Section 26 24 13 - Switchboards

G. Section 26 27 13 - Electrical Metering

H. Section 26 28 16 - Enclosed Switches and Circuit Breakers

1.02 REFERENCE

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

1.03 DESCRIPTION

A. Section includes acceptance testing requirements for assessing the suitability for service and reliability of the power distribution system.

B. Contractor to ensure all tested electrical equipment, is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.

C. Tests and inspections shall be performed after installation.

D. Tests and inspections shall determine suitability for energization.

E. Electrical systems shall pass tests prior to substantial completion or Owner occupancy.

F. This specification requires Contractor to engage services of testing agency.

G. All tests tables referenced in this specification provided in Section 26 0813 – Power Distribution Acceptance Test Tables.

H. Items to be tested and inspected as follows:
   1. 600-volt conductors and cables
   2. Electrical metering
   3. Dry type transformers (small)

4. Switchboard
5. Low-voltage insulated-case/molded-case circuit breakers
6. Low-voltage disconnect switches
7. Motor control
8. Ground fault protection systems
9. Grounding systems
10. Instrument transformers
11. Thermographic survey

1.04 REFERENCE STANDARDS

A. ANSI/IEEE C37 – Guides and Standards for Circuit Breakers, Switchgear, Relays, Substations, and Fuses

B. ANSI/IEEE C57 – Distribution, Power, and Regulating Transformers

C. ANSI/IEEE C57.13.1 – Guide for Field Testing of Relaying Current Transformers

D. ANSI/IEEE C57.13.3 – Grounding of Instrument Transformer Secondary Circuits and Gases

E. ANSI/IEEE C62 – Surge Protection

F. ANSI/IEEE 43 – IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery

G. ANSI/IEEE 81 – Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

H. ANSI/IEEE 142 – IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems (IEEE Green Book)

I. ANSI/IEEE 241– IEEE Recommended Practice for Electrical Power Systems in Commercial Buildings (IEEE Gray Book)

J. ANSI/IEEE 242 – IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (IEEE Buff Book)

K. ANSI/IEEE 399 – IEEE Recommended Practice for Power Systems Analysis (IEEE Brown Book)

L. ANSI/IEEE 400 – Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field

M. ANSI/IEEE 493 – IEEE Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems (IEEE Gold Book)

N. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems

O. NEMA AB 4 – Guidelines for Inspection and Preventive Maintenance of Molded-Case Circuit Breakers Used in Commercial and Industrial Applications

P. NEMA MG 00001 – Motors and Generators

Q. NFPA 70 – National Electrical Code

R. NFPA 70B – Recommended Practice for Electrical Equipment Maintenance

S. NFPA 70E – Electrical Safety Requirements for Employee Workplaces

T. NFPA 101 – Life Safety Code

U. OSHA – Part 1910 – Subpart S – 1910.308 – Special Systems

1.05 SUBMITTALS

A. Test Reports: Include the following:
   1. Summary of project
   2. Description of equipment tested
   3. Equipment used to conduct the test
   4. Description of test
   5. Test results, as compared to manufacturers' or industry accepted standards and tolerances
   6. Conclusions and recommendations
   7. Signature of responsible test organization authority

B. List of equipment used to perform tests. Identify the following:
   1. Type
   2. Manufacturer
   3. Model number
   4. Serial number
   5. Date of last calibration
   6. Documentation of calibration leading to NIST standards

1.06 QUALITY ASSURANCE

A. Refer to Division 01, Section 01 4000 - Quality Requirements

B. Qualifications of Testing Agency:
   1. Testing firm shall be a corporately and financially independent testing organization that can function as an unbiased testing authority, professionally independent of the manufacturer, supplier, and installers of equipment or system evaluated by the testing firm.
   2. Testing firm shall be regularly engaged in testing of electrical equipment, devices, installations and systems.
   3. Testing firm shall meet Federal Occupational Safety and Health Administration (OSHA) requirements for accreditation of independent testing laboratories.
   4. On-site technical person shall be currently certified by the International Electrical Testing Association in electrical power distribution system testing.
   5. Testing firm shall use technicians who are regularly employed by the firm for testing services.
   6. Testing firm shall submit proof of above qualifications with bid documents when requested.

PART 2 - PRODUCTS

2.01 NOT APPLICABLE TO THIS SECTION.

PART 3 - EXECUTION

3.01 PREPARATION

A. Documentation: Deliver the following to testing firm, minimum two weeks prior to commencement of testing:
   1. Complete set of electrical plans and specifications, with available short circuit indicated on power riser diagrams.
   2. Approved submittals and shop drawings of equipment being tested.
   3. Pertinent change orders.
   4. Evaluation, overcurrent protective device coordination and arc flash studies, per requirements in Section 26 05 73 - Power System Studies.

B. Schedule: Notify Owner 10 working days prior to performance of any tests.

C. Coordination: Coordinate with Owner the testing schedule and availability of equipment ready for testing.

D. Test Power: Provide test power (including specialized) for equipment testing before and after service energizing.

3.02 FIELD QUALITY CONTROL

A. Inspection and Test Procedures: Comply with NETA.
   1. 600 V Conductors and Cables:
      a. Visual and Mechanical Inspection:
         1) Compare cable data with drawing and specifications.
         2) Inspect exposed sections of cables for physical damage.
         3) Verify tightness of accessible bolted electrical connections by calibrated torque wrench in accordance with manufacturer's published data or Table 12.
         4) Perform thermographic survey of bolted electrical connections in accordance with paragraph "Thermographic Survey."
         5) Inspect compression-applied connectors for correct cable match and indentation.
         6) Verify visible cable bends meet or exceed ICEA and manufacturer's minimum allowable bending radius.
         7) For cables are terminated through window-type current transformers, provide an inspection to verify neutral and ground conductors are correctly placed for operation of protective devices.
         8) Inspect for correct identification and arrangements.
         9) Inspect jacket and insulation condition.

b. Electrical Tests:
    1) Perform insulation-resistance test using megohm meter. Applied potential to be 1000 VDC. Individually test each conductor with other conductors grounded. Test duration shall be one minute.
    2) Perform continuity tests to ensure correct cable connection.
c. Test Values:
    1) Insulation-resistance values should not be less than 50 megohms.

2. Electrical Metering:
    a. Visual and Mechanical Inspection:
        1) Compare equipment nameplate data with drawings and specifications.
        2) Inspect physical and mechanical condition.
        3) Verify tightness of electrical connections.
        4) Inspect cover gasket, cover glass, condition of spiral spring, disc clearance, contacts, and case-shorting contacts, as applicable.
        5) Verify freedom of movement, correct travel and alignment, and tightness of mounting hardware.
    b. Electrical Tests:
        1) Check calibration of meters at cardinal points.
        2) Calibrate watt-hour meters according to manufacturer's published data.
        3) Verify instrument multipliers.
        4) Electrically confirm current transformer and voltage transformer secondary circuits are intact.
3. Dry Type Transformers (Small):
    a. Visual and Mechanical Inspection:
        1) Compare equipment nameplate data with drawings and specifications.
        2) Inspect physical and mechanical condition.
        3) Inspect anchorage, alignment, and grounding.
        4) Verify that resilient mounts are free and that any shipping brackets have been removed.
        5) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 12.
        6) Verify that as-lift tap connections are as specified.
    b. Electrical Tests:
        1) Perform insulation-resistance tests winding-to-winding and each winding-to-ground with test voltage in accordance with Table 5. Calculate dielectric absorption ratio or polarization index.
    c. Test Values:
        1) Bolt-torque levels should be in accordance with Table 12, unless otherwise specified by manufacturer.
        2) Insulation-resistance test values at one minute should be in accordance with Table 5.
        3) The dielectric absorption or polarization index shall be greater than 1.0 and shall be recorded for future reference.

4. Low-Voltage Switchboard Assemblies:
    a. Visual and Mechanical Inspection:
        1) Compare equipment nameplate data with drawings and specifications.
        2) Inspect physical and mechanical condition.
        3) Confirm correct application of manufacturer's recommended lubricants.
        4) Verify appropriate anchorage, required area clearances, grounding and correct alignment.
        5) Inspect doors, panels, and sections for paint, dents, scratches, fit, and missing hardware.
        6) Verify fuse and/or circuit breaker sizes and types correspond to drawings and coordination study as well as to circuit breaker's address for microprocessor-communication packages.
        7) Verify that current and potential transformer ratios correspond to drawings.
        8) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench. Refer to manufacturer's published data or Table 12 for proper torque values.
        9) Perform thermographic survey of bolted electrical connections in accordance with paragraph "Thermographic Survey."
        10) Confirm correct operation and sequencing of electrical and mechanical interlock systems.
            a) Attempt closure on locked-open devices. Attempt to open locked-closed devices.
            b) Make key exchange with devices operated in off-normal positions.
        11) Inspect insulators for evidence of physical damage or contaminated surfaces.
        12) Verify correct barrier installation and operation.
        13) Exercise active components.
        14) Inspect mechanical indicating devices for correct operation.
        15) Verify filters are in place and/or vents are clear.
        16) Perform visual and mechanical inspection of instrument transformers, in accordance with paragraph "Instrument Transformers."
        17) Inspect control power transformers.
            a) Inspect physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
            b) Verify that primary and secondary fuse ratings or circuit breakers match drawings.
            c) Verify correct functioning of draw-out disconnecting and grounding contacts and interlocks.
    b. Electrical Tests:
        1) Perform tests on all instrument transformers in accordance with paragraph "Instrument Transformers."
        2) Perform resistance tests through bus joints with low-resistance ohmmeter. Joints that cannot be directly measured due to permanently installed insulation wrap shall be indirectly measured from closest accessible connection.
        3) Perform insulation-resistance tests in each bus section, phase-to-phase and phase-to-ground for one minute in accordance with Table 1.
        4) Perform over-potential test on each bus section, each phase-to-ground with phases not under test grounded, in accordance with manufacturer's published data. In the absence of any published data, Table 2 shall apply. Test voltage shall be applied for one minute.

5) Perform insulation-resistance tests at 1000 VDC on control wiring. Test duration shall be one minute. Do not perform this test on wiring connected to solid-state components. Follow manufacturer's recommendation.

6) Perform current injection tests on the entire current circuit in each section of switchgear.

   a) Perform current tests by primary injection, where possible, with magnitudes such that minimum of 1.0 amp flows in secondary circuit.

   b) Where primary injection is impractical, utilize secondary injection with minimum current of 1.0 amp.

   c) Test current at each device.

7) Determine accuracy of meters and calibrate watt-hour meters in accordance with paragraph "Electrical Metering." Verify multipliers.

8) Perform the following tests on control power transformers:

   a) Perform insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground. Test voltages shall be in accordance with Table 1 unless otherwise specified by manufacturer.

   b) Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to correct secondary voltage. Confirm potential at all devices.

   c) Verify correct secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with secondary wiring disconnected.

   d) Verify correct function of control transfer relays located in switchboard/switchgear with multiple control power sources.

9) Potential Transformer Circuits:

   a) Perform insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground. Test voltages shall be in accordance with Table 1, unless otherwise specified by manufacturer.

   b) Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to correct secondary voltage.

   c) Verify secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with secondary wiring disconnected.

10) Verify operation of switchgear/switchboard space heaters.

c. Test Values:

1) Bolt-torque levels shall be in accordance with Table 12, unless otherwise specified by manufacturer.

2) Compare bus connection resistances to values of similar connections.

3) Insulation-resistance values for bus, control wiring, and control power transformers shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 1. Values of insulation resistance less than this table or manufacturer's minimum should be investigated. Over-potential tests should not proceed until insulation-resistance levels are raised above minimum values.

4) Bus insulation shall withstand the over-potential test voltage applied.

5) Contact resistance values shall not exceed high limit of normal range as indicated in manufacturer's published data. If manufacturer's data is not available, investigate values that deviate from similar bus by more than 50% of lowest value.

5. Low-Voltage Molded-Case Circuit Breakers, 225A and Larger:
   a. Visual and Mechanical Inspection:
      1) Compare nameplate date with drawings and specifications.
      2) Inspect circuit breaker for correct mounting.
      3) Operate circuit breaker to ensure smooth operation.
      4) Inspect case for cracks or other defects.
      5) Verify tightness of accessible bolted electrical connections and/or cable connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 12.
      6) Inspect mechanism contacts and arc chutes in unsealed units.
   b. Electrical Tests:
      1) Perform a contact-resistance test.
      2) Perform insulation-resistance test at 1000 VDC from pole-to-pole and from each pole-to-ground with breaker closed and across open contacts of each phase. Test duration shall be one minute. Use a minimum test voltage in accordance with Table 1 or manufacturer's published data.
      3) Perform insulation-resistance test at 1000 VDC on all control wiring. Test duration shall be one minute. Do not perform the test on wiring connected to solid-state components. Follow manufacturer's recommendation.
      4) Perform adjustments for final trip settings in accordance with overcurrent protective device coordination study.
      5) Perform long-time delay time-current characteristic tests by passing 300% rated current through each pole separately, unless series testing is required to defeat ground fault functions.
      6) Determine short-time pickup and delay by primary current injection.
      7) Determine ground-fault pickup and time delay by primary current injection.
      8) Determine instantaneous pickup current by primary injection using run-up or pulse method.
      9) Verify correct operation of auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and anti-pump function.
      10) Verify trip unit calibrations by secondary injection.
      11) Determine minimum operation voltage on shunt trip and close coils in accordance with Table 20.
      12) Check charging mechanism.
   c. Test Values:
      1) Bolt-torque levels shall be in accordance with Table 12, unless otherwise specified by manufacturer.
      2) Compare microhm or millivolt drop values to adjacent poles or similar breakers. Investigate deviations of more than 50% of lowest value. Investigate any value exceeding manufacturer's recommendations.
      3) Circuit breaker insulation-resistance shall be in accordance with Table 1.
      4) Control wiring insulation-resistance shall comply with manufacturer's published data. In the absence of manufacturer's published data, use Table 1. Values of insulation resistance less than this table or manufacturer's minimum shall be investigated.

5) Trip characteristic of breakers shall fall within manufacturer's published time-current characteristic tolerance band, including adjustment factors. If manufacturer's curves are not available, trip times shall not exceed the value shown in Table 7. Circuit breakers exceeding specified trip time at 300% of pickup shall be tagged defective.
6) For molded-case circuit breakers, instantaneous pickup values shall be within manufacturer's published data or tolerances shown in Table 8.
7) Minimum operation voltages on shunt trip and close coils shall be in accordance with manufacturer's published data. In the absence of manufacturer's data, refer to Table 20.

6. Low-Voltage Disconnect Switches:
   a. Visual and Mechanical Inspection:
      1) Compare equipment nameplate data with drawings and specifications.
      2) Inspect physical and mechanical condition.
      3) Inspect anchorage, alignment, grounding, and required clearances.
      4) Verify correct blade alignment, blade penetration, travel stops, and mechanical operation.
      5) Verify that fuse sizes and types are in accordance with drawings, short-circuit and overcurrent protective device coordination studies.
      6) Verify that each fuse has adequate mechanical support and contact integrity.
      7) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 12.
      8) Perform thermographic survey of accessible bolted electrical connection in accordance with paragraph "Thermographic Survey."
      9) Verify operation and sequencing of interlocking systems.
      10) Verify correct phase barrier installation.
      11) Verify correct operation of all indicating and control devices.
      12) Confirm correct application of manufacturer's recommended lubricants.
   b. Electrical Tests:
      1) Measure contact resistance across each switchblade and fuseholder.
      2) Perform insulation-resistance test at 1000 VDC from pole-to-pole and from each pole-to-ground. Test duration shall be one minute. Use a minimum test voltage in accordance with Table 1 or manufacturer's published data.
      3) Measure fuse resistance.
      4) Perform ground fault test, if applicable.
   c. Test Values:
      1) Compare bolted connection resistances to values of similar connections.
      2) Bolt-torque levels should be in accordance with Table 12, unless otherwise specified by the manufacturer.
      3) Compare microhm or millivolt drop values to adjacent poles or similar switches. Investigate deviations of more than 50% of lowest value. Investigate any value exceeding manufacturer's recommendations.
      4) Minimum insulation-resistance shall be in accordance with manufacturer's published data or Table 1.
      5) Investigate fuse-resistance values that deviate from each other by more than 15%.

7. Motor Control:
    a. Visual and Mechanical Inspection:
        1) Compare equipment nameplate data with drawings and specifications.
        2) Inspect physical and mechanical condition.
        3) Inspect anchorage, alignment and grounding.
        4) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 12.
        5) Verify controller mechanical operations. Inspect gap, wipe, alignment, and pressure are in accordance with manufacturer's published data.
        6) Verify motor running protection installed and properly sized.
        7) Confirm correct application of manufacturer's recommended lubricants.
    b. Electrical Tests:
        1) Perform insulation-resistance tests at 1000 VDC on control wiring. Test duration shall be one minute. Do not perform this test on wiring connected to solid-state components. Follow manufacturer's recommendations.
        2) Test motor protection devices in accordance with manufacturer's published data. In the absence of manufacturer's data, use paragraph "Protective Relays."
        3) Test circuit breakers in accordance with paragraph "Low-Voltage Insulated-Case/Molded-Case Circuit Breakers."
        4) Perform operational tests by initiating control devices.
    c. Test Values:
        1) Bolt-torque levels shall be in accordance with Table 12, unless otherwise specified by manufacturer.
        2) Compare bus connection resistances to values of similar connections.
        3) Insulation-resistance values for control wiring, and control power transformers shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 1. Values of insulation-resistance less than this table or manufacturer's minimum should be investigated.
        4) Motor protection parameters shall be in accordance with manufacturer's published data.
8. Ground Fault Protection Systems:
    a. Visual and Mechanical Inspection:
        1) Compare equipment nameplate data with drawings and specifications.
        2) Visually inspect components for damage and errors in polarity or conductor routing:
            a) Verify ground connection is made ahead of neutral disconnect link and on line side of any ground fault sensor.
            b) Verify neutral sensors are connected with correct polarity on both primary and secondary.
            c) Verify all phase conductors and neutral pass through sensor in same direction for zero sequence systems.
            d) Verify grounding conductors do not pass through zero sequence sensors.
            e) Verify grounded conductor is solidly grounded.
        3) Verify tightness of accessible bolted electrical connections, including control circuits, by calibrated torque-wrench method in accordance with manufacturer's published data or Table 12.

4) Verify correct operation of self-test panel.
5) Set pickup and time-delay settings in accordance with settings provided on drawings and in specifications. Record operation and test sequences as required by NFPA 70.
6) Verify the control power transformer has adequate capacity for the system.

b. Electrical Tests:
1) Measure system neutral-to-ground insulation resistance with neutral disconnect link temporarily removed. Replace neutral disconnect link after testing.
2) Perform insulation-resistance test of control wiring at 1000 VDC for one minute. Do not perform this test on wiring connected to solid-state components. Follow manufacturer's recommendations.
3) Perform the following pickup tests using primary injection:
a) Verify relay does not operate at 90% of pickup setting.
b) Verify pickup is less than 125% of setting or 1200 amp, whichever is smaller.
4) For summation type systems using phase-neutral current transformers, verify correct polarities by applying current to each phase-neutral current transformer pair. This test also applies to molded-case breakers using external neutral current transformer.
a) Relay should operate when current direction is the same relative to polarity marks in the two current transformers.
b) Relay should not operate when current direction is opposite relative to polarity marks in the two current transformers.
5) Measure time delay of the relay at 150% or greater of pickup.
6) Verify reduced voltage tripping capability: 55% for AC systems and 80% for DC systems.

c. Test Values:
1) System neutral-to-ground insulation shall be minimum of one megohm.
2) Insulation resistance values shall be in accordance with Table 1.
3) Relay timing shall be in accordance with manufacturer's specifications but must also be no longer than one second at 3000 amp.
4) Bus bolt-torque levels shall be in accordance with Table 12, unless otherwise specified by manufacturer.

9. Grounding Systems:
a. Visual and Mechanical Inspection:
1) Verify ground system is in compliance with drawings, specifications, and NFPA 70.
2) Inspect physical and mechanical condition.
3) Inspect anchorage.

b. Electrical Tests:
1) Perform fall-of-potential or alternative test in accordance with ANSI/IEEE 81 on the main grounding electrode or system.
2) Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.
3) Make resistance measurements in dry weather not earlier than 48 hours after rainfall.

c. Test Values:

1) The resistance between the main grounding electrode and ground should be no greater than five ohms. (Reference ANSI/IEEE 142.) Investigate any values above five ohms and notify Engineer immediately for further instructions.

2) Investigate point-to-point resistance values that exceed 0.5 ohm.

10. Instrument Transformers:

a. Visual and Mechanical Inspection:

1) Compare equipment nameplate data with drawings and specifications.

2) Inspect physical and mechanical condition.

3) Verify correct connection of transformers with system requirements.

4) Verify adequate clearance between primary and secondary circuit wiring.

5) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 12.

6) Perform thermographic survey of bolted electrical connections in accordance with paragraph "Thermographic Survey."

7) Verify required grounding and shorting connections provide contact.

8) Verify correct operation of transformer withdrawal mechanism and grounding operation.

9) Verify correct primary and secondary fuse sizes for potential transformers.

10) Confirm correct application of manufacturer's recommended lubricants.

b. Electrical Tests – Current Transformers:

1) Perform insulation-resistance test of current transformer and wiring-to-ground at 1000 VDC. Do not perform this test on wiring connected to units with solid-state components. Follow manufacturer's recommendations.

2) Perform polarity test of each current transformer.

3) Perform ratio-verification test using voltage or current method in accordance with ANSI/IEEE C57.13.1.

4) Perform excitation test on transformers used for relaying applications in accordance with ANSI/IEEE C57.13.1.

5) Measure current circuit burdens at transformer terminal and determine total burden.

6) When applicable, perform insulation-resistance and dielectric withstand tests on primary winding with secondary grounded. Test voltages shall be in accordance with Tables 5 and 9 respectively.

7) Verify that current circuits are grounded and have only one grounding point in accordance with ANSI/IEEE C57.13.3.

c. Electrical Tests – Voltage Transformers:

1) Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Test voltages shall be applied for one minute in accordance with Table 5. For units with solid-state components, follow manufacturer's recommendation.

2) Perform polarity test on each transformer to verify polarity marks or H1-X1 relationship as applicable.

3) Perform turns ratio test on all tap positions, if applicable.

4) Measure potential circuit burdens at transformer terminals and determine total burden.

5) Perform dielectric withstand test on primary windings with secondary windings connected to ground. Dielectric voltage shall be in accordance with Table 9. Test voltage shall be applied for one minute.

d. Test Values:

1) Insulation-resistance measurement on instrument transformer shall not be less than that shown in Table 5.

2) Bolt-torque levels shall be in accordance with Table 12, unless otherwise specified by the manufacturer.

3) Polarity results shall agree with system drawings.

4) Compare measured burdens to calculated burdens supplied by Owner.

5) Ratio accuracies shall be within 0.5% of nameplate or manufacturer's published data.

6) Insulation shall withstand over-potential test voltage applied.

11. Thermographic Survey:

a. Visual and Mechanical Inspection:

1) Inspect physical, electrical, and mechanical conditions.

2) Remove all necessary covers prior to thermographic inspection.

3) Equipment to be inspected shall include all current-carrying devices. Provide report including the following:

a) Discrepancies.

b) Temperature difference between area of concern and reference area.

c) Cause of temperature difference.

d) Areas inspected. Identify inaccessible and unobservable areas and equipment.

e) Identify load conditions at time of inspection.

f) Provide photographs and thermogram of deficient area.

b. Test Parameters:

1) Inspect distribution systems with imaging equipment capable of detecting minimum temperature difference of 2°F at 86°F.

2) Equipment shall detect emitted radiation and convert detected radiation to visual signal.

3) Thermographic surveys should be performed during periods of maximum possible loading but not less than 40% of rated load of the electrical equipment being inspected. Refer to NFPA 70B, Section 20.17 (Infrared Inspection).

c. Test Results:

1) Temperature differences of 2°F to 5°F indicate possible deficiency and warrant investigation.

2) Temperature differences of 7°F to 27°F indicate deficiency; repair as time permits.

3) Temperature differences of 29°F and above indicate major deficiency; repair immediately.

4) Suggested actions based on temperature rise can be found in Table 18.

B. Test Reports:

1. Testing firm shall do the following:

a. Prepare test report, including description of equipment tested, description of test, test results, conclusions and recommendations, retesting results, list of test equipment used and calibration date.

b. Show test results in comparison to industry and manufacturer's values and tolerances.

c. Interpret test results in writing and give recommendations for acceptance or rejection upon consultation with Engineer and prior to energizing equipment.

d. Assure electrical equipment is operational and within industry and manufacturer's tolerances, and is installed in accordance with contract documents.

e. Assure suitability of energization.

f. Report to the Owner any system, material, or workmanship that is found defective on the basis of acceptance tests.

g. Retest equipment when required.

h. Maintain written record of tests.

i. Utilize safety practices during the tests in accordance with:

1) Acceptable state and local safety operating procedures

2) Owner's safety practices

3) OSHA

4) NFPA 70E

j. Perform tests with apparatus de-energized and grounded, except where otherwise specifically required ungrounded by test procedures.

k. Assemble and certify final test report.

l. Provide 4 copies of complete test report.

m. Attach label to all tested equipment with indication of date tested and testing firm name.

2. Contractor shall do the following:

a. Investigate, replace, or repair any fault in material or in any part of the installation revealed by the tests.

b. Deliver one copy of each test report directly to Contracting Officer within 30 days after completion of testing, unless directed otherwise. Insert a copy of each test report in the equipment operation and maintenance manuals.

C. Test Equipment:

1. Test Instrument Calibration:

a. Testing firm shall have calibration program that assures test instruments are maintained with rated accuracy.

b. Instruments shall be calibrated in accordance with the following frequency schedule:

1) Field instruments: Analog, 6 months maximum; Digital, 12 months maximum

2) Laboratory instruments: 12 months

3) Leased specialty equipment: 12 months where accuracy is guaranteed by lessor

c. Dated calibration labels shall be visible on test equipment.

d. Records, which show date and results of instruments calibrated or tested, must be kept up-to-date.

e. Up-to-date instrument calibration instructions and procedures shall be maintained for test instrument.

f. Equipment used for field testing shall be more accurate than instrument being tested.

g. Calibrating standard applied to testing equipment shall be of higher accuracy than instrument tested.

END OF SECTION

SECTION 26 08 13
POWER DISTRIBUTION ACCEPTANCE TEST TABLES

TABLE 1

INSULATION RESISTANCE TEST VALUES

ELECTRICAL APPARATUS AND SYSTEMS

Voltage Rating	**Minimum DC Test Voltage**	**Recommended Minimum Insulation Resistance In Megohms**
250	500	25
600	1,000	100
1,000	1,000	100
2,500	1,000	500
5,000	2,500	1,000
8,000	2,500	2,000
15,000	2,500	5,000
25,000	5,000	20,000
34,500 and above	15,000	100,000

See Table 14 for temperature correction factors.

TABLE 2

Switchgear Low-Frequency Withstand Test Voltages

(NOT USED)

TABLE 3

RECOMMENDED DISSIPATION FACTOR/POWER FACTOR AT 20°C

LIQUID FILLED TRANSFORMERS, REGULATORS, AND REACTORS

ACCEPTANCE TEST VALUES

(NOT USED)

TABLE 4

INSULATING FLUID LIMITS

(NOT USED)

TABLE 5

TRANSFORMER INSULATION-RESISTANCE

ACCEPTANCE TEST VOLTAGE AND MINIMUM RESULTS

		Recommended Minimum Insulation Resistance in Megohms	
Transformer Coil Rating Type in Volts	**Minimum DC Test Voltage**	**Liquid Filled**	**Dry**
0 - 600	1000	100	500
601 - 5000	2500	1000	5000
5001 - 15000	5000	5000	25000

See Table 14 for Temperature Correction Factors.

NOTE: Since insulation resistance depends on insulation rating (kV) and winding capacity (kVA), values obtained should be compared to manufacturer's test data.

TABLE 6

MEDIUM-VOLTAGE CABLES

ACCEPTANCE TEST VALUES

(NOT USED)

TABLE 7

MOLDED-CASE CIRCUIT BREAKERS

VALUES FOR INVERSE TIME TRIP TEST

(AT 300% OF RATED CONTINUOUS CURRENT OF CIRCUIT BREAKER)

Range of Rated Continuous Current Amperes	Maximum Trip Time in Seconds For Each Maximum Frame Rating[1]	
	250V	251 - 600V
0-30	50	70
31-50	80	100
51-100	140	160
101-150	200	250
151-225	230	275
226-400	300	350
401-600	----------	450
601-800	----------	500
801-1000	----------	600
1001-1200	----------	700
1201-1600	----------	775
1601-2000	----------	800
2001-2500	----------	850
2501-5000	----------	900

Reproduction of Table 5-3 from NEMA AB 4-1996.

[1] For integrally-fused circuit breakers, trip times may be substantially longer if tested with the fuses replaced by solid links (shorting bars).

TABLE 8

INSTANTANEOUS TRIP SETTING TOLERANCES FOR FIELD TESTING

OF MARKED ADJUSTABLE TRIP CIRCUIT BREAKERS

	Tolerances of High and Low Settings	
Ampere Rating	High	Low
Adjustable	+40%	-30%
Non-adjustable	+25%	-25%

For circuit breakers with nonadjustable instantaneous trips, tolerances apply to the manufacturer's published trip range, i.e., +40% on high side, -30% on low side.

TABLE 9

INSTRUMENT TRANSFORMER DIELECTRIC TESTS

FIELD ACCEPTANCE

Nominal System (kV)	**BIL (kV)**	**Applied Potential Tests Field Test Voltage (kV)**	
		AC	**DC[1]**
0.6	10	3	4
1.2	30	7.5	10
2.4	45	11.25	15
5.0	60	14.25	19
8.7	75	19.5	26
15	95	25.5	34
15	110	25.5	34
25	125	30	40
25	150	37.5	50
34.5	150	37.5	50
34.5	200	52.5	70

Derived from Paragraph 8.8.2 and Tables 2 and 7 of ANSI/IEEE C57.13-1993 (Standard Requirements for Instrument Transformers).

[1] DC potential tests are not recommended for transformers rated higher than 200 kV BIL. DC tests may prove beneficial as a reference for future testing. In such cases the test direct voltage should not exceed the original factory test RMS alternating voltages.

TABLE 10

MAXIMUM ALLOWABLE VIBRATION AMPLITUDE

RPM @ 60 Hz	Velocity in/s peak	Velocity mm/s	RPM @ 60 Hz	Velocity in/s peak	Velocity mm/s
3600	0.15	3.8	3000	0.15	3.8
1800	0.15	3.8	1500	0.15	3.8
1200	0.15	3.8	1000	0.13	3.3
900	0.12	3.0	750	0.10	2.5
720	0.09	2.3	600	0.08	2.0
600	0.08	2.0	500	0.07	1.7

Derived from NEMA publication MG 1-1998, Section 7.8.1, Table 7-1. Table is unfiltered vibration limits for resiliently mounted machines. For machines with rigid mounting, multiply the limiting values by 0.8.

TABLE 11

OVERPOTENTIAL TEST VOLTAGES FOR ELECTRICAL APPARATUS OTHER THAN INDUCTIVE EQUIPMENT

Nominal System (Line) Voltage[1] (kV)	Insulation Class	AC Factory Test (kV)	Maximum Field Applied AC Test (kV)	Maximum Field Applied DC Test (kV)
1.2	1.2	10	6.0	8.5
2.4	2.5	15	9.0	12.7
4.8	5.0	19	11.4	16.1
8.3	8.7	26	15.6	22.1
14.4	15.0	34	20.4	28.8
18.0	18.0	40	4.0	33.9
25.0	25.0	50	30.0	42.4
34.5	35.0	70	42.0	59.4
46.0	46.0	95	57.0	80.6
69.0	69.0	140	84.0	118.8

[1] Intermediate voltage ratings are placed in the next higher insulation class.

TABLE 12

U.S. 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 (psi)	64K	105K	133K	150K
Bolt Diameter In Inches	Torque (Foot Pounds)			
1/4	4	6	8	8
5/16	7	11	15	18
3/8	12	20	27	30
7/16	19	32	44	48
1/2	30	48	68	74
9/16	42	70	96	105
5/8	59	96	135	145
3/4	96	160	225	235
7/8	150	240	350	380
1.0	225	370	530	570

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 PSI.

TABLE 12 (CONT.)

BOLT TORQUES FOR BUS CONNECTIONS

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

[2] Aluminum alloy bolts shall have a minimum tensile strength of 55,000 psi.

BOLT TORQUES FOR BUS CONNECTIONS

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 13

SF_6 GAS TESTS

(NOT USED)

TABLE 14

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	1.25
30	86	1.98	1.58
35	95	2.80	2.00
40	104	3.95	2.50
45	113	5.60	3.15
50	122	7.85	3.98
55	131	11.20	5.00
60	140	15.85	6.30
65	149	22.40	7.90
70	158	31.75	10.00
75	167	44.70	12.60
80	176	63.50	15.80

TABLE 15

HIGH-POTENTIAL TEST VOLTAGE

AUTOMATIC CIRCUIT RECLOSERS

(NOT USED)

TABLE 16

HIGH-POTENTIAL TEST VOLTAGE

FOR ACCEPTANCE TEST OF LINE SECTIONALIZERS

(NOT USED)

TABLE 17

DIELECTRIC WITHSTAND TEST VOLTAGES

METAL-ENCLOSED BUS

(NOT USED)

TABLE 18

THERMOGRAPHIC SURVEY

SUGGESTED ACTIONS BASED ON TEMPERATURE RISE

Temperature difference (TD) based on comparisons between similar components under similar loading	Temperature difference (TD) based upon comparisons between component and ambient air temperatures	Recommended action
1°C to 3°C	1°C to 10°C	Possible deficiency; warrants investigation
4°C to 15°C	11°C to 20°C	Indicates probably deficiency; repair as time permits
-- -- --	21°C to 40°C	Monitor until corrective measures can be accomplished
>15°C	>40°C	Major discrepancy; repair immediately

Temperature specifications vary depending on the exact type of equipment. Even in the same class of equipment (i.e., cables) there are various temperature ratings. Heating is generally related to the square of the current; therefore, the load current will have a major impact on □T. In the absence of consensus standards for TD, the values in this table will provide reasonable guidelines.

An alternative method of evaluation is the standards-based temperature rating system as discussed in Chapter 8.9.2, Conducting an IR Thermographic Inspection, Electrical Power Systems Maintenance and Testing, by Paul Gill, PE, 1998.

It is a necessary and valid requirement that the person performing the electrical inspection be thoroughly trained and experienced concerning the apparatus and systems being evaluated as well as knowledgeable of thermographic methodology.

TABLE 19

OVERPOTENTIAL TEST VOLTAGES

ELECTRICAL APPARATUS OTHER THAN INDUCTIVE EQUIPMENT

Nominal System (Line) Voltage[a] (kV)	Insulation Class	AC Factory Test (kV)	Maximum Field Applied AC Test (kV)	Maximum Field Applied DC Test (kV)
1.2	1.2	10	6.0	8.5
2.4	2.5	15	9.0	12.7
4.8	5.0	19	11.4	16.1
8.3	8.7	26	15.6	22.1
14.4	15.0	34	20.4	28.8
18.0	18.0	40	24.0	33.9
25.0	25.0	50	30.0	42.4
34.5	35.0	70	42.0	59.4

[a] Intermediate voltage ratings are placed in the next higher insulation class.

TABLE 20

RATED CONTROL VOLTAGES AND THEIR RANGES

FOR CIRCUIT BREAKERS

The maximum voltage is measured at the point of user connection to the circuit breaker (see Notes (9) (10)) with no operating current flowing, and the minimum voltage is measured with maximum operating current flowing.

Rated Control Voltages and their Ranges for Circuit Breakers					
Rated Control Voltage (8)	**Direct Current Voltage Ranges (1)(2) Volts, DC**		**Opening Functions All Types**	**Rated Control Voltage (60 Hz)**	**Alternating Current (1)(2)(3)(5) Closing, Tripping, and Auxiliary Functions**
	Closing and Auxiliary Functions				
	Indoor Circuit Breakers	**Outdoor Circuit Breakers**		**Single Phase**	**SINGLE PHASE**
24	---	---	14-28	120 240	104-127 (4) 208-254 (4)
48	38-56	36-56	28-56		
125	100-140	90-140	70-140	Polyphase	Polyphase
250	200-280	180-280	140-280		
---	---	---	---	208Y/120	180Y/104-220Y/127
---	---	---	---	240	208-254

Derived from Table 8, ANSI C37.06-2000, AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis – Preferred Ratings and Related Required Capabilities.

Rated Control Voltages and their Ranges for Circuit Breakers Solenoid-Operated Devices	
Rated Voltage	**Closing Voltage Ranges for Power Supply**
125 dc	90 – 115 or 105 – 130
250 dc	180 – 230 or 210 – 260
230 ac	190 – 230 or 210 - 260

Notes:

1. Electrically operated motors, contactors, solenoids, valves, and the like need not carry a nameplate voltage rating that corresponds to the control voltage rating shown in the table as long as these components perform the intended duty cycle (usually intermittent) in the voltage range specified.
2. Relays, motors, or other auxiliary equipment that function as a part of the control for a device shall be subject to the voltage limits imposed by this standard, whether mounted at the device or at a remote location.
3. Includes supply for pump or compressor motors. Note that rated voltages for motors and their operating ranges are covered by ANSI/NEA MG-1-1978.
4. Includes heater circuits.
5. Voltage ranges apply to all closing and auxiliary devices when cold. Breakers using standard auxiliary relays for control functions may not comply at lower extremes of voltage ranges when relay coils are hot, as after repeated or continuous operation.
6. Direct current control voltage sources, such as those derived from rectified alternating current, may contain sufficient inherent ripple to modify the operation of control devices to the extent that they may not function over the entire specified voltage ranges.
7. This table also applies for circuit breakers in gas-insulation substation installations.
8. For an outdoor circuit breaker, the point of user connection to the circuit breaker is the secondary terminal block point at which the wires from the circuit breaker operating mechanism components are connected to the user's control circuit wiring.
9. In cases where other operational ratings are a function of the specific control voltage applied, tests in C37.09 may refer to the "Rated Control Voltage." In these cases, tests shall be performed at the levels in this column.
10. For an indoor circuit breaker, the point of user connection to the circuit breaker is either the secondary disconnecting contact (where the control power is connected from the stationary housing to the removable circuit breaker), or the terminal block point in the housing nearest to the secondary disconnecting contact.
11. Some solenoid operating mechanisms are not capable of satisfactory performance over the range of voltage specified in the standard; moreover, two ranges of voltage may be required for such mechanisms to achieve an acceptable standard of performance.

12. The preferred method of obtaining the double range of closing voltage is by use of tapped coils. Otherwise, it will be necessary to designate one of the two closing voltage ranges listed above as representing the condition existing at the device location due to battery or lead voltage drop or control power transformer regulation. Also, caution should be exercised to ensure that the maximum voltage of the range used is not exceeded.

END OF SECTION

SECTION 26 09 23
LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 00 00 - General Electrical Requirements

B. Section 26 27 26 - Wiring Devices

C. Section 26 50 00 - Lighting

1.02 REFERENCE

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

1.03 DESCRIPTION OF SYSTEM

A. Provide devices such as wall box dimmers, wall and ceiling-mounted occupancy sensors, ambient light sensors, sensor power packs, etc., as shown on drawings.

B. Openings shall be covered with devices and matching plates.

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

1.04 REFERENCE STANDARDS

A. UL 20 - General Use Snap Switches.

B. UL 773A - Non-Industrial Photoelectric Switches for Lighting Control.

C. UL 924 - Emergency Lighting and Power Equipment

D. NEMA WD 7 - Occupancy Motion Sensors.

1.05 SUBMITTALS

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

B. Shop Drawings shall include:
   1. Bill of material
   2. Schematic diagrams
   3. Suggested manufacturer layouts of all devices including overlays of product range.

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

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

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

1.06 QUALITY ASSURANCE

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

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

1.07 DELIVERY, STORAGE, AND HANDLING

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

1.08 WARRANTY

A. Refer to Division 01 and Section 26 00 00 - General Electrical Requirements for general warranty requirements.

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

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers:
   1. Wall Box Dimmers: Wattstopper DCLV or equal
   2. Low Voltage Switches: Wattstopper LVSW series or equal
   3. Sensors and Power Packs: Wattstopper series BZ or equal
   4. Exterior Occupancy Sensors: Wattstopper EW-200-120-W or equal.
   5. UL 924 Emergency Bypass/Control Device: Wattstopper ELCU-200 or equal
   6. Exterior Photocells: Hubbell 5638
   7. Timeclocks: Intermatic T101P or equal
   8. Self-Contained Automatic Timer Switches: Wattstopper TS-400-W or equal

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

2.02 FABRICATION AND MANUFACTURE

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

2.03 WALL BOX DIMMERS

A. Dimmers shall:
   1. Operate in ambient temperature range of 32°F to 104°F.
   2. Be linear slide or pushbutton preset or programmable dimmers with power-failure memory.
   3. Incorporate separate control of intensity and ON/OFF.
   4. Include voltage compensation circuitry that adjusts firing angle of dimmer to compensate light output for variations in AC line voltage. Dimmers in which firing angle is held constant with varying AC line voltage shall not be acceptable.
   5. Provide smooth and continuous IESNA Square Law Dimming Curve throughout entire dimming range.
   6. Incorporate filter network to minimize interference (RFI) with radio, audio, and video equipment.
   7. Incorporate air-gap switch to meet requirements of UL 20 for air-gap switches in incandescent dimmers.

B. LED dimmers shall:
   1. Be approved for use with luminaire and driver.
   2. Provide smooth non-flicker dimming of controlled luminaires.
   3. Be 0-10V type, unless otherwise noted on drawings.
   4. Provide at least 10 steps for continuously dimmed luminaires.
   5. Refer to Section 26 50 00 - Lighting for solid state dimming ballast/driver specification.

2.04 LOW-VOLTAGE SWITCHES

A. Low voltage switches shall:
   1. Mount in a single or double gang box.
   2. Be capable of multi-way switching.

2.05 OCCUPANCY AND VACANCY SENSORS

A. Sensors shall:
   1. Operate with all solid-state ballasts/drivers.
   2. Operate with ultrasonic, microphonic, passive infrared or presence technologies as indicated on drawings.
   3. Have visible LED to indicate occupant detection.
   4. Have adjustable time delay or remote relay with a maximum setting of 30 minutes and adjustable sensitivity.

5. Contain isolated relay with normally open, normally closed, and common outputs for use with HVAC system, data logging, controlled receptacles or other system control options where indicated in contract documents.
6. Be provided with ceiling, wall or wall switch style mounting as indicated on drawings.
7. Have daylight filter to ensure PIR sensor is insensitive to short-wavelength waves emitted by the sun.
8. Incorporate by-pass switch to enable lighting to be turned on if sensor fails.
9. Be low voltage wired in parallel to common power pack

B. Occupancy Sensor shall:
1. Provide automatic ON, automatic OFF operation where indicated on drawings.

C. Vacancy Sensor shall:
1. Provide manual ON, automatic OFF operation where indicated on drawings.

D. Partial-ON Occupancy Sensor shall:
1. Provide automatic ON for a portion of the luminaires within a space and automatic OFF for all luminaires within a space where indicated on drawings. The additional luminaires within a space will be controlled ON manually, but will be forced OFF when occupancy is not detected.

E. Partial-OFF Occupancy Sensor shall:
1. Provide manual ON, automatic OFF for a portion of the luminaires within an area where indicated on drawings.

2.06 POWER PACKS

A. Sensor power packs shall:
1. Be self-contained transformer relay modules.
2. Have universal rated voltage inputs 120-277 VAC, 60 Hz.
3. Have normally closed dry contacts rated for switching 120-277 volts, 60 Hz. 20 amp loads. Provide 24VDC output capable of controlling low-voltage occupancy sensors.

2.07 EXTERIOR OCCUPANCY SENSORS

A. Exterior occupancy sensors shall:
1. Be a completely self-contained device capable of detecting presence in the controlled range by detecting changes between infrared energy in motion and the background space.
2. Utilize passive infrared detection technology and a three level Fresnel lens to increase detection density and accuracy of motion detection.
3. Be capable of mounting vertically or horizontally onto a standard outdoor junction box or integral to exterior luminaires.
4. Cover up to 35 ft with a field of view of 180 degrees or 52.5 ft with a field of view of 270 degrees.
5. Have an operating temperature range of -40°F to 130°F.
6. Be IP66 rated for outdoor applications.
7. Include a built-in light level sensor, adjustable by the user that will keep lights from turning on during daylight hours.

8. Have user-adjustable time delay settings, including an override ON option that enables controlled lights to be turned on remotely for the length of the time delay.
9. Be compatible with all electronic ballasts and LED drivers with no minimum load requirements.
10. Provide continuous dimming control to reduce electric light levels from a minimum of 40% to a maximum of 80% based on area occupancy.

2.08 UL 924 EMERGENCY BYPASS/CONTROL DEVICES

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

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

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

2.09 EXTERIOR PHOTOCELLS

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

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

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

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

E. Enclosure shall include positioning lug on top.

F. Mounting shall be for 1/2” conduit nipple.

2.10 TIMECLOCKS

A. Timeclocks shall:
   1. Be multi-purpose, 7-day, 365-day advance single and skip a day, combination 2-channel electronic astronomical time clock with SPDT switching configuration.
   2. Have universal rated voltage inputs 120-277 VAC, 60 Hz.
   3. Be capable of programming in AM/PM or 24-hour format by jumper selection or digital setting, in one-minute resolution, using 2 buttons for basic settings.
   4. Have 365-day and/or holiday selection capabilities, with 16 single date and 5 holiday selection options and user selectable daylight savings/standard time functions.
   5. Have 72-hour memory backup with rechargeable battery and charger.
   6. Have manual override, ON/OFF to the next scheduled event, using one button for each channel.
   7. Have operational temperature range of -40°F to 150°F.
   8. Have a maximum allowed over-ride period no greater than 2 hours.

B. Contacts shall be rated 10 amp resistive at 120/250 VAC, 7.5 amps inductive at 120/250 VAC, 5 amps inductive at 30 VDC and up to 1/2 hp at 250 VAC.

C. Display shall be LCD type.

D. Enclosure shall be rated for installation location.

2.11 SELF-CONTAINED AUTOMATIC TIMER SWITCHES

A. Timer switches shall:
   1. Have universal rated voltage inputs 120-277 VAC, 60 Hz.
   2. Be programmable to turn lights OFF after a preset time.
   3. Have a ground wire and ground strap for safety with a latching air gap relay switching mechanism.
   4. Use Zero Crossing Circuitry to increase the relay life, protect from the effects of inrush current.
   5. Be compatible with all electronic ballasts, motor loads, LEDs and LED drivers, compact fluorescent and inductive loads. Triac and other harmonic generating devices shall not be allowed.
   6. Have no minimum load requirement and shall be capable of controlling 0 to 800 watt incandescent, fluorescent @ 100/120 VAC, 50/60 Hz; 0 to 1200 watts fluorescent @ 230/277 VAC, 50/60 Hz; 1/6 hp @ 125 VAC. LED with internal or external driver@ 100/120VAC.
   7. Have the option for light flash warning at five minutes before the timer runs out and again when the countdown reaches one minute.
   8. Have the option for a beep warning that shall sound every five seconds once the time switch countdown reaches one minute.
   9. Have manual feature for timer reset where pressing the ON/OFF switch for more than 2 seconds resets the timer to the programmed time-out period.
   10. Have a feature that shows the timer's countdown.
   11. Have the calibration switch for setting time-out, time scroll, one second light flash, and beep warning shall be concealed to prevent tampering of adjustments and hardware.
   12. Have a maximum allowed over-ride period no greater than 2 hours.
   13. Be capable of operating as an ON/OFF switch.
   14. Utilize terminal style wiring.

15. Have a 100% OFF override switch with no leakage current to the load.

2.12 FINISHES

A. Color:
   1. Wall box dimmers, low-voltage switches, occupancy sensors, ambient light sensors and device cover plates: Match the colors required by Section 26 27 26 Wiring Devices.

PART 3 - EXECUTION

3.01 INSTALLATION

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

B. Install wall devices vertically on latch side of door within 6” of frame edge, unless otherwise noted.

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

D. Ceiling mounted occupancy sensors shall be located minimum of 6 ft from supply air diffusers.

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

F. Verify device locations prior to rough in.

G. Control wiring shall be low voltage, Class II wiring, electrically isolated from power wiring by a Class II transformer.

H. Provide separate neutral conductor for each dimmer.

I. Provide remote power pack and isolated relay outputs where wall switch style mounting is specified.

J. Wiring shall be in conduit.

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

3.02 TESTING

A. Verify proper location and operation of all devices.

B. Verify dimmers function without:
   1. Producing lamp flicker or audible noise.
   2. Interference of audio and visual equipment.

C. Adjust occupancy sensors for a 30 minute time delay.

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

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

END OF SECTION

SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems

C. Section 26 05 29 - Hangers and Supports for Electrical Systems

D. Section 26 05 33 - Raceway and Boxes for Electrical Systems

E. Section 26 05 48 - Vibration Controls For Electrical Systems

F. Section 26 05 53 - Electrical Systems Identification

G. Section 26 08 12 - Power Distribution Acceptance Tests

H. Section 26 08 13 - Power Distribution Acceptance Test Tables

1.02 REFERENCE

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

1.03 DESCRIPTION

A. Section includes dry type distribution and buck-boost transformers rated 600V and less, with capacities up to 300 kVA.

1.04 REFERENCE STANDARDS

A. ANSI/NECA 1 – Standard Practices for Good Workmanship in Electrical Contracting

B. IEEE C57.12.91 – Test Code for Dry Type Distribution and Power Transformers

C. NEMA EN 10250 – Enclosures for Electrical Equipment (1000 Volts Maximum)

D. NEMA ST 1 – Specialty Transformers (except General Purpose Type)

E. NEMA ST 20 – Dry-Type Transformers for General Applications

F. NFPA 70 – National Electrical Code

G. UL 506 – Specialty Transformers

H. UL 1561 – Dry-Type General Purpose and Power Transformers

I. 10 CFR 431, Subpart K (a) (2) – Energy Conservation Standards and Their Effective Dates

1.05 SUBMITTALS

A. Product Data:
   1. Include rated nameplate data, capacities, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings:
   1. For each transformer size and type:
      a. Physical dimensions, including bolting templates, weight, and center of gravity
      b. Loads, method of field assembly, components, and location and size of each field connection
      c. Wiring Diagrams: Power, signal, and control wiring
      d. kVA rating
      e. Primary taps
      f. Insulation class and temperature rise
      g. Efficiency values measured at 0, 25, 50, 75, and 100% load
      h. Impedance value – X/R and %Z
      i. Sound level
      j. “K” factor listing, where applicable

C. Submit 1/4” scale electrical room floor plans with transformer locations.

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

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

F. Output Settings Report: Record output voltages and tap settings.

G. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual locations of transformers.
   2. Operation and Maintenance Data:
      a. Include manufacturer’s recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.

1.06 QUALITY ASSURANCE

A. Refer to Division 01, Section 01 4000 - Quality Requirements

B. Obtain transformers from one source and by single manufacturer.

C. Regulatory Requirements:
   1. Comply with NFPA 70 for components and installation.

2. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

D. Certifications:

1. Furnish Contracting Officer with manufacturer's Ultra Quiet Transformers Sound Level Certification, where applicable: Submit certification that ultra quiet transformers have sound level not exceeding 35 dB. Submit for each ultra quiet transformer. Include the following:
2. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculations.

1.07 DELIVERY, STORAGE, AND HANDLING

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

B. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.08 WARRANTY

A. Refer to Section 26 00 00 - General Electrical Requirements for general warranty requirements.

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

PART 2 - PRODUCTS

2.01 DISTRIBUTION TRANSFORMERS

A. Salient Characteristics

1. Physical:
   a. Factory assembled and tested
   b. Two winding dry type
   c. Coils:
      1) Continuous wound construction and impregnated with non-hydroscopic, thermosetting varnish.
      2) Conductors: Continuous windings without splices, except for taps, and encapsulated wire resin compound to seal out moisture and air.
      3) Materials: Copper
      4) Separate primary and secondary
      5) Internal Connections: Braised or pressure type
   d. Cores: High-grade silicon steel, non-aging, with high magnetic permeability, low eddy current losses and low hysteresis. Magnetic flux densities below saturation point. Core laminations clamped with steel members, one leg per phase.
   e. Rubber vibration absorbing mounts to isolate base of enclosure from core and coil assembly.

f. Transformer neutral visibly grounded to enclosures with flexible grounding conductor.

g. Enclosure:

1) Type 2, unless otherwise indicated to comply with environmental conditions at installed location.

2) Code-gauge steel panel over core and coil.

3) Ventilated (air-cooled): Louvered openings for convection cooling.

4) Cooling and terminal chamber access with both sides and rear obstructed.

5) Manufacturer's lifting eyes or brackets.

h. Lugs:

1) Manufacturer's primary and secondary bolted lugs: labeled for 75°C copper and aluminum conductors for ventilated enclosures and labeled for 90°C copper and aluminum conductors for non-ventilated enclosures.

2) Connections at sides near bottom, accessible from front of cabinet.

2. Functional:

a. NEMA ST 20, UL 1561

b. Air-cooled, for 60Hz Service

c. Enclosure: NEMA EN 10250

d. Ratings:

1) KVA Rating: 300kVA maximum

2) Primary Voltage: 480V, 3-phase, 3 wires

3) Secondary Voltage: 208Y/120V, 3-phase, 4 wires

4) Insulation Class and Winding Temperature Rise:

a) Transformers 15kVA and smaller: Class 185°C, with 115°C temperature rise above 40°C ambient temperature, capable of carrying 15% continuous overload without exceeding 150°C rise.

b) Transformers 25kVA – 112.5kVA: Class 220°C, with 115°C temperature rise above 40°C ambient temperature, capable of carrying 15% continuous overload without exceeding 150°C rise.

c) Transformers above 112.5kVA: Class 220°C, with 80°C temperature rise above 40°C ambient temperature, capable of carrying 30% continuous overload without exceeding 150°C.

5) Top of Enclosure Temperature: Maximum 35°C above 40°C ambient temperature at warmest point at full load.

6) K-Factor Rating: UL 1561, as indicated.

e. Primary Taps

1) Transformers rated less than 3kVA: One 5% tap above normal full capacity

2) Transformers rated 3kVA - 15kVA: One 5% above and one 5% below normal full capacity

3) Transformers rated 15kVA and larger: Two 2.5% above and two 2.5% below normal full capacity, minimum of four taps.

f. Electrostatic Shielding, where indicated: Each winding with an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.

1) Coil leads and terminal strips arranged to minimize capacitive coupling between input and output terminals.
2) Special terminal included for grounding the shield.

3. Performance:
   a. Energy Efficiency:
      1) Transformers rated 15kVA and larger, except K-rated, quiet type and ultra quiet type: 10 CFR 431, Subpart K .196 (a) (2) compliant
   b. Sound Levels:
      1) NEMA ST 20, maximum average sound levels as follows:
         a) 45 dB for general-purpose transformer sizes less than 51kVA.50 dB for general-purpose transformer sizes 51-150kVA.55 dB for general-purpose transformer sizes 151-300kVA.
         b) 50 dB for general-purpose transformer sizes 51-150kVA.
         c) 55 dB for general-purpose transformer sizes 151-300kVA.
      2) Minimum of 3 dB less than NEMA ST 20. Maximum average sound levels when factory tested according to IEEE C57.12.91 as follows:
         a) 42 dB for quiet type transformer sizes less than 51kVA.
         b) 47 dB for quiet type transformer sizes 51-150kVA.
         c) 52 dB for quiet type transformer sizes 151-300kVA.
      3) Maximum average sound levels, when factory tested according to IEEE C57.12.91as follows:
         a) 35 dB for ultra quiet transformers, for all sizes through 300kVA.
      4) Shield Effectiveness:
         a) Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
         b) Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
         c) Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.

2.02 BUCK-BOOST TRANSFORMERS

A. Salient Characteristics
   1. Physical:
      a. Same as distribution transformers, except with wiring terminals suitable for connections as autotransformer.
      b. Enclosure: Ventilated, NEMA EN 10250, Type 2.
         1) Finish Color: Gray enamel over prime coat
   2. Functional:
      a. Same as distribution transformers, except rated for continuous duty.
   3. Performance:
      a. NEMA ST 1, UL 506, UL 1561

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine conditions for compliance with enclosure and ambient temperature requirements for each transformer.

B. Examine areas and surface to receive transformers for compliance with requirements, installation tolerances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Verify space indicated for transformers' mounting meets code-required working clearances.

D. Notify Contracting Officer of any discrepancies prior to submittal of product data and shop drawings.

E. Verify that ground connections are in place and requirements in Section 26 05 26 - Grounding and Bonding for Electrical Systems have been met.

F. Verify with manufacturer that "touch-up" paint kit is available for repainting.

3.02 INSTALLATION

A. Install transformers in accordance with ANSI/NECA 1.

B. Install level and plumb within 1/2 degree, and at least 6" from the adjacent wall or structure to ensure proper ventilation, in accordance with manufacturer's written instruction, and in compliance with recognized industry practices.

C. Transformer mounting and vibration control:
   1. Install transformer anchorage devices and vibration control based on design by an Engineer registered and licensed in the State of New York, and to comply with Section 26 05 48 - Vibration Controls For Electrical Systems.
   2. Mount transformers as indicated.
   3. Floor mounting:
      a. Secure to floor via isolation pads between floor brackets (per manufacturer recommendations) and transformer.
      b. Mount on spring isolator.
   4. Wall mounting:
      a. Secure to concrete-and-block wall via isolation pads between wall brackets (fabricated by manufacturer) and transformer.
      b. Secure to gypsum walls with independent steel slotted channel supports, secured to floor via isolation pads between wall brackets (fabricated by manufacturer) and transformer.
      c. Mount on spring isolator.
   5. Suspended mounting:
      a. Suspend transformer enclosures designed for floor mounting, where suspended from structural ceiling, via trapeze constructed of steel slotted channel support system hung via 3/8" minimum steel threaded hanger rods attached to structural members or inserts in structural slab. Each rod to contain spring isolator ceiling hanger. Use locking type nuts in assembly.

b. Install restraint cables sway bracing sized to resist a horizontal force of 162% of the operating weight acting in any direction for normal power transformers and 212% of the operating weight for emergency/standby power transformers.

c. Anchor and fasten transformers and their supports to building structural elements by the methods described in Section 26 05 29 - Hangers and Supports for Electrical Systems.

D. Install engraved plastic nameplates under provisions of Section 26 05 53 - Electrical Systems Identification. Attach nameplate to transformer using small, corrosion-resistant metal screws or rivets. Do not use contact adhesive.

1. Indicate kVA rating, voltage/phase rating, taps, insulation class and temperature rise, impedance value, sound level, and K-factor listing.

E. Install conduit per requirements in Section 26 05 33 - Raceway and Boxes for Electrical Systems.

F. Install transformer in dedicated electrical space per NFPA 70 and as shown on drawings. Coordinate with miscellaneous trades for equipment foreign to the electrical installation to be outside of dedicated electrical space.

3.03 CONNECTIONS

A. Ground transformers according to Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Connect wiring according to Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.

3.04 FIELD QUALITY CONTROL

A. Inspect transformers for physical damage, proper alignment, anchorage, grounding, connections, and installation.

B. Test transformers per requirements in Sections 26 08 12 - Power Distribution Acceptance Tests and 26 08 13 - Power Distribution Acceptance Test Tables.

C. Interpret test results in writing and submit to Contracting Officer.

D. Output Settings Report: Prepare a written report recording output voltages and tap settings and submit to Contracting Officer.

3.05 REPAINTING

A. Remove paint splatters and other marks from surface of equipment.

B. Touch-up chips, scratches, or marred finishes to match original finish, using manufacturer-supplied paint kit. Leave remaining paint with Contracting Officer.

3.06 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10% and not being lower than nameplate voltage minus 3% at maximum load conditions.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5%, at secondary terminals.

3.07 CLEANING

A. Vacuum dirt and construction debris from interior and exterior of equipment; do not use compressed air to assist in cleaning.

END OF SECTION

SECTION 26 24 13
SWITCHBOARDS

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems

C. Section 26 05 29 - Hangers and Supports for Electrical Systems

D. Section 26 05 48 - Vibration Controls For Electrical Systems

E. Section 26 05 53 - Electrical Systems Identification

F. Section 26 05 73 - Power System Studies

G. Section 26 08 12 - Power Distribution Acceptance Tests

H. Section 26 08 13 - Power Distribution Acceptance Test Tables

I. Section 26 27 13 - Electrical Metering

J. Section 26 28 13 - Fuses

K. Section 26 43 00 - Surge Protective Devices (SPD)

1.02 REFERENCE

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

1.03 DESCRIPTION

A. Section includes free-standing, dead-front type low-voltage distribution switchboards.

1.04 REFERENCE STANDARDS

A. ANSI/IEEE C37.13 – Low-Voltage AC Power Circuit Breakers Used in Enclosures

B. ANSI/NECA 400 – Recommended Practice for Installing and Maintaining Switchboards

C. IEEE C62.41.1 Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits

D. IEEE C62.41.2 Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

E. NFPA 70 – National Electrical Code

F. NEMA AB 1 – Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures

G. NEMA AB 3 – Molded-Case Circuit Breakers and Their Applications

H. NEMA FU 1 – Low-Voltage Cartridge Fuses

I. NEMA BS 31047 – Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

J. NEMA PB 2 – Dead-Front Distribution Switchboards

K. NEMA PB 2.1 – General Instructions for Proper Handling, Installation and Maintenance of Dead-Front Distribution Switchboards Rated 600 Volts or Less

L. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

M. UL 98– Enclosed and Dead-Front Switches

N. UL 486A-486B – Wire Connectors

O. UL 489 – Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

P. UL 869A – Reference Standard for Service Equipment

Q. UL 891 – Dead-Front Switchboards

R. UL 1053 – Ground-Fault Sensing and Relaying Equipment

S. UL 1066 – Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures

1.05 SUBMITTALS

A. Product Data: For each switchboard, components and accessories indicated:
   1. Include data on features and components and complete description; submit catalog cut sheets showing voltage, size, rating and size of surge protective devices, switching and overcurrent protective devices.
   2. Features, characteristics, factory settings and time-current curves of individual protective devices, auxiliary components and ground fault relaying.

B. Shop Drawings:
   1. For each switchboard specified in this Section:
      a. General Arrangement:
         1) Indicate front, plan, and side views of switchboards; access requirements (front, side, rear); overall dimensions and components list; shipping splits and weights.
         2) Front elevation indicating location of devices and instruments.
         3) Sections through switchboard showing space available for conduits.
      b. Conduit entrance locations and requirements.
      c. Nameplate legends.
      d. Configuration, size and number of bus bars for each phase and current rating of buses.
      e. Ground bus.
      f. Neutral bus.

g. Short circuit ratings of switchboards and overcurrent protective devices, and bus withstand rating.

h. Instrument details; enclosure types and details.

i. Wiring diagrams: power, signal and control wiring.

j. Utility company's metering provisions with indication of approval by utility company.

k. Descriptive documentation of optional barriers specified for electrical insulation and isolation.

l. UL listing for series rating of installed devices.

2. Contractor to submit 1/4" scale floor plans with switchboard locations and required clearances and service space around equipment.

C. Manufacturer's Installation Instructions:

1. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

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

E. Complete review of this specification noting for each paragraph whether proposed equipment complies with project specifications or deviates. Justification must be given for each deviation.

F. Closeout Submittals:

1. Project Record Documents:

a. Record actual locations, configurations, and ratings of switchboard and major components on single-line diagrams and plan layouts.

2. Operation and Maintenance Data:

a. Include manufacturer's recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.

b. Include manufacturer's written instructions for testing and adjusting overcurrent protective devices.

c. Include spare parts data listing, source, and current prices of replacement parts and supplies.

d. Include time-current curves, including selectable ranges for each type of overcurrent protective device.

1.06 QUALITY ASSURANCE

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

B. Regulatory Requirements:

1. Comply with NFPA 70 for components and installation.

2. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, fumes, water, corrosive substances, construction debris, and traffic. Provide temporary heaters in switchboards as required to prevent condensation.

B. Deliver switchgear in 48" maximum width shipping splits. , individually wrapped for protection, and mounted on shipping skids. Mark crates, boxes, and cartons clearly to identify equipment. Show crate, box, or carton identification number on shipping invoices.

C. Handle switchboards in accordance with NEMA PB 2.1 and ANSI/NECA 400. Use factory-installed lifting provisions. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.08 WARRANTY

A. Refer to Division 01 and Section 26 00 00 - General Electrical Requirements for general warranty requirements.

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

1.09 MAINTENANCE

A. Extra Materials: Furnish extra materials described below that match product installed, are packaged with protective covering for storage, and are identified with labels describing contents.
   1. Potential Transformer Fuses: Equal to 10% of amount installed for each size and type, but no fewer than 2 of each size and type.
   2. Control-Power Fuses: Equal to 10% of amount installed for each size and type, but no fewer than 2 of each size and type.
   3. Indicating Lights: Furnish quantity equal to 10% of amount installed for each size and type, but no fewer than 2 of each size and type.

PART 2 - PRODUCTS

2.01 SALIENT CHARACTERISTICS

A. Salient Characteristics
   1. Physical
      a. Free-standing, dead-front type; vertical sections bolted together; sides and rear covered with removable bolt-on covers; adequate ventilation within enclosure; supporting frame: steel channels rigidly fastened together, with same outside dimensions as the enclosure.
      b. Adequate strength and rigidity necessary to resist conditions of use to which it may be subjected and to support equipment, devices and appurtenances contained therein.
      c. Barriers shall be placed such that no uninsulated, ungrounded service busbar or service terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations.
      d. Incoming lug locations: Top, or, and bottom, as applicable per drawings.
      e. Connection to the supply source by conduit and wire.
      f. UL service entrance label.
      g. Front accessible switchboard: Front and rear aligned for placement against the wall:
         1) Main and tie device: Fixed mounted molded case circuit breaker.
         2) Feeder devices: Panel mounted molded-case circuit breakers.

3) Devices: Front removable; load connections: Front accessible.

h. Bus Material: Copper with silver plating; copper: 98% conductivity. The bus bars shall have sufficient cross-sectional area to meet UL 891 temperature rise requirements through actual tests. The bus bars shall be standard density rated for 1000 amperes per square inch copper.

2. Functional
   a. Construction: NEMA PB 2, UL 891
   b. Enclosure: Steel, NEMA EN 10250, Type 1
3. Performance
   a. Nominal system voltage: 480Y/277V
   b. Main bus continuous amp: As indicated on the drawings or scheduled.
   c. Short circuit current rating: as indicated on drawings
   d. Ambient temperatures: Not exceeding 40°C.
   e. Altitude: Not exceeding 6500 ft
   f. Temperature rise: Not to exceed 65°C over a 40°C ambient environment, with no derating required.

2.02 CONSTRUCTION

A. Bus:
1. Connections:
   a. Bolted:
      1) Not fewer than 4 bolts for each 4” x 4” contact.
      2) Not fewer than 2 bolts for each 2” x 2” contact.
      3) Grade 5 bolts and conical spring-type washers.
      4) Clamp joints are not allowed.
2. Sizing: Standard size, based on 65°C over 40°C.
3. Main Phase Buses: Three phase, 4 wire; fully rated; uniform capacity for entire length of switchboard; ampacity as indicated on drawings; rated for the main protective device frame size or main incoming conductors.
4. All feeder device line and load connection straps: Rated to carry current rating of device frame (not trip rating).
5. Support for Buses: Mounted on high-impact, non-tracking insulated supports; joints in the vertical bus are not permitted.
6. Bus arrangement: A-B-C (left to right, top to bottom, front to rear).

B. Ground Bus: Insulated, extend length of switchboard.
1. 1/4” x 2” minimum-size, hard-drawn copper of 98 percent conductivity, equipped with pressure connectors for feeder ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection.

C. Neutral Bus: 100% of the ampacity of phase buses, as indicated on drawings, equipped with pressure connectors for outgoing circuit neutral cables. Bus extensions for busway feeder neutral bus are braced.

D. Main incoming compartment.
   1. Hinged Front Doors: Allow access to metering and accessory compartments; concealed hinges; fastened by head bolts.

E. Cable Supports: For each vertical section.

F. Vertical Insulating Barrier: Between the device compartment and bus compartment.

G. Vertical Insulating Barrier: Between the bus compartment and cable compartment.

H. Barriers: Between adjacent sections.

I. Hinged Front Doors: Over device compartments, with concealed hinges and fastened by hex head bolts.

J. Bus Connections: Extend from load side of devices into rear compartment for connections to outgoing cables.

K. All buswork shall have 30 cycles withstand rating.

L. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
   1. Pull Section: 40", depth and height to match switchboard Arrange as indicated on drawings.

M. Pull Box on Top of Switchboard:
   1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
   2. Removable top, front, and sides, same construction as switchboard.
   3. Insulating, fire-resistive bottom with separate holes for cable drops into switchboard.
   4. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

N. Future Provisions: Fully equip spaces for future devices with bussing, mounting brackets, supports, and appurtenances, insulated and braced for short circuit currents, with continuous current rating as indicated on drawings. Extension of phase, neutral, and ground buses from both ends.

O. Adequate lifting means.

P. Dimensions: 90" maximum height, excluding floor sills, lifting members and pull boxes. Length and depth indicated noted on the drawing are maximum allowed.

Q. Line and Load Terminations: Mechanical type accessible from front only of switchboard, labeled for 75°C copper and aluminum conductors; suitable for number, size and trip ratings.

2.03 SERVICE ENTRANCE

A. UL 869A

B. Switchboards labeled as suitable for use as service entrance equipment, where applicable, with incoming line isolation barriers, and a removable neutral bond to switchboard ground for solidly grounded wye systems.

C. Surge arrestors on all phases: per requirements in Section 26 43 00 - Surge Protective Devices (SPD).

2.04 SHORT CIRCUIT CURRENT RATING

A. Each switchboard with minimum short circuit current rating as indicated on drawings.

B. Switchboards: Marked with their maximum short circuit current rating at supply voltage.

C. Switchboards: Fully rated

2.05 SURGE PROTECTIVE DEVICES (SPD)

A. By switchboard manufacturer.

B. IEEE C62.41.1; integrally mounted, plug-in style, solid-state, parallel-connected, suppression and filtering modules

C. Per requirements in Section 26 43 00 - Surge Protective Devices (SPD)

2.06 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 1, NEMA AB 3, UL 489; lockable handle; interrupting capacity to meet available fault current.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit breaker frame sizes 225 A and below.
   2. Electronic (solid-state microprocessor based) trip unit circuit breakers: digital true RMS sensing trip units; interchangeable in the field within the frame size (field-replaceable rating plug to determine the breaker trip rating), field-adjustable settings and the following trip functions for circuit breaker frame sizes 250 A - 1200 A:
      a. Instantaneous trip
      b. Long- and short-time pickup levels
      c. Long- and short-time time delay adjustments with I2t response
      d. Ground-fault pickup level, time delay, and I2t response
   3. Current-Limiting Circuit Breakers: No fusible element, frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

B. Molded-Case Circuit Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
   1. Undervoltage Trip: 120 V, set to operate at 35 to 75% of rated voltage without intentional time delay.
   2. Auxiliary Contacts: One SPDT switch with “a“ and “b“ contacts; “a“ contacts mimic circuit breaker contacts, “b“ contacts operate in reverse of circuit breaker contacts.
   3. Position: ON and OFF, clearly marked on escutcheon; trip-to-test means on the escutcheon for manually tripping the breaker and exercising the mechanism and trip latch.

C. Power Circuit Breaker and Accessories: ANSI/IEEE C37.13; UL 1066; metal frame; field interchangeable electrical accessories, including shunt trip, spring release, electrical operator, auxiliary contacts and trip unit.
   1. Ratings: As indicated for continuous, interrupting, and short-time current ratings for each circuit breaker; voltage and frequency ratings same as switchboard.

2. Operating Mechanism: Mechanically and electrically trip-free, stored-energy operating mechanism with the following features:
    a. Normal Closing Speed: Independent of both control and operator.
    b. Slow Closing Speed: Optional with operator for inspection and adjustment.
    c. Store-Energy Mechanism: Electrically charged, with optional manual charging.
    d. Means for manual opening and closing
    e. Operation counter
3. Trip Devices: Electronic (solid-state, microprocessor-based) overcurrent trip-device system consisting of one or two current transformers or sensors per phase, a release mechanism, and the following features:
    a. Functions: Long-time pickup and delay, short-time pickup and delay, ground-fault pickup and delay and instantaneous trip functions, independent of each other in both action and adjustment.
    b. Temperature Compensation: Ensures accuracy and calibration stability from 23°F to 104°F.
    c. Field-adjustable time-current characteristics.
    d. Current Adjustability: Dial settings and ratings plugs on trip units or sensors on circuit breakers, or a combination of these methods.
    e. Three bands, minimum, for long-time- and short-time-delay functions; marked “minimum,” “intermediate,” and “maximum.”
    f. Pickup Points: Five minimum, for long-time- and short-time-trip functions. Equip short-time-trip function for switchable I2t operation.
    g. Pickup Points: Five minimum, for instantaneous-trip functions.
    h. Trip Indication: Labeled, battery-powered lights or mechanical targets on trip device to indicate type of fault.
4. Auxiliary Contacts: For interlocking or remote indication of circuit breaker position, with spare auxiliary switches and other auxiliary switches required for normal circuit breaker operation. Each consists of two type “a” and two type “b” contacts wired through secondary disconnect devices to a terminal block in stationary housing; “a” contacts mimic circuit breaker contacts, “b” contacts operate in reverse of circuit breaker contacts.
5. Drawout Features: Circuit breaker mounting assembly equipped with a racking mechanism to position circuit breaker and hold it rigidly in connected, test, and disconnected positions. Include the following features:
    a. Interlocks: Prevent movement of circuit breaker to or from connected position when it is closed, and prevent closure of circuit breaker unless it is in connected, test, or disconnected position.
    b. Circuit Breaker Positioning: An open circuit breaker may be racked to or from connected, test, and disconnected positions only with the associated compartment door closed unless live parts are covered by a full dead-front shield. An open circuit breaker may be manually withdrawn to a position for removal from the structure with the door open. Status for connection devices for different positions includes the following:
        1) Test Position: Primary disconnect devices disengaged, and secondary disconnect devices and ground contact engaged.
        2) Disconnected Position: Primary and secondary devices and ground contact disengaged.
6. Arc Chutes: Readily removable from associated circuit breaker when it is in disconnected position and arranged to permit inspection of contacts without removing circuit breaker from switchboard.

7. Padlocking Provisions: For installing at least three padlocks on each circuit breaker to secure its enclosure and prevent movement of drawout mechanism.
8. Operating Handle: One for each circuit breaker capable of manual operation.
9. Electric Close Button: One for each electrically operated circuit breaker.
10. Undervoltage Trip Devices: Adjustable time-delay and pickup voltage.
11. Shunt-Trip Devices: Where indicated.
12. Indicating Lights: To indicate circuit breaker is open or closed, for main and bus tie circuit breakers interlocked with each other or with exterior devices.
13. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground fault protection function, and/or short time function.
14. Control Voltage: 24 V DC
15. Trip Voltage: 120 V AC, close and charge
16. Listed for 100% of breaker's continuous ampere rating.

D. Circuit Breaker Electronic Trip Units general characteristics:
1. Circuit breakers, with solid-state microprocessor based trip units:
   a. Unit shall consist of current sensors, solid-state trip device, and solid-state adjustable time/current curve shaping elements.
   b. Trip units shall be removable to allow for field upgrades.
   c. Trip units shall incorporate "True RMS Sensing."
2. Solid-state elements shall provide functions as indicated above.
3. Adjustments shall be made using non-removable, discrete steps.
4. Sealable transparent cover shall be provided over adjustments.
5. Adjustable long-time pickup (Ir) and delay shall be available in an adjustable rating plug that is UL listed as field-replaceable. Adjustable rating plug shall allow for five minimum long-time pickup settings from 0.4 to 1.0 times the sensor plug (In). Other adjustable rating plugs shall be available for more precise settings to match the application. Long-time delay settings shall be at least three bands.
6. Short-time pickup shall allow for five minimum settings from 1.5 to 10 times Ir. Short-time delay shall be at least three bands with I2t ON and OFF.
7. Instantaneous settings on the trip units shall be available in five minimum bands from 2 to 15 times In. The instantaneous settings shall also have an OFF setting when short-time pickup is provided.
8. Trip units shall have the capability to electronically adjust the settings locally and remotely to fine increments below the switch settings. Fine increments for pickup adjustments are to be one ampere. Fine increments for delay adjustments are to be one second.
9. Trip unit shall indicate:
   a. Long-time fault
   b. Short-time fault
   c. Instantaneous fault
   d. Ground fault, where provided
10. Trip unit shall provide local trip indication and capability to indicate local and remote reason for trip, i.e., overload, short circuit or ground fault.
11. Trip unit shall contain means to conduct circuit breaker test, or via separate test kit.
12. Breaker shall be equipped with externally accessible test points to be used for field testing.

13. Trip units shall be available to provide real time metering. Metering functions include current, voltage, power and frequency.
14. Trip units shall be provided with the following standard features:
    a. True RMS sensing
    b. LSIG/Ground-fault trip
    c. Adjustable rating plugs
    d. LCD or LED – Long-time pickup
    e. LCD or LED – Trip indication
    f. Digital Ammeter
    g. Communications
    h. LCD dot matrix display
    i. Advanced user interface
    j. Protective relay functions
    k. Neutral protection
    l. Incremental fine tuning of settings
    m. Selectable long-time delay bands
    n. Power measurement
    o. Maximum peak demand (measure of average power over a 15-minute period) continuously recorded over a one-year period

E. Ground Fault protection equipment on breakers, where indicated: Integrally mounted relay and trip unit, push-to-test feature and ground fault indicator:
1. Ground-fault protection with at least three adjustable short-time delay settings and three trip-time delay bands; adjustable current pickup with maximum setting of 1200 amps. Arrange to provide protection for the following:
    a. Four-wire circuit or system
2. Trip units shall be capable of the following types of ground-fault protection: zero sequence. Ground fault sensing systems shall be changed in the field.
3. Neutral current transformers shall be provided for 4-wire system.
4. Ground-fault settings for circuit breaker sensor sizes 1200 A or below shall be in nine bands from 0.2 to 1.0 times In. The ground-fault settings for circuit breakers above 1200 A shall be in minimum three bands up to 1200 A.

F. Arc Energy Reduction on breakers rated or adjustable to 1200A or larger.
1. Provide one of the following methods to reduce clearing time to less than the available arcing current:
    a. Energy Reducing Maintenance Switch (ERMS)

2.07 CONTROL POWER, COMPONENTS IDENTIFICATION, AND CONTROL WIRING

A. Control Circuits: 120 V, supplied through secondary disconnecting devices from control-power transformer.

B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

C. Control components mounted within assembly, such as relays, pushbuttons, switches, etc.: Suitably marked for identification, corresponding to appropriate designations on manufacturer's wiring diagrams.

D. Control Wiring: Factory installed, with bundling, lacing, and protection included; flexible conductors for #8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units; insulated locking spade terminals for all control connections, except where saddle type terminals, integral to a device; current transformer secondary leads, connected to short circuit terminal blocks; terminal blocks with suitable numbering strips for group of control wires leaving switchboard, with wire markers at each end of control wiring.

2.08 ACCESSORY COMPONENTS AND FEATURES

A. Furnish portable test set to test functions of solid-state trip devices without removal from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

B. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

C. Furnish one portable, floor-supported, roller-based, elevating carriage arranged for movement of circuit breakers in and out of compartments for present and future circuit breakers.

D. Furnish overhead circuit breaker lifting devices, mounted at top front of switchboard, with hoist and lifting yokes matching each drawout circuit breaker.

E. Furnish set of tools for manually charging circuit breaker stored energy device.

F. Lockout Devices: Circuit breakers with integral, lockout/tagout devices.

G. Provide energy-reducing maintenance switching with local status indicator for all breakers 1200A and higher.

2.09 CUSTOMER METERING

A. Per requirements in Section 26 27 13 - Electrical Metering.

PART 3 - EXECUTION

3.01 COORDINATION

A. Instruct manufacturer about the location of incoming lugs, i.e., top or bottom feed based on incoming feeder entrance location.

B. Coordinate installation of housekeeping concrete pad based on actual equipment supplied:
   1. Concrete: Per requirements in Division 03 – Concrete.
   2. Dimensions: Per requirements in Section 26 05 29 - Hangers and Supports for Electrical Systems.

C. Coordinate with miscellaneous trades for equipment foreign to the electrical installation to be outside of dedicated electrical space.

D. Coordinate utility company metering equipment requirements.

E. Verify with manufacturer that "touch-up" paint kit is available for repainting.

3.02 EXAMINATION

A. Examine areas and surface to receive switchboards for compliance with requirements, installation tolerances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Verify that space indicated for switchboard mounting meets code-required working clearances.

C. Notify Contracting Officer/Engineer of any discrepancies prior to submittal of product data and shop drawings.

3.03 INSTALLATION

A. Install switchboard in accordance with NEMA PB 2.1 and ANSI/NECA 400.

B. Switchboard mounting and seismic restraints:

1. Install switchboard anchorage devices based on design by an Engineer registered and licensed in the State of New York, and to comply with Section 26 05 48 - Vibration Controls For Electrical Systems for seismic criteria.
2. Bolt switchboards to concrete housekeeping pads, using anchor bolts in accordance with Section 26 05 29 - Hangers and Supports for Electrical Systems. Cast anchor bolt inserts into pads.

C. Install engraved plastic nameplates under provisions of Section 26 05 53 - Electrical Systems Identification for each switchboard, every instrument, overcurrent protective device and disconnect device. Attach nameplate to exterior of each switchboard using small corrosion-resistant metal screws and rivets. Do not use contact adhesive. Indicate switchboard manufacturer's name and drawing number, name, amperage, voltage, phase, number of wires, short circuit current rating (amp, RMS symmetrical and MVA 3-phase symmetrical) and momentary and fault-closing ratings (amp, RMS asymmetrical). For each overcurrent protective device and disconnect device, include circuit, load and area served, voltage/phase rating, and fuse size and type, when applicable.

D. Provide framed, printed operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of switchboards.

E. Install switchboards in dedicated electrical space per NFPA 70, and as indicated on drawings.

F. Tighten electrical connectors and terminal according to equipment manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

G. Install surge arrestors in cable termination compartments and connect to each phase of circuit, per requirements in Section 26 43 00 - Surge Protective Devices (SPD).

H. Connect surge protective devices to switchboard bus per requirements in Section 26 43 00 - Surge Protective Devices (SPD).

I. Tighten electrical connectors and terminals according to equipment manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

J. Apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.04 CONNECTIONS

A. Ground switchboards according to Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Connect power and control wiring according to Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.

3.05 FIELD QUALITY CONTROL

A. Inspect switchboards for physical damage, proper alignment, connections, anchorage, seismic restraints and grounding.

B. Test continuity of each circuit.

C. Test switchboards per requirements in Sections 26 08 12 - Power Distribution Acceptance Tests and 26 0813 – Power Distribution Acceptance Test Tables.

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

E. Test switch operators once after energizing.

3.06 REPAINTING

A. Remove paint splatters and other marks from surface of equipment.

B. Touch-up chips, scratches or marred finishes to match original finish, using manufacturer-supplied paint kit. Leave remaining paint with Owner.

3.07 ADJUSTING

A. Set field-adjustable circuit breakers trip settings or change the trip settings to values indicated on drawings or recommended by the overcurrent protective device coordination study per Section 26 05 73 - Power System Studies.

B. Field adjustments or changing of trip setting and adjustment or replacement of equipment to comply with Section 26 05 73 - Power System Studies; no additional cost to Owner.

3.08 CLEANING

A. Vacuum dirt and construction debris from interior and exterior of equipment; do not use compressed air to assist in cleaning.

3.09 DEMONSTRATION

A. Provide training session by manufacturer for one workday at a job location, to train the Owner's personnel in the operation and maintenance of switchboards.

END OF SECTION

SECTION 26 24 16.13
LIGHTING AND APPLIANCE PANELBOARDS

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems

C. Section 26 05 29 - Hangers and Supports for Electrical Systems

D. Section 26 05 33 - Raceway and Boxes for Electrical Systems

E. Section 26 05 48 - Vibration Controls For Electrical Systems

F. Section 26 05 53 - Electrical Systems Identification

G. Section 26 05 73 - Power System Studies

H. Section 26 08 12 - Power Distribution Acceptance Tests

I. Section 26 08 13 - Power Distribution Acceptance Test Tables

1.02 REFERENCE

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

1.03 DESCRIPTION

A. Section includes circuit breaker type lighting and appliance branch circuit panelboards as shown on drawings and as scheduled.

1.04 REFERENCE STANDARDS

A. NECA 407 - Recommended Practice for Installing and Maintaining Panelboards

B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

C. NEMA AB 1 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures

D. NEMA PB 1 - Panelboards

E. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less

F. NFPA 70 - National Electrical Code

G. UL 50 - Enclosures for Electrical Equipment

H. UL 67 - Panelboards

I. UL 486A-486B - Wire Connectors

J. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures

1.05 SUBMITTALS

A. Product Data:
   1. Submit catalog data showing specified features of standard products. Eliminate extraneous catalog data.

B. Shop Drawings:
   1. Submit for review prior to manufacture. Include complete description, front view, dimensions, voltage, main bus ampacity, circuit breaker arrangement and sizes, short circuit current rating, and factory settings of individual protective devices.
   2. Submit 1/4” scale electrical room floor plans with panelboard locations.
   3. Submit features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   4. Submit together with the power studies required by Section 26 0573 - Power System Studies.

C. Partial Submittals:
   1. Panelboards shall be submitted for review together. Partial submittals of panelboards are not acceptable and will be rejected.

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

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

F. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual locations of panelboards and record actual circuiting arrangements.
   2. Operation and Maintenance Data:
      a. Include manufacturer’s recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.
      b. Include manufacturer’s written instructions for testing and adjusting overcurrent protective devices.
      c. Include time-current curves and selectable ranges for each type of overcurrent protective device.
      d. Include spare parts data listing, source, and current prices of replacement parts and supplies.
      e. Include manufacturer’s Seismic Qualification Certification and Installation Seismic Qualification Certification.

1.06 QUALITY ASSURANCE

A. Refer to Division 01, Section 01 4000 - Quality Requirements

B. Obtain panelboards, overcurrent protective devices, components, and accessories from one source and by single manufacturer.

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

1.07 DELIVERY, STORAGE, AND HANDLING

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

B. Comply with NEMA PB 1.1 and manufacturer's written instructions.

1.08 WARRANTY

A. Refer to Section 26 00 00 - General Electrical Requirements for general warranty requirements.

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

1.09 MAINTENANCE

A. Extra Materials:
   1. Furnish Owner with two keys per panelboard.

PART 2 - PRODUCTS

2.01 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

A. Salient Characteristics
   1. Physical:
      a. Factory assembled.
      b. door-in-door construction.
      c. Incoming feeder lugs: copper conductors.
      d. Multiple lugs to match number of conductors per phase.
      e. Sub-feed (double) lugs, or feed-through lugs where indicated.
      f. Filler plates.
      g. Wiring terminals for field installed conductors: Pressure wire connectors, except wire-binding screws for #10 AWG or smaller conductors.
      h. Each panelboard with minimum short circuit current rating as indicated on drawings.
      i. Panelboards marked with their maximum short circuit current rating at supply voltage.

j. Panelboards: Fully rated

k. Buses:

1) Copper

2) Ground bus: uninsulated

3) Insulated neutral bus: 100 % of phase bus rating

l. Molded-Case Circuit Breakers:

1) Bolt-on type, labeled for 75 degree C copper and aluminum conductors

2) Bussing, device mounting hardware, and steel knockouts in dead front where “space” is indicated.

2. Functional:

a. Panelboard

1) NEMA PB 1, UL 67, UL 98

2) Bus ampere rating as scheduled

3) Ground bus bonded to panelboard cabinet

b. Molded Case circuit breaker

1) NEMA AB 1, UL 489

2) Quick-make, quick-break, with thermal-magnetic trip.

3) Common internal trip on multi-pole breakers. Handle-ties are not permitted.

4) Ampere rating as scheduled

5) Listed as Type SWD for lighting circuits

6) Listed as Type HACR for air conditioning equipment circuits

7) Tandem circuit breakers are not acceptable

8) Locks on trip handles where indicated.

9) Main breakers with shunt trip in laboratory branch circuit panels, where indicated.

10) Ground fault equipment protection (GFEP), rated 30 mA trip, to provide equipment protection for branch circuits feeding electrical heat tracing, where indicated

11) Ground fault circuit interrupter (GFCI), rated at 4-6 mA trip for protection of personnel, where indicated

c. Cabinet:

1) NEMA EN 10250, UL 50

2) NEMA 1, NEMA 3R (outdoor locations) enclosure

d. Surge protective device:

1) By panelboard manufacturer.

2) As indicated on drawings and as scheduled.

3) Per requirements in Section 26 43 00 - Surge Protective Devices (SPD)

3. Performance: Power distribution

PART 3 - EXECUTION

3.01 COORDINATION WITH MANUFACTURER

A. Instruct manufacturer about the location of additional wiring gutter space when required (i.e., top, bottom, right, left, or combination).

B. Instruct manufacturer about the location of main lugs or main circuit breaker (i.e., top or bottom feed based on incoming feeder entrance location).

C. Instruct manufacturer to provide multiple lugs where conductors in parallel or sub-feed (double) lugs or feed-through lugs are indicated.

D. Instruct manufacturer on the size of cross-connection cables for panelboards fed via sub-feed (double) lugs or feed-through lugs. Make cable size with ampacity equal to incoming feeder.

E. Verify that “touch-up” paint kit is available for repainting.

3.02 EXAMINATION

A. Verify that space indicated for panelboard mounting meets code-required working clearances and dedicated equipment space.

B. Notify Contracting Officer of any discrepancies prior to submittal of product data and shop drawings.

3.03 INSTALLATION

A. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.

B. Install panelboards plumb and rigid without distortion of box, in accordance with manufacturer's written instructions, and in compliance with recognized industry practices.

C. Panelboard mounting:

1. Install panelboard anchorage devices based on design by an Engineer registered and licensed in the State of New York, and to comply with Section 26 05 48 - Vibration Controls For Electrical Systems for seismic criteria.
2. Fasten panelboards firmly to walls and structural surfaces, ensuring they are permanently and mechanically anchored.
3. Anchor and fasten panelboards and their supports to building structural elements (wood, concrete, masonry, hollow walls and nonstructural building surfaces) by the methods described in Section 26 05 29 - Hangers and Supports for Electrical Systems.
4. Install two rows of steel slotted channel, with a minimum of 4 attachment points, for each panelboard section.
5. When not located directly on wall, provide support frame of steel slotted channel anchored to floor and ceiling structure.

D. Install top breaker handle a maximum of 6’-7” above finished floor or working platform with handle in its highest position.

E. Tighten electrical connectors and terminals according to equipment manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

F. Install as-built typewritten circuit directory in directory frame (to indicate installed circuit loads) mounted inside each panelboard door. Include description of connected loads, room number, room name, area, or item served for each branch circuit. Indicate motor names and horsepower as applicable. Cover circuit directory with colorless plastic. Coordinate with Owner to ensure that room numbers used in panel directory are final numbers assigned by Owner.

G. Install engraved plastic nameplates under provisions of Section 26 05 53 - Electrical Systems Identification. Attach nameplate to exterior of each panelboard using small metal screws or rivets. Do not use contact adhesive.

1. Include panelboard name, amperage, voltage, phase, and number of wires.

H. Label spare circuits as SPARE. Leave spare breakers in OFF position.

I. Room numbers used shall be those used by Owner.

J. Install panelboard in dedicated electrical space per NFPA 70 and as shown on drawings. Coordinate with miscellaneous trades for equipment foreign to the electrical installation to be outside of dedicated electrical space.

K. Install filler plates in unused spaces.

3.04 CONNECTIONS

A. Ground panelboards according to Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Connect wiring according to Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.

3.05 FIELD QUALITY CONTROL

A. Inspect for physical damage, proper alignment, anchorage, and grounding.

B. Maintain proper phasing for multi-wire circuits.

C. Test main circuit breakers in accordance with requirements in Sections 26 08 12 - Power Distribution Acceptance Tests and 26 08 13 - Power Distribution Acceptance Test Tables.

D. Interpret test results in writing and submit to Owner.

E. Check phase-to-phase and phase-to-ground insulation resistance levels prior to energization of panelboards.

F. Check panelboards for electrical continuity of circuits and for short-circuits prior to energization.

3.06 REPAINTING

A. Remove paint splatters or other marks from surface of panelboards.

B. Touch-up chips, scratches, or marred finishes to match original finish, using manufacturer-supplied paint kit. Leave remaining paint with Owner.

3.07 ADJUSTING

A. Adjust fronts, covers, hinges, and locks.

3.08 CLEANING

A. Clean panelboard interiors and exteriors prior to final inspection. Remove paint splatters and other spots, dirt and debris.

END OF SECTION

SECTION 26 27 13
ELECTRICAL METERING

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems

C. Section 26 05 29 - Hangers and Supports for Electrical Systems

D. Section 26 05 48 - Vibration Controls for Electrical Systems

E. Section 26 05 53 - Electrical Systems Identification

F. Section 26 08 12 - Power Distribution Acceptance Tests

G. Section 26 08 13 - Power Distribution Acceptance Test Tables

H. Section 26 24 13 - Switchboards

I. Section 26 28 13 - Fuses

1.02 REFERENCE

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

1.03 DESCRIPTION

A. Section includes equipment for energy and demand metering by Owner. It also includes options that provide for monitoring or automatic control of demand at a remote location.

1.04 REFERENCE STANDARDS

A. ANSI C12.1 – Code for Electricity Metering

B. ANSI C12.7 – Requirements for Watthour Meter Sockets

C. NEMA C12.9 – Test Switches for Transformer-Rated Meters

D. ANSI C12.10 – Watthour Meters

E. ANSI C12.11 – Instrument Transformers for Revenue Metering, 10 kV BIL Through 350 kV BIL (0.6 kV NSV Through 69 kV NSV)

F. ANSI C12.18 – Protocol Specification for ANSI Type 2 Optical Port

G. ANSI C12.19 – Utility Industry End Device Data Tables

H. ANSI C12.20 – Electricity Meters-0.2 and 0.5 Accuracy Classes

I. ANSI C39.1 – Requirements, Electrical Analog Indicating Instruments

J. IEEE C37.90.1 – Standard Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

K. IEEE C57.13 – Standard Requirements for Instrument Transformers

L. IEEE C62.11 – Metal-Oxide Surge Arresters for Alternating Current Power Circuits

M. IEEE C62.41.1 – Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits

N. IEEE C62.41.2 – Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

O. IEEE C62.45 – Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits

P. NECA 1 – Standard Practices for Good Workmanship in Electrical Contracting

Q. NECA 400 – Recommended Practice for Installing and Maintaining Switchboards

R. NEMA EN 10250 – Enclosures for Electrical Equipment (1000 Volts Maximum)

S. NEMA AB 1 – Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures

T. NEMA AB 3 – Molded-Case Circuit Breakers and Their Applications

U. NEMA EI 21.1 – Instrument Transformers for Revenue Metering (110KV BIL and Less)

V. NEMA BS 31047 – Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

W. NEMA LA 1 – Surge Arresters

X. NEMA PB 2 – Dead-Front Distribution Switchboard

Y. NFPA 70 – National Electrical Code

Z. UL 50 – Standard for Enclosures for Electrical Equipment (1995)

AA. UL 98 – Enclosed and Dead-Front Switches

BB. UL 467 – Grounding and Bonding Equipment

CC. UL 486A-486B – Wire Connectors

DD. UL 489 – Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures

EE. UL 891 – Dead-Front Switchboards

1. ASTM D1535 – Standard Practice for Specifying Color by the Munsell System

1.05 SUBMITTALS

A. Product Data: For metering equipment, components and accessories indicated:
   1. Include data on features, components, and complete description; submit catalog cut sheets showing electrical characteristics and ratings.
   2. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Describe operating sequences, both automatic and manual.

B. Shop Drawings:
   1. Dimensioned plans and sections or elevation layouts.
   2. Wiring Diagrams: Power, signal, and control wiring. Identify terminals and wiring designations and color codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field installed wiring, and show circuit protection features.

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

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

E. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual locations and ratings of metering equipment on single-line diagrams and plan layouts.
   2. Operation and Maintenance Data:
      a. Include manufacturer's recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.
      b. Include manufacturer's written instructions for testing.
      c. Include spare parts data listing, source, and current prices of replacement parts and supplies.
      d. Include manufacturer's Seismic Qualification Certification and Installation Seismic Qualification Certification.

1.06 QUALITY ASSURANCE

A. Obtain metering equipment from one source and by single manufacturer.

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

1.07 WARRANTY

A. Refer to Division 01 and Section 26 00 00 - General Electrical Requirements for general warranty requirements.

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

1.08 MAINTENANCE

A. Extra Materials: Furnish extra materials described below that match product installed, are packaged with protective covering for storage, and are identified with labels describing contents.
   1. Potential Transformer Fuses: Equal to 10% of amount installed for each size and type, minimum of 2 of each size and type.
   2. Control-Power Fuses: Equal to 10% of amount installed for each size and type, minimum of 2 of each size and type.
   3. Fuses for Fused Switches: Equal to 10% of amount installed for each size and type, minimum of 3 of each size and type.

PART 2 - PRODUCTS

2.01 EQUIPMENT FOR UTILITY COMPANY ELECTRICAL METERING

A. Utility metering compartments in switchboard per requirements in section 26 24 13 - Switchboards

B. Cabinets and Sockets:
   1. Current Transformer Cabinets: Comply with requirements of electrical power utility company.
   2. Meter Cabinets: Comply with requirements of electrical power utility company.
   3. Meter Sockets: Comply with requirements of electrical power utility company.

2.02 EQUIPMENT FOR OWNER ELECTRICAL METERING

A. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
   1. Manufacturers:
      a. Square D
      b. General Electric
      c. Siemens
      d. Cutler-Hammer
      e. Approved equal
   2. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
      a. Phase Currents, Each Phase: +/-0.5%
      b. Phase-to-Phase Voltages, Three Phase: +/-1%
      c. Phase-to-Neutral Voltages, Three Phase: +/-1%
      d. Megawatts: +/-2%
      e. Megavars: +/-2%
      f. Power Factor: +/-2%
      g. Frequency: +/-0.5%
      h. Megawatt Demand: +/-2%; demand interval programmable from 5 to 60 minutes

i. Accumulated Energy, Megawatt Hours: +/-2%. Accumulated values unaffected by power outages up to 72 hours

j. Maximum demand (measure of average power demand over a 15-minute period) continuously recorded over a one-year period.

k. Total Harmonic Distortion, Amperes

l. Total Harmonic Distortion, Volts

m. Individual Amperage Harmonics through the 63rd

n. Integral Communications Port

3. Mounting: Display and control unit flush or semiflush, mounted in instrument compartment door.

4. Provide Advanced Energy Meter as required by EPAct of 2005 requirements.

B. Instrumentation:

1. Manufacturers:

a. Schneider Square D

b. ABB

c. Siemens

d. Eaton

e. Approved equal

2. Instrument Transformers: NEMA EI 21.1, IEEE C57.13, and the following:

a. Potential Transformers: Secondary voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.

1) 600 V and below: external PTs not required; fused potential connection.

b. Current Transformers: Window type; ratios shall be as indicated with accuracy class and burden suitable for connected relays, meters, and instruments; shorting test blocks: 10 poles – 4 potential and 6 current, mounted with meter or in accessible location.

c. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondaries to ground overcurrent relays to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit breaker ground-fault protection.

C. Data Communications:

1. Means to transmit data to central control and monitoring system.

a. Keypad and scrollable display for local reading of measured values.

D. Kilowatt-Hour Meters:

1. Manufacturers:

a. E-MON L.P

b. National Meter Industries, Inc.

c. Osaki Meter Sales, Inc.

d. Power Measurement

e. Schneider Square D

f. Eaton

g. ABB

h. Siemens

i. Approved equal

2. Kilowatt-Hour/Demand Meter: Electronic three-phase meters, measuring electricity use and demand.
   a. Voltage and Phase Configuration: Designed for use on circuits with voltage rating and phase configuration indicated for its application.
   b. Display: Digital liquid crystal, indicating accumulative kilowatt hours, current time and date, current demand, historic peak demand, and time and date of historic peak demand.
   c. Demand Signal Communication Interface: Match signal to building automation system input and arrange to convey the instantaneous, integrated, demand level measured by meter to provide data for processing and possible programmed demand control action by destination system.
   d. Programmable Contact Module: Unit shall have push-button switches and a display for setting the demand level at which an integral set of Form C contacts shall be operated to initiate indicated action.
   e. Enclosure: NEMA EN 10250, Type 1 minimum, with hasp for padlocking or sealing.
   f. Identification: Comply with Section 26 05 53 - Electrical Systems Identification.
   g. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.
   h. Sensors: Current-sensing type, with current or voltage output, selected for optimum range and accuracy for ratings of circuits indicated for this application.
      1) Type: Split, or, and solid core.
   i. Meter Accuracy: Nationally recognized testing laboratory certified to comply with ANSI C12.1.
   j. Current-Transformer Cabinet: Listed or recommended by metering equipment manufacturer for use with sensors indicated.

PART 3 - EXECUTION

3.01 COORDINATION

A. Coordinate adjustment and programming of metering equipment with manufacturer.

B. Instruct manufacturer about the location of incoming lugs (i.e., top or bottom feed based on incoming feeder entrance location).

C. Coordinate installation of housekeeping concrete pad based on actual equipment supplied:
   1. Concrete: Per requirements in Division 03 – Concrete.
   2. Dimensions: Per requirements in Section 26 05 29 - Hangers and Supports for Electrical Systems.

D. Coordinate with miscellaneous trades for equipment foreign to electrical installation to be outside of dedicated electrical space.

E. Verify with manufacturer that “touch-up” paint kit is available for repainting.

F. Coordinate utility company metering equipment requirements.

G. Coordinate meter data transmission with campus power monitoring system (CPMS) Building Management System (BMS) Supervisory Control and Data Acquisition (SCADA) System to integrate metering components with system architecture.

H. Coordinate meter data transmission with Building Management System (BMS) Supervisory Control and Data Acquisition (SCADA) System to integrate electrical system metering data with CPMS, BMS, SCADA, GUI and (LEED) (Energy Code) reporting requirements.

3.02 EXAMINATION

A. Examine areas and surface to receive modular meter center for compliance with requirements, installation tolerances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Notify Contracting Officer /Engineer of any discrepancies prior to submittal of product data and shop drawings.

3.03 INSTALLATION

A. Comply with installation requirements in NECA 1.

B. Install utility company metering equipment per requirements in Section(s) 26 24 13 - Switchboards

C. Install current transformer cabinets, meter cabinets or meter sockets to comply with requirements of electrical power utility company. Install empty conduits for metering leads and extend grounding connections as required by utility company.

D. Install engraved plastic nameplates under provisions of Section 26 05 53 - Electrical Systems Identification for modular meter center, every instrument, overcurrent protective device, and disconnect device. Attach nameplate to exterior of modular meter center using small corrosion-resistant metal screws and rivets. Do not use contact adhesive. Indicate modular meter center manufacturer's name and drawing number, name, amperage, voltage, phase, number of wires, short circuit current rating (amp, RMS symmetrical and MVA three-phase symmetrical), and momentary and fault-closing ratings (amp, RMS asymmetrical). For each overcurrent protective device and disconnect device, include tenant name, load served, voltage/phase rating, and fuse size and type, when applicable.

E. Tighten electrical connectors and terminal according to equipment manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

F. Mount meters in the locations indicated on the drawings. Mounting height: 5'-6" or less from finished floor.

3.04 FIELD WIRING

A. Install field wiring to complete the electricity metering installation.
   1. Self-contained meter:
      a. Field wiring for building automation system (BAS) connection to solid-state electricity meter:
         1) Conduit: Install a 3/4" conduit routed underground from meter to BAS panel in the building; terminate conduit within 12" of BAS panel.

2) Communications Wiring: In the 3/4” conduit, install a 3-conductor communications cable as recommended by meter manufacturer. Connect one end to cable lead from meter KYZ pulse initiator module. Leave 4 ft excess cable coiled at opposite end for connection to BAS panel.

3.05 CONNECTIONS

A. Ground metering equipment according to Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Connect power and control wiring according to Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.

3.06 FIELD QUALITY CONTROL

A. Test continuity of each circuit.

B. Test metering equipment per requirements in Sections 26 08 12 - Power Distribution Acceptance Tests and 26 08 13 - Power Distribution Acceptance Test Tables.

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

D. Test Owner’s electricity-metering installation for proper operation, accuracy, and usability of output data.

1. Connect a load of known kilowatt rating, 1.5 hp minimum, to a circuit supplied by metered feeder.
2. Turn off circuits supplied by metered feeder and secure them in off condition.
3. Run test load continuously for 8 hours minimum, or longer to obtain a measurable meter indication. Use test load placement and setting that ensures continuous, safe operation.
4. Check and record meter reading at end of test period and compare with actual electricity used based on test load rating, duration of test, and sample measurements of supply voltage at test load connection. Record test results.
5. Repair or replace deficient or malfunctioning metering equipment, or correct test setup; then retest. Repeat for each meter in installation until proper operation of entire system is verified.

E. Verify that correct multiplier is indicated on face of meter.

F. Verify that current transformer secondary circuits are intact.

G. Inspect indicating devices for proper operation.

3.07 REPAINTING

A. Remove paint splatters and other marks from surface of equipment.

B. Touch-up chips, scratches or marred finishes to match original finish, using manufacturer-supplied paint kit. Leave remaining paint with Owner.

3.08 ADJUSTING

A. Adjustment and programming of metering equipment: By factory-authorized representative.

B. Compare meter display readings with readings taken with clamp on ammeter and handheld volt-meter.

C. Make adjustments as necessary.

3.09 CLEANING

A. Vacuum dirt and construction debris from interior and exterior of equipment; do not use compressed air to assist in cleaning.

3.10 DEMONSTRATION

A. Provide training session by manufacturer for up to 4 hours at a job location, to train the Owner's personnel in the operation and maintenance of metering equipment.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems

B. Section 26 05 53 - Electrical Systems Identification

1.02 REFERENCE

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

1.03 DESCRIPTION

A. Section includes general-use snap switches, wall-box dimmers, fan speed controls, receptacles, pendant cord-connector devices, cord and plug sets and device cover plates.

1.04 REFERENCE STANDARDS

A. IEEE C62.41.2 – Characterization of Surges in Low-Voltage (1000V and less) AC Power Circuits

B. IEEE C62.45 – Surge Testing for Equipment Connected to Low-Voltage (1000V and less) AC Power Circuits

C. NECA 1 – Good Workmanship in Electrical Contracting

D. NFPA 70 – National Electrical Code

E. NEMA WD 1 – General Color Requirements for Wiring Devices

F. NEMA WD 6 – Wiring Devices - Dimensional Requirements

G. NEMA EN 10250 – Enclosures for Electrical Equipment (1000 Volts Maximum)

H. UL 20 – General-Use Snap Switches

I. UL 498 – Attachment Plugs and Receptacles

J. UL 943 – Ground-Fault Circuit-Interrupters

K. UL 1436 – Outlet Circuit Testers and Similar Indicating Devices

L. UL 1449 – Transient Voltage Surge Suppressors

M. UL 1472 – Solid-State Dimming Controls

N. UL 1917 – Solid-State Fan Speed Controls

1.05 SUBMITTALS

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

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

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

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

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

1.06 QUALITY ASSURANCE

A. Refer to Division 01, Section 01 4000 - Quality Requirements

B. Obtain wiring devices from one source and by single manufacturer.

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

1.07 DELIVERY, STORAGE, AND HANDLING

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

1.08 WARRANTY

A. Refer to Section 26 00 00 - General Electrical Requirements for general warranty requirements.

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

1.09 MAINTENANCE

A. Extra Materials: Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

PART 2 - PRODUCTS

2.01 GENERAL-USE SNAP SWITCHES

A. Salient Characteristics
   1. Physical:
      a. Switches: Heavy-duty (specification grade); back and side wired; flush or surface mounting; Body and Handle: thermoplastic with toggle handle; for connection to copper or copper-clad conductors.
   2. Functional:
      a. With NEMA WD 1 and UL 20.

2.02 RECEPTACLES

A. Salient Characteristics
   1. Physical:
      a. Receptacles: 125V, 20A, heavy-duty (specification grade); back and side wired; flush or surface mounted; straight blade; 2 pole, 3 wire grounding; thermoplastic body; duplex as indicated on drawings.
   2. Functional:
      a. NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
      b. Ground Fault Circuit Interrupter (GFCI):
         1) Additional compliance with UL 943 Class A.
         2) Leakage current trip level: 4 to 6 mA.
         3) Trip time: .025 seconds nominal.
         4) Non-feed through type
         5) Reverse line-load function to prevent GFCI from functioning if wired incorrectly.
         6) Indicator Light: Lighted when device is tripped.
      c. Twist Locking
         1) NEMA WD 6 configuration as indicated on drawings.
      d. Switched: Upper half switched and lower half not switched.
      e. Dedicated: Labeled “Dedicated.”
      f. Special Purpose Receptacles: Specification grade, rated for voltage, amperage and NEMA configuration as noted on drawings.
   3. Performance: connection of an attachment plug

2.03 PENDANT CORD-CONNECTOR DEVICES

A. Salient Characteristics
   1. Physical:
      a. Matching, locking-type plug and receptacle body connector; heavy-duty grade.
      b. Body: Nylon
      c. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-stell wire strand, matched to cable diameter

2. Functional:
    a. NEMA WD 6 configuration L5-20P and L5-20R,
    b. Body: screw-open cable-gripping jaws and provision for attaching external cable grip.
    c. External Cable Grip: attachment provision designed for corresponding connector.
3. Performance: power distribution to equipment

2.04 CORD AND PLUG SETS

A. Salient Characteristics
1. Physical:
    a. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
    b. Cord: Thermoset-insulated, stranded-copper conductors; with green-insulated grounding conductor.
    c. Plug: Nylon body and integral cable-clamping jaws.
2. Functional:
    a. Cord: Type SOOW jacket; equipment rating ampacity plus a minimum of 30%
    b. Plug: Match cord and receptacle type for connection.
3. Performance: power distribution to equipment

2.05 DEVICE COVER PLATES

A. Salient Characteristics
1. Physical
    a. Single and combination types to match corresponding wiring devices:
    b. Attachment: Metal screws with head color to match plate finish.
        1) Material for Finished Spaces: as selected by the Architect.
    c. Material for Unfinished Spaces: Galvanized steel.
        1) Material for Damp Locations: Cast aluminum with while-in-use hinged cover, and listed and labeled for use in “wet locations”.
    d. Weatherproof Cover Plates: , die-cast aluminum with weatherproof while-in-use hinged cover.
2. Functional:
    a. Weatherproof Cover Plates: NEMA EN 10250, complying with type 3R weather-resistant cover
    b. Lockable Cover:
        1) Hinged cover with cylinder lock.
        2) Keyed all the same.
3. Performance: to protect wiring device and outlet wiring

2.06 FINISHES

A. Color:
1. Switch handles, receptacle faceplates, and device cover plates: as selected by the Architect, except as follows:

a. Switch handles and receptacle faceplates connected to Emergency or Standby Power System: Red; labeled “Emergency.”

b. UPS Receptacles: Gray

PART 3 - EXECUTION

3.01 COORDINATION

A. Special Purpose Receptacles: Coordinate final selections of NEMA configuration (locking, straight, blade, etc.) with configuration of plug on utilization equipment.

B. Receptacles for Owner-furnished equipment and equipment furnished under other divisions of specifications: Match plug configurations.

C. Cord and Plug Sets: Match equipment requirements.

D. Coordination with Other Trades:

1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the device cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

3.02 EXAMINATION

A. Verify location of wiring devices with architectural interior elevation drawings, prior to rough-in.

B. Verify outlet boxes are installed at proper height.

C. Verify wall openings are neatly cut and completely covered by wall plates.

D. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.03 PREPARATION

A. Clean debris from outlet boxes.

3.04 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise scheduled or indicated on drawings. Indicated dimensions are to center of device.

B. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

3. Length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Do not place bare stranded conductors directly under device screws. Use crimp on fork terminals for device terminations.

C. Device Installation:
1. Replace all devices that have been in temporary use during construction or show signs of installation prior to completion of building finishing operations.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6” in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than #12 AWG are installed on 15A or 20A circuits, splice #12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
10. Install devices plumb, level with finished surfaces and free from blemishes.
11. Install lighting switches vertically on latch side of door within 6” of frame edge.
12. Install devices above counters, 2” to the bottom of device above countertop or backsplash. Install all devices at same height above any one counter or fixed cabinet.
13. Install special purpose receptacles and switches according to shop and rough-in drawings furnished by trade(s) producing such equipment. Verify locations prior to rough-in.
14. Install weatherproof GFCI receptacles:
    a. Within 25’-0” of roof-mounted mechanical equipment
    b. Outdoors
    c. As indicated on drawings
15. Group adjacent switches under single, multigang wall plates.
16. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor. Ground per requirements in Section 26 05 26 - Grounding and Bonding for Electrical Systems.

D. Installation Orientations:
1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.
2. Install switches with handle operating vertically, with “ON” position up.
3. Unless otherwise indicated or where space problem occurs, mount devices flush, with long dimension vertical.

E. Device Cover Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

F. Wall-Box Dimmers:
   1. Install dimmers within terms of their listing.
   2. Verify that dimmers used for fan speed control are listed for that application.
   3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

G. Arrangement of Devices:
   1. Unless otherwise indicated or where space problem occurs, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.05 IDENTIFICATION

A. Comply with Section 26 05 53 - Electrical Systems Identification.
   1. Switches and Receptacles: Use hot, stamped or engraved machine printing with black-filled lettering on face of cover plate, and durable wire markers or tags inside outlet boxes.
      a. Receptacles: Label shall indicate receptacle voltage, phase, and amperage for receptacles other than 20A, 120 V, at top of cover plate, and panel and circuit number at bottom of cover plate.
      b. Switches: Label shall indicate switch voltage, phase, and amperage at top of cover plate, and panel, circuit number and switch designation at bottom of cover plate.
   2. Engrave cover plates on all Owner-furnished equipment and equipment furnished under other divisions of these specifications with panelboard, circuit number and "emergency" (where applicable) as specified in this section.

3.06 FIELD QUALITY CONTROL

A. Inspect wiring devices for defects.

B. Operate wall switches with circuits energized and verify proper operation.

C. Verify receptacle device is energized.

D. Perform tests and prepare test reports:
   1. Test receptacle devices for proper polarity:
      a. Test every receptacle with receptacle circuit tester. Tester shall test for open ground, reverse polarity, open hot, open neutral, hot and ground reversed, hot or neutral and hot open. Rewire receptacles with faults and retest.
   2. Test each GFCI receptacle device for proper operation:
      a. Perform testing using an instrument specifically designed and manufactured for testing ground-fault circuit interrupters. Apply the test to the receptacle. "TEST" button operation will not be acceptable as a substitute for this test. Replace receptacles that do not shut off power with 5/1000 A within 1/40 second and retest.
   3. Test Instruments: Use instruments that comply with UL 1436.
   4. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

E. Tests for Convenience Receptacles:
   1. Line Voltage: Acceptable range is 105 V to 132 V.

2. Percent Voltage Drop under 15A Load: A value of 5% or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

F. Test straight blade hospital-grade convenience outlets for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz.

G. Operational Tests: Demonstrate the operation of each switch with the systems fully energized and operating. Each switch shall be demonstrated three times.

H. Interpret test results in writing and submit to Owner.

3.07 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.08 CLEANING

A. Remove excess plaster from interior of outlet boxes.

B. Clean devices and cover plates after painting is complete. Replace stained or improperly painted devices and cover plates.

END OF SECTION

SECTION 26 28 13
FUSES

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 05 73 - Power System Studies

B. Section 26 24 13 - Switchboards

C. Section 26 28 16 - Enclosed Switches and Circuit Breakers

1.02 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents, including section under Division 01 General Requirements.

1.03 DESCRIPTION

A. Section includes nonrenewable cartridge fuses, rated 600V and less, for use in low-voltage power distribution system and spare fuse cabinet.

1.04 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses

B. UL 248-1 - Low Voltage Fuses - Part 1: General Requirements

C. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses

D. UL 512 - Fuseholders

1.05 SUBMITTALS

A. Product Data:
   1. Submit the following for each fuse type and size indicated:
      a. Manufacturer's technical data on features, performance, electrical characteristics, ratings, and dimensions.
      b. Time-current curves, coordination charts and tables, and related data.
      c. Let-through current curves for fuses with current-limiting characteristics.
      d. Fuse size for each elevator disconnect switch.

B. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual class, size, and location of fuses.

1.06 QUALITY ASSURANCE

A. Refer to Division 01, Section 01 4000 - Quality Requirements

B. Obtain fuses from one source and by single manufacturer.

C. Comply with NFPA 70 for components and installation.

1.07 MAINTENANCE

A. Extra Materials:
   1. Furnish to the Owner a quantity of spare fuses equal to 10% of the total quantity of each fuse class and size installed, minimum of 3 of each fuse class and size.
   2. Furnish 2 fuse pullers for each size fuse.

PART 2 - PRODUCTS

2.01 CARTRIDGE FUSES

A. Salient Characteristics

B. Physical:
   1. Nonrenewable current-limiting cartridge fuse; current rating and class, as specified or indicated, and voltage rating consistent with circuit voltage.

C. Functional:
   1. NEMA FU 1, UL 248-1

D. Performance:

UL Standard	Class	Volts	Amperage	Interrupting Rating (Amp RMS Sym.)
248-12	RK1	250 or 600	0-600	200,000
248-12	RK5	250 or 600	0-600	200,000

2.02 FUSEBLOCKS

A. Salient Characteristics
   1. Physical:
      a. Thermoplastic base with UL flammability 94VO
      b. Clip reinforcing springs – 100A and above
      c. Copper or aluminum connections
   2. Functional:
      a. UL 512
   3. Performance:
      a. 200,000 A RMS Sym withstand rating

2.03 TOUCH SAFE FUSEHOLDERS

A. Salient Characteristics
   1. Physical:
      a. Thermoplastic base with UL flammability 94VO
   2. Cover over fuses
   3. Neon indicator lamp
   4. Functional:
      a. UL 512
      b. Neon indicator lamp: “ON” when fuse opens
   5. Performance:
      a. 200,000 A RMS Sym withstand rating

2.04 SPARE FUSE CABINET

A. Salient Characteristics
   1. Physical:
      a. Wall-mounted sheet metal cabinet with shelves, suitably sized to store spare fuses and fuse pullers specified with 10% capacity minimum.
      b. Doors shall be hinged, with hasp for Owner’s padlock.
      c. Finish shall be gray enamel.
      d. Cabinet shall have nameplate engraved “Spare Fuses” in 1/2” letters on door.
   2. Functional: None
   3. Performance: Storage

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

3.02 INSTALLATION

A. Verify proper fuse locations, sizes, and characteristics.

B. Install fuses in fusible devices (specified in Sections 26 28 16 - Enclosed Switches and Circuit Breakers) at job site.

C. Arrange fuses so manufacturer, class, and size are readable without removing fuse.

D. Install typewritten labels on inside door of each fused device, indicating fuse replacement information.

E. Install spare fuse cabinet as directed by the Contracting Officer.

3.03 APPLICATION

A. Motor Branch Circuits: Class RK1.

3.04 CLEANING

A. Clean fuses and tighten connections prior to energizing of equipment.

END OF SECTION

SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables 2

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems

C. Section 26 05 29 - Hangers and Supports for Electrical Systems

D. Section 26 05 53 - Electrical Systems Identification

E. Section 26 08 12 - Power Distribution Acceptance Tests

F. Section 26 08 13 - Power Distribution Acceptance Test Tables

1.02 REFERENCE

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

1.03 DESCRIPTION

A. Section includes fusible and non-fusible disconnect switches and circuit breakers in individual enclosures.

1.04 REFERENCE STANDARDS

A. ANSI//NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting

B. NEMA AB 1 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breakers Enclosures

C. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

D. NFPA 70 - National Electrical Code

E. UL 98 - Enclosed and Dead Front Switches

F. UL 486A - 468B - Wire Connectors

G. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures

1.05 SUBMITTALS

A. Product Data:

1. Submit catalog cut sheet indicating voltage, amperage, HP ratings, enclosure type, and dimension, fuse clip features, terminal lugs and all accessories including interlock devices, short circuit current ampere rating and factory settings of individual protective devices.

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

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

D. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual locations of disconnect switches and ratings of installed fuses.
      b. Record actual locations and continuous current ratings of enclosed circuit breakers.
   2. Operation and Maintenance Data:
      a. Include manufacturer's recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.
      b. Include spare parts data listing, source, and current prices of replacement parts and supplies.

1.06 QUALITY ASSURANCE

A. Refer to Division 01, Section 01 40 00 – Quality Requirements.

B. Obtain disconnect switches and enclosed circuit breakers from one source and by single manufacturer.

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

1.07 DELIVERY, STORAGE, AND HANDLING

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

B. Comply with manufacturer's written instructions.

1.08 WARRANTY

A. Refer to Section 26 00 00 - General Electrical Requirements for general warranty requirements.

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

PART 2 - PRODUCTS

2.01 DISCONNECT SWITCHES

A. Salient Characteristics

1. Physical:
    a. Load interrupter enclosed knife switch, heavy-duty type
    b. Fusible or non-fusible type as indicated.
2. Functional:
    a. NEMA KS 1, UL 98
    b. UL 869A, Switches identified for use as service entrance equipment are to be labeled for this application, provided with solid neutral assembly and equipment ground bar, and must include connection for bonding and grounding of neutral conductor.
    c. Switch Interiors:
        1) Switch blades that are visible in "OFF" position when switch door is open.
        2) Plated current carrying parts.
        3) Removable arc suppressors to permit easy access to line side lugs.
    d. Switch Mechanism:
        1) Quick-make, quick-break, with visible blades and externally operable handle.
        2) Lockable only in “OFF” position and accept three industrial type, heavy-duty padlocks.
        3) Dual cover interlock to prevent unauthorized opening of switch door when handle is in "ON" position, and to prevent closing of switch mechanism with door open.
        4) Defeater mechanism to bypass interlock.
        5) Operating handle integral part of enclosure.
        6) Handle to physically indicate "ON" and "OFF" position.
    e. Fusible Switches:
        1) Rejection clips for Class R fuses specified.
        2) Provisions for Class J or Class L fuses, as applicable.
        3) Fuses: Per requirements in Section 26 2813 – Fuses.
3. Performance
    a. Ratings:
        1) Ampacity as indicated on drawings.
        2) Horsepower rated.

2.02 ENCLOSED CIRCUIT BREAKERS

A. Salient Characteristics
1. Physical:
    a. None
2. Functional:
    a. NEMA AB 1, UL 489.
    b. UL 869A, Enclosed circuit breakers identified for use as service entrance equipment are to be labeled for this application, provided with solid neutral assembly and equipment ground bar, and must include connection for bonding and grounding of neutral conductor.
    c. Enclosed molded-case circuit breakers:
        1) Tripped indication clearly shown on breaker handle taking position between “ON” and “OFF”.
        2) 225A frame size and below: thermal-magnetic trip.

3) 250A frame size and above: electronic (solid-state microprocessor-based) trip units interchangeable in the field within the frame size and field-adjustable long time pick-up, long time delay, short time pick-up, short time delay, and instantaneous current settings. Each adjustment shall have discrete settings and shall be independent of other adjustments.

d. Breaker Mechanism:

1) Quick-make, quick-break.

3. Performance

a. Ratings:

1) Each circuit breaker shall have minimum short circuit current rating as indicated on drawings.

2) Ampacity as indicated on drawings.

3) Listed as Type HACR for air conditioning equipment circuits.

4) Listed as Type SWD for lighting circuits.

2.03 LUGS

A. Salient Characteristics

1. Physical:

a. Front removable lugs.

b. Labeled for 75°C copper and aluminum conductors.

c. Multiple lugs to match number of conductors per phase.

d. Termination of field installed conductors: Pressure wire connectors, except wire-binding screws for #10 AWG or smaller conductors.

2. Functional:

a. None

3. Performance:

a. None

2.04 ACCESSORIES

A. Salient Characteristics

1. Physical:

a. Solid neutral assembly, where required.

b. Equipment ground kit.

c. Blown fuse indicators on fused disconnect switches.

d. Factory installed fuse puller on fused disconnect switches.

2. Functional:

a. None

3. Performance:

a. None

2.05 ENCLOSURES

A. Salient Characteristics
   1. Physical:
      a. NEMA Type 1, Type 3R (outdoor locations) enclosure.
      b. Code-gauge galvanized steel.
      c. Manufacturer's standard gray enamel finish over prime coat.
      d. Surface-mounted.
   2. Functional:
      a. NEMA KS 1, NEMA AB 1, UL 98, UL 489, as applicable.
   3. Performance:
      a. None

PART 3 - EXECUTION

3.01 COORDINATION WITH MANUFACTURER

A. Instruct manufacturer about the location of incoming lugs, i.e., top or bottom feed based on incoming feeder entrance location.

B. Verify that "touch-up" paint kit is available for repainting.

3.02 EXAMINATION

A. Examine areas and surface to receive disconnect switches and enclosed circuit breakers for compliance with requirements, installation tolerances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Verify that space indicated for disconnect switches and enclosed circuit breakers mounting meets code-required working clearances.

C. Notify Contracting Officer of any discrepancies prior to submittal of product data and shop drawings.

3.03 INSTALLATION

A. Install disconnect switches and/or enclosed circuit breakers in accordance with ANSI/NECA

B. Install disconnect switches and/or enclosed circuit breakers level and plumb, in accordance with manufacturer's written instruction.

C. Disconnect switches and enclosed circuit breakers mounting:
   1. Install disconnect switches and enclosed circuit breakers anchorage devices based on design by an Engineer registered and licensed in the Commonwealth of Kentucky.
   2. Fasten disconnect switches and enclosed circuit breakers firmly to walls and structural surfaces, ensuring they are permanently and mechanically anchored.
   3. Anchor and fasten disconnect switches and enclosed circuit breakers and their supports to building structural elements (wood, concrete, masonry, hollow walls and nonstructural building surfaces) by the methods described in Section 26 05 29 - Hangers and Supports for Electrical Systems.

4. Install two rows of steel slotted channel, with a minimum of four attachment points, for each disconnect switch and enclosed circuit breaker.
5. When not located directly on wall, install support frame of steel slotted channel anchored to floor and ceiling structure.

D. Do not support disconnect switches and/or enclosed circuit breakers by raceway.

E. Install top disconnect switch and/or enclosed circuit breaker handle a minimum of 3’-6” and maximum of 6’-6” above finished floor.

F. Tighten electrical connectors and terminals according to equipment manufacturer's published torque-tightening values. Where manufacturer’s torque values are not indicated, use those specified in UL 486A - 486B.

G. Install engraved plastic nameplates under provisions of Section 26 05 53 - Electrical Systems Identification. Attach nameplate to exterior of each switch and/or enclosed circuit breaker using small corrosion-resistant metal screws or rivets. Do not use contact adhesive.
1. Include switch and/or enclosed circuit breaker name, amperage, voltage, phase, and number of wires.

H. Install fuses in fusible switches at job site per requirements in Section 26 28 13 - Fuses.

3.04 CONNECTIONS

A. Ground equipment according to Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Connect wiring according to Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.

3.05 FIELD QUALITY CONTROL

A. Inspect for physical damage, proper alignment connections, anchorage, and grounding.

B. Correct malfunctioning units on-site and retest to demonstrate compliance. Remove and replace with new units and retest.

C. Test disconnect switches and/or enclosed circuit breakers per requirements in Sections 26 08 12 - Power Distribution Acceptance Tests and 26 08 13 – Power Distribution Acceptance Test Tables.

D. Interpret test results in writing and submit to Contracting Officer.

3.06 REPAINTING

A. Remove paint splatters and other marks from surface of equipment.

B. Touch-up chips, scratches, or marred finishes to match original finish, using manufacturer-supplied paint kit. Leave remaining paint with Contracting Officer.

3.07 ADJUSTING

A. Circuit Breakers: Set field-adjustable trip settings or change the trip settings recommended by the overcurrent protective device coordination study per Section 26 05 73 - Power System Studies.

3.08 CLEANING

A. Vacuum dirt and construction debris from interior and exterior of equipment; do not use compressed air to assist in cleaning.

END OF SECTION

SECTION 26 33 53.23
CENTRAL BATTERY INVERTERS

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 00 00 – General Electrical Requirements

B. Section 26 05 26 – Grounding and Bonding for Electrical Systems

C. Section 26 05 29 – Hangers and Supports for Electrical Systems

D. Section 26 05 53 – Electrical Systems Identification

E. Section 26 08 12 – Power Distribution Acceptance Tests

F. Section 26 08 13 – Power Distribution Acceptance Test Tables

G. Section 26 24 16.13 – Lighting and Appliance Panelboards

1.02 REFERENCE

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

1.03 DESCRIPTION OF SYSTEM

A. Provide a line-interactive central battery inverter to furnish regulated alternating current (AC) power as part of an emergency lighting system.

B. Inverter shall consist of a rectifier/battery charger, battery, inverter, static bypass transfer switch, protective devices, and accessories.

C. Continuity of electric power to loads shall be maintained with the inverter-supplied power by the batteries for not less than 90 minutes or until restoration of the AC power source.

D. Inverter system shall be capable of providing power to any combination of LED drivers, fluorescent ballast fixtures, incandescent lamps, electronic and high power factor fluorescent ballasts, and HID fixtures.

1.04 REFERENCE STANDARDS

A. ANSI/IEEE Standard C62.41 - Guide on Surge Voltages in AC Power Circuits Rated up to 600 V

B. ANSI/IEEE 450 - Recommended Practice for Maintenance, Testing and Replacement of Large Lead Storage Batteries for Generating Stations and Substations.

C. ANSI/IEEE 519 - Standard Practice and Requirements for Harmonic Control in Electrical Power Systems.

D. FCC Part 15, Subpart J, Class A

E. NEMA PE 1 - Uninterruptible Power Systems

F. UL 924 – Emergency Lighting Equipment

G. UL 1778 - Uninterruptible Power Supply Equipment

1.05 SUBMITTALS

A. Provide cover letter with compliance table listing each specification section and indicating compliance "C", deviation for alternate "D", or exception with explanation "E". Any deviation or exception shall be accompanied with detailed explanation of how design intent is being upheld.

B. Product Data:
   1. Manufacturer's technical datasheet(s) indicating system performance characteristics, including guaranteed efficiency at 25%, 50%, 75%, and 100% load.

C. Shop Drawings:
   1. General Arrangement:
      a. Front, plan, and side views; access requirements (front, side, rear); overall dimensions and components list; shipping splits and weights.
   2. Wiring Diagrams:
      a. Showing input, output, and bypass power flow within the inverter.
      b. Identifying terminal numbers / labels for all external connections.
   3. Unit Data:
      a. Input power requirements
      b. Heat dissipation

D. Manufacturer's Installation, Start Up, and Application Instructions:
   1. Submit manufacturer's installation, start up, and application instructions in searchable PDF format within 30 days of approval of shop drawings to support development of pre-functional procedures and documentation.
   2. Submit blank forms proposed for use to document start up activities as required by manufacturer and vendors of equipment along with the startup instructions.

E. Training Plan Agendas and Training Record Documentation:
   1. Submit proposed training agendas for work covered by this section in accordance with Division 01. Coordinate with CM for formatting of agendas
   2. Submit record of all demonstration and training in accordance with Division 01.

F. Closeout Submittals:
   1. Operations and Maintenance (O&M) Manual:
      a. Installation instructions
      b. Operating instructions
      c. Maintenance instructions including recommended maintenance intervals
   2. As-built shop drawings

1.06 QUALITY ASSURANCE

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

1.07 REGULATORY REQUIREMENTS:

A. Comply with NFPA 70 and NFPA 101.

B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, fumes, water, corrosive substances, construction debris, and traffic. Provide temporary heaters as required to prevent condensation.

1.09 WARRANTY

A. Refer to Division 01 and Section 26 00 00 – General Electrical Requirements for general warranty requirements.

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

C. Extended factory warranty shall include replacement coverage for central inverter parts for a period of 24 months from Contracting Officer system acceptance after commissioning.

D. Service protection package shall include on-site repair/replacement labor for central inverter parts and batteries and technical support coverage. Standard response time shall be 24 hours from receipt of call.

PART 2 - PRODUCTS

2.01 CENTRAL BATTERY INVERTER

A. Salient Characteristics
   1. Physical
      a. Protection Input Molded case circuit breaker, 125% of full load current. Single phase protection. Wrong phase rotation protection.
   2. Functional
      a. Voltage Transient: Meet the requirements of ANSI/IEEE C62.41 at 4000 V peak.
   3. Performance
      a. Input Power
         1) Normal Voltage Range: 208/120 VAC 3-Phase, 4-wire + 10%, - 15%
         2) Bypass Voltage Range: 208/120 VAC, ±10%, 3-phase, 4 wire plus equipment ground
         3) Power Factor: Not less than 0.92 lagging at full load.

4) Current Limit:125% of normal input full load current if the load is connected to the inverter module, or to the bypass line by the static transfer switch, or if the load is disconnected. If the load is connected to the maintenance bypass line, the input current limit to the inverter module is to automatically reduce to 25% of normal full load input current.
5) Frequency Range: 60 Hz ± 5%
6) Magnetizing Sub-cycle: 6 times normal full load input current maximum
7) Current Harmonics at 3% SHD 5% THD Maximum, with a 3:1 crest factor, full load nonlinear load.

b. Output Power
1) Voltage208/120 VAC, 3-Phase, 4 wire
2) Voltage Regulation - 3-phase, 4-wire, frequency 60 Hz ± 1% nominal for any of the following conditions:
a) No load to full load
b) 1.0 to 0.8 lagging power factor
c) Minimum to maximum DC input voltage
d) 0° to 40°C ambient temperature
3) Voltage Adjustment Range: ± 5% manually

c. Voltage Unbalance:
1) Balanced Load: All 3 line-to-line voltages within ± 1%
2) 20% Unbalanced Load: All 3 line-to-line voltages within ± 1%
3) 50% Unbalanced Load: All 3 line-to-line voltages within ± 2%
4) 100% Unbalanced Load: All 3 line-to-line voltages within ± 1%
a) (Single phase line-to-neutral load including phase-controlled loads creating 3rd, 5th and 7th harmonics)

d. Voltage Transients:
1) 100% Load Step: ± 5%
2) Loss or return of AC input power: ± 8%
3) Manual transfer of 100% load to the Bypass line or to the UPS: ± 4%Automatic transfer of 100% load to the Bypass line or to the UPS± 8%Overload at Full Voltage:
4) Manual transfer of 100% load to the Bypass line or to the UPS: ± 4%
5) Overload at Full Voltage:
a) 125% for 12 cycles
b) 115% for 5 minutes
c) 100% continuous
6) Voltage Transient Recovery: To within 1% of output voltage rating within 20 milliseconds.
7) Distortion: 5% THD maximum, 3% any single harmonic
8) Voltage Adjustment: ± 3% from the nominal value for all load conditions.

e. Environmental Conditions:
1) Operating ambient temperature:
a) UPS Module 0° to 40°C

b) Battery20°C to 30°C

2) Non-operating and storage ambient temperature -20° to 70°C.

3) Relative humidity 0% to 95% for temperatures in the operating range without condensation.

f. Audible Noise:

1) Noise generated by the inverter under any condition of normal operation shall not exceed 65 dB measured at 3 ft from the nearest surface of the cabinet

g. Efficiency:

1) Efficiency measured under following conditions:

a) Operating at full-rated load

b) Battery fully charged and floating on the system

c) Input voltage within the specified range.

d) Full load efficiency shall be not less than 92%.

2.02 SYSTEM OPERATION

A. Normal:

1. Inverter shall supply AC power to the critical loads through the static transfer switch.
2. Inverter output shall be connected to AC power source provided that the AC power source is within the specified frequency range.
3. The rectifier/charger shall convert the AC input power to DC power for the inverter and for float charging the battery.

B. Loss of Normal AC Input Power:

1. Battery shall supply DC power to the inverter so that there is no interruption of AC power to the critical load whenever the AC input power source of the inverter module deviates from the specified tolerances or fails completely.
2. The battery shall continue to supply power to the inverter for a minimum of 90 minutes.

C. Return of AC Power Source:

1. Rectifier/charger shall assume the DC load from the battery when the AC power source returns.
2. Rectifier/charger shall supply the inverter with DC power and recharge the battery.

D. Bypass Mode:

1. If the inverter is taken out of service for maintenance or repair, or should the inverter capacity be exceeded, the static transfer switch shall perform a transfer of the load from the inverter to the AC power source.
2. Transfer back to Normal Mode shall be accomplished with no interruption in power to the emergency loads.

E. Retransfer to Inverter:

1. Static transfer switch shall automatically retransfer the load back to the inverter after the inverter has returned to normal voltage and synchronizes with the alternate bypass source.

2.03 INVERTER MODULE

A. Rectifier/Charger:

1. Rectifier/charger shall include:

   a. Circuit to limit AC input current to an adjustable level of 100% to 125% of the full input current rating.

   b. Circuit to limit battery-charging current to an adjustable level of 2% to 25% of maximum battery discharge current.

      1) A second circuit shall provide greater limiting when signaled by an external contact (i.e., operation of generator).

      2) Battery charge current limit to be factory set at 10% for normal operation and 2% for generator operation.

   c. Input circuit breaker.

      1) Circuit breaker shall be frame size and trip rating to supply full rated load and recharge battery at same time.

   d. Output filter to minimize ripple current to the battery. Ripple current to the battery shall not exceed 2% RMS. Filter shall insure that the DC output of the rectifier/charger will meet the input requirements of the inverter.

B. Inverter:

1. Solid-state, capable of accepting the rectifier/charger or battery output and providing rated output power.
2. Insulated gate bipolar transistor (IGBT) phase-controlled, pulse width modulated (PWM) design.
3. Able to sustain an overload of up to 125% with + 2% output voltage regulation.
4. If short circuit is sustained, inverter shall transfer load to bypass.

C. Momentary Overloads:

1. In event of load current inrush or branch load circuit fault, static transfer switch to pulse on for at least 40 milliseconds allowing up to 100% load current to flow from the bypass line to clear the overload.

D. Automatic Closing:

1. When load is transferred to bypass line by static transfer switch, bypass switch to automatically close removing static transfer switch from power flow.

E. Manual Transfers:

1. Manual load transfer between inverter system and bypass line can be initiated from control panel.

2.04 SYSTEM BYPASS SECTION

A. System bypass section:

1. Shall contain devices to electromechanically transfer the load from the inverter system to the bypass source and vice versa.
2. Devices shall provide isolation of the inverter system from the critical load when utilizing the bypass as a source
3. Shall provide system overload protection for the inverter system.

B. Static transfer switch:
   1. Solid-state device that automatically transfers load to bypass without interruption if the inverter cannot supply continuous power.

C. Bypass switch:
   1. Motor operated circuit breaker that connects the load to bypass.
   2. Automatic load transfers to be initiated when a sustained system overload occurs or when an essential (non-redundant) inverter module is taken offline.

D. System bypass shall be an in-phase non-interruptive bypass.

E. Operation of the bypass switch shall cause transfer of the load to AC input power without deviation of the output bus beyond acceptable limits. At the same time, the bypass switch shall isolate the load bus from the inverter output bus.

F. System bypass shall have appropriate phase, voltage and frequency monitors to prevent a synchronous transfer or a transfer to a bypass source with unacceptable voltage, frequency or phase rotation.

2.05 CONTROLS

A. Inverter system shall have local and remote controls, indicators and meters. When a fault occurs, the indicator shall light and an audible alarm shall sound continuously.

B. All panel meters shall be digital readout with accuracy of ± 2% of full range over all ranges and shall be true RMS type.

C. Monitoring functions to be displayed in numbers and words on a digital display.

D. Operator controls and monitors to be located on front of inverter module cabinet.
   1. Controls:
      a. Inverter On
      b. Bypass On
      c. Emergency Power Off
      d. Alarm Silence
      e. Lamp Test
      f. Meter Phase Select
      g. Meter Source Select
   2. Meters:
      a. AC Input Voltage, 3 phase, L-L, and L-N for each phase
      b. Bypass Input Voltage, 3 phase, L-L and L-N for each phase
      c. AC Input Current, each phase
      d. AC Output Voltage, 3 phase, L-L and L-N for each phase
      e. AC Output Current, each phase
      f. AC Output Frequency
      g. Battery Voltage
      h. Battery Charge/Discharge Current

i. Percent of Rated Load Being Supplied by Inverter
j. Battery Time Left During Battery Operation

3. Alarms to be displayed:
   a. Inverter off-line
   b. Input power failed
   c. Alternate source power failed
   d. Battery discharging
   e. Low battery
   f. Overload
   g. Overload shutdown
   h. Load on bypass
   i. Equipment over temperature
   j. Over temperature shutdown
   k. Fan failure
   l. DC overvoltage
   m. Control power failed
   n. Output overvoltage
   o. Output undervoltage
   p. Fuse open
   q. Rectifier/charger failure
   r. Static transfer switch failure
   s. Emergency power off
4. An audible alarm of greater than 65dB to sound when any of above alarms occur.
5. Following alarms shall be displayed but will not activate audible alarm:
   a. On maintenance bypass
   b. On static bypass line
   c. Sync with line
   d. Not sync with line
   e. Out of frequency range
   f. Rectifier/charger in current limit
   g. Battery circuit breaker open
6. Pushbuttons to test and reset visual and audio alarms.

2.06 STORAGE BATTERY

A. Storage batteries shall
   1. Have ampere hour rating to maintain the inverter output at full capacity for 90 minutes.
   2. Be supplied with:
      a. Racks protected with electrolyte resistant paint
      b. Intercell and inter-tier connectors
      c. Solid copper bus bars

3. Sealed Lead Calcium type
4. Be insulated to withstand a ± 1000 V DC high potential test applied to either the positive or negative terminals, while connected to the inverter system in operable condition with the DC disconnect open.
5. Have a design life of at least 10 years and be so guaranteed by the battery manufacturer.

B. At end of discharge, cell voltage shall not be less than 1.67 EVPC and 1.250 specific gravity.

C. Provide battery circuit breaker.
1. Provide 24 VDC shunt trip operator and (2) N.O./N.C. auxiliary controls to be manually operated or by system EPO.
2. Provide a pushbutton to trip battery breaker from system control panel.

2.07 CONSTRUCTION AND MOUNTING:

A. Inverter shall be housed in NEMA Type 1 metal enclosures, designed for floor mounting.

B. Inverter cabinets shall be painted with manufacturer's standard color.

C. Adequate ventilation shall be provided to ensure that all components are operated within their environmental ratings.

D. Temperature sensors shall be provided to monitor temperature of critical components.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Wiring shall be in accordance with manufacturer's recommendations.

B. Wiring shall be run in conduit.

C. Final connections and start-up shall be made by inverter factory representative.

D. Provide infrared scan of battery connections under full load test.

3.02 USING AGENCY TRAINING

A. Electrical Contractor to provide training in start-up, operation, and maintenance of equipment supplied. Training to be conducted by factory-certified instructors.

B. Electrical Contractor to submit training plan for Using Agency's approval. Training plan to include duration of training sessions, suggested class size/attendees, locations, lesson objectives, and outline of training topics.

C. Electrical Contractor may, at request of Using Agency, be required to hold 2 separate training sessions to accommodate multiple personnel shifts.

3.03 TESTING REQUIREMENTS

A. Factory Testing:

1. Inverter system shall be tested during manufacturing process to assure that equipment is fully functioning, and its performance meets specifications. Upon request, manufacturer shall describe testing program and supply sample test procedures and test data sheets to document testing program.

B. Site Testing:

1. Inverter equipment shall be fully tested after installation. Testing shall be part of start-up service provided by manufacturer. Site testing shall include complete inspection of installation to assure it was performed in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 26 43 00
SURGE PROTECTIVE DEVICES (SPD)

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 00 00 - General Electrical Requirements

B. Section 26 05 26 - Grounding and Bonding for Electrical Systems

C. Section 26 24 13 - Switchboards

D. Section 26 24 16.13 - Lighting and Appliance Panelboards

E. Section 26 27 26 - Wiring Devices

1.02 REFERENCE

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

1.03 DESCRIPTION

A. Provide Type 1 Surge Protective Devices (SPD) for the protection of AC electrical circuits formerly known as Transient Voltage Surge Suppression (TVSS) System. Provide high energy surge current diversion and be suitable for application in Type 1 environments.

B. Modes of Protection:
   1. Line to Ground, Line to Neutral, and Neutral to Ground for services with a neutral
   2. For Services without a neutral, Line to Line and Line to Ground

C. Provide common and normal modes of protection.

1.04 REFERENCE STANDARDS

A. ANSI/UL 1449 Surge Protective Devices Fourth Edition

B. IEEE C62.41.1 – Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits FIPS PUB 94

C. IEEE C62.11 – Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (> 1 kV)

D. IEEE C62.41.1 Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits

E. IEEE C62.41.2 Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

F. IEEE C62.45 IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and less) AC Power Circuits

G. IEEE C62.62 IEEE Standard Test Specifications for Surge Protective Devices (SPDs) for Use on the Load Side of the Service Equipment in Low Voltage (1000V and less) AC Power Circuits

H. National Electrical Code – Article 285

I. NEMA LA 1 – Surge Arresters

J. National Fire Protection Association – NFPA 20, 70, 75, and 780

K. UL 96A Installation Requirements for Lightning Protection Systems

1.05 SUBMITTALS

A. Submit Shop Drawings for equipment provided under this Section.

B. Submit shop drawings and product information for approval and final documentation in quantities listed according to Conditions of the Contract. Identify customer name, customer location, and customer order number.

C. Submit ANSI/UL 1449 Listing documentation to indicate the following:
   1. Short Circuit Current Rating (SCCR)
   2. Voltage Protection Ratings (VPRs) for all modes
   3. Maximum Continuous Operating Voltage rating (MCOV)
   4. Nominal Discharge Current rating (I-n)
   5. Type 1 device
   6. VPR, MCOV, I-n, and Type 1 information is posted at www.UL.com under Certifications; search using UL Category Code: VZCA. SCCRs are posted in manufacturer's published documentation.
   7. UL data and visual inspection takes precedence over manufacturer's published documentation.

D. Provide shop drawings including manufacturer installation instruction manual and line drawings detailing dimensions and weight of enclosure, internal wiring diagram illustrating all modes of protection in each type of SPD required, wiring diagram showing field connections, and manufacturer's recommended wire and breaker sizes (if required).

E. Upon request, modules using encapsulation shall be presented without encapsulation for visual inspection, proprietary technology included. MOV type and quantity shall reflect kA ratings on cutsheets, verification of diagnostic monitoring, thermal and overcurrent protection, etc.

1.06 WARRANTY

A. Provide warranty for a period of 10 years, incorporating unlimited replacements of suppressor parts if they are destroyed by transients during the warranty period.

PART 2 - PRODUCTS

2.01 SALIENT CHARACTERISTICS

A. Physical:
   1. SPD Modules:

a. Suppression components: Heavy-duty MOVs, selenium cells, or combination of both.
b. Provide service entrance SPD audible alarm.
c. Provide service entrance SPD with 1 set of NO/NC dry contacts for alarm conditions.
d. Provide visual LED diagnostics including a minimum of 1 green LED indicator per phase, and 1 red service LED. Include an audible alarm with on/off silence function and diagnostic test function (excluding branch).
e. If a dedicated breaker for the SPD is not provided in the switchgear, switchboard, or panelboard include an integral UL Recognized disconnect switch. Dedicated breaker to serve as a means of disconnect for distribution SPDs
f. Provide serviceable, replaceable modules (excluding Branch).

2. SPD Low-Impedance Interconnect Cable:
   a. Provide low-impedance cable specifically listed for SPD installations.
   b. Low impedance approximately 25% of conventional pipe and wire for improved clamping voltage.

B. Functional:
1. Temperature range: -40°F to 122°F
2. Relative humidity range: 0 to 95%, non-condensing
3. Audible noise level: > 40 dBA at 5 ft
4. SPD Surface Temperature: less than 131°F
5. For use without need for external or supplemental overcurrent controls.
6. Protect suppression component of every mode, including N-G, by internal overcurrent and thermal overtemperature controls.
7. SPDs relying on external or supplementary installed safety disconnects do not meet intent of specification.
8. Provide surge current diversion paths for all modes of protection: L-N, L-G, N-G in WYE systems, and L-L, L-G in DELTA systems.
9. Provide service entrance SPD audible diagnostic monitoring by way of audible alarm.

C. Performance:
1. UL Labeled as Type 1 (verifiable at www.UL.com).
2. SPD shall bear the UL Mark and shall be Listed to Third Edition of ANSI/UL 1449. “Manufactured in accordance with” is not equivalent to UL Listing and does not meet intent of specification.
3. Post SPD and performance parameters at www.UL.com under Category Code: VZCA. Products or parameter without posting at UL.com are not approved.
4. Minimum surge current capacity for Service Entrance units based on 8 x 20 microsecond current waveform:
   a. 200,000 A between each phase for line-to-line mode
   b. 200,000 A each phase for line-to-ground mode
   c. 200,000 A each phase for line-to-neutral mode
   d. 200,000 A for neutral-to-ground mode
5. Minimum surge current capacity for panelboard units based on 8 x 20 microsecond current waveform:
   a. 80,000 A between each phase for line-to-line mode

b. 80,000 A each phase for line-to-ground mode
c. 80,000 A each phase for line-to-neutral mode
d. 80,000 A for neutral-to-ground mode

6. Sequential Surge Current Survivability:
   a. 1,000 sequential category surges without failure.
7. Current Rating:
   a. Rated for continuous current and AIC rating of equipment protected.
   b. Mark SPD Short-Circuit Current Rating on the SPD label.
8. Meet or exceed the following criteria:
   a. ANSI/UL 1449 Listed Voltage Protection Ratings (VPRs) for 6kV 3000A testing as follows:

VOLTAGE	**L-N** **L-G** **N-G**	**L-L**
208Y/120V	≤800V	≤1200V
480Y/277V	≤1200V	≤2000V

   b. ANSI/UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) (verifiable at UL.com):

System Voltage	**Allowable System Voltage Fluctuation (%)**	**MCOV**
208Y/120	15%	150V
480Y/277	15%	350V

PART 3 - EXECUTION

3.01 APPLICATION OF SPD

A. Provide UL approved disconnect switch at Service Entrance or Transfer Switch as a means of service disconnect if a breaker sized per manufacturer's recommendations is not available.

B. Provide independent means of servicing disconnect at Distribution, MCC, and Branch such that the protected panel remains energized. A 30A breaker (or larger based on manufacturer's recommendations) may serve this function.

C. Provide SPD for each panel, switchboard, and distribution panel associated with the Emergency branch(es) of power.

3.02 INSTALLATION

A. Install per manufacturer's recommended practices.

B. Provide short and straight conductors not exceeding 3 ft in length. Manufacturer-approved cables may be used that allow conductor length to extend beyond 3 ft in length without affecting capability of unit.

C. Service Entrance:
   1. Install 1 primary suppressor external to the service entrance in accordance with manufacturer instructions.
   2. Install SPD online or load side.
   3. Bond SPD ground to service entrance ground.

D. Distribution Panelboards:
   1. Install 1 suppressor external to each designated distribution panelboard.
   2. Install surge suppression device in accordance with manufacturer instructions.

E. Input conductors twisted together to reduce inductance.

F. Avoid 90-degree bends in cable.

3.03 QUALITY ASSURANCE

A. Refer to Division 01, Section 01 40 00 - Quality Requirements

B. Factory test system before shipment. Include quality control check, “Hi-Pot” tests at 2 times rated voltage plus 1,000 V, ground leakage tests, and calibration.

C. Manufacturer Qualifications: Engage a firm with at least 5 yrs experience in manufacturing surge protective devices.

D. Manufacturer of equipment shall have produced similar electrical equipment for a minimum period of 5 yrs. When requested by Contracting Officer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with requirement.

E. Provide SPD compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

3.04 FIELD QUALITY CONTROL

A. Inspections before SPD startup:
   1. Visual Inspection:
      a. Verify installation per drawings.
      b. Verify phase, neutral, and ground conductors are properly sized and configured.
   2. Mechanical Inspection:
      a. Check connections for tightness.
      b. Check terminal screws, nuts and/or connectors for tightness.
   3. Electrical Inspection:
      a. Confirm input voltage.
      b. Confirm phase, neutral and ground connections are proper.

3.05 WARRANTY

A. Refer to Section 26 00 00 – General Electrical Requirements for general warranty requirements

B. Provide 10 year manufacturer warranty.

END OF SECTION

SECTION 26 50 00
LIGHTING

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 26 00 00 - General Electrical Requirements

B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables

C. Section 26 05 26 - Grounding and Bonding for Electrical Systems

D. Section 26 05 33 - Raceway and Boxes for Electrical Systems

E. Section 26 09 23 - Lighting Control Devices

1.02 REFERENCE

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

1.03 DESCRIPTION OF WORK

A. Provide complete and fully operational lighting system per Contract Drawings and Specifications.

B. Luminaires shall be provided complete with necessary accessories for proper installation.

C. Catalog numbers shown in luminaire schedule are basic luminaire types. Additional features, accessories and options specified, scheduled or necessary for proper installation shall be included.

D. Specifications and drawings convey the features and functions of luminaires only and do not show every item or detail necessary for the work.

E. Work includes final aiming and focusing of luminaires under direction of the Contracting Officer /Engineer.

1.04 REFERENCE STANDARDS

A. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems (ANSI)

B. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems (ANSI)

C. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility

D. UL 773 - Plug-in Photocontrols for use with area lighting

E. UL 924 - Emergency Lighting and Power Equipment

F. UL 1598 – Luminaires

G. UL 2562 – Pendant Cable

H. UL 8750 – LED Light Sources for use in Lighting Products

I. ANSI C78.377 – Chromaticity

J. IESNA LM-79 – Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products

K. IESNA LM-80 - Approved Method: Testing Lumen Maintenance of LED Light Sources

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

M. IEEE STD 1789-2015 - Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers

1.05 QUALITY ASSURANCE

A. Luminaire and accessory components shall be constructed of materials appropriate for their use. Luminaires intended for use in marine environments shall be constructed of materials resistant to corrosion.

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

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

D. Contractor shall coordinate installation of lighting systems with all trades.
   1. Manufacturers listed in the luminaire schedule shall be assumed capable of supplying listed luminaires. Any such exceptions shall immediately be brought to the attention of Contracting Officer, Engineer, or Lighting Designer.
   2. Multiple Name Specification:
      a. When multiple manufacturers are listed, Electrical Contractor shall choose which of the listed products are to be provided.
      b. Products of the same type shall be of same manufacturer.
   3. Single Name Specification:
      a. When only one product is suitable for the application and/or no other known acceptable products exist, only one manufacturer/product is listed in the Luminaire Schedule. For such instances, Electrical Contractor shall provide the listed product with no exceptions.
   4. Contractor shall coordinate and verify compatibility of luminaires with lighting control system
      a. Control protocol indicated for luminaires matches protocol of lighting control system specified. Contractor shall coordinate and verify compatibility of all dimming luminaires with control system to ensure that dimming is flicker free, continuous dimming through the dimming range noted on the luminaire schedule.

E. Substitution requests:
   1. Will be evaluated prior to Bid.
   2. Shall follow procedures set forth in this Section under paragraph 1.7 and in Section 01 25 00 - Substitution Procedures.

3. Shall be made not less than 10 days prior to bid date.
4. Shall include the following information indicating that the proposed substitution is of similar construction quality and assembly, lumen output and distribution, color temperature, color consistency, and controllability:
    a. Specified and proposed manufacturer's product data sheet, noting options and features.
    b. Provide dimensioned drawing of luminaire.
    c. Provide photometric data in form of an electronic IES file on USB or via email.
5. Electrical Contractor shall be responsible for all costs incurred by substitution request sample and/or mockup production and review.
6. Equipment delivery lead time shall not be held as a valid reason for requesting luminaire substitution unless luminaire lead time from specified manufacturer is in excess of 14 weeks. It shall be sole responsibility of Electrical Contractor to determine necessary equipment lead times, deliver submittals for review in a timely fashion, and place orders accordingly to ensure timely delivery.
7. When requesting a substitution, Electrical Contractor shall provide unit and extended pricing for specified luminaire, unit and extended pricing for proposed alternate, and unit and extended delta savings to Owner to be realized by accepting proposed alternate. If requested, provide unit pricing for each luminaire type specified to provide a baseline comparison for substitution request.
8. Electrical Contractor shall guarantee pricing on all luminaire types for which a substitution request has been granted. This price guarantee shall be per unit and shall be maintained through the end of construction, regardless of quantity purchased.
9. For all luminaire types using an LED light source, provide independently tested, IESNA LM-79 compliant photometry testing data and IESNA LM-80 Lumen Maintenance data.

1.06 WARRANTY

A. Exit Signs Utilizing LED Technology: Provide manufacturer’s warranty for a period of not less than five years from the date of substantial completion including parts and labor for full replacement of defective product.

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

C. Luminaires without integral LED sources: Provide manufacturer’s warranty for a period of not less than one year from the date of substantial completion including parts and labor for full replacement of defective product.

1.07 SUBMITTALS

A. Electronic submittal format shall be limited to the greater of 500 pages or 30 MB to ensure that all pages load correctly. Bookmarks by luminaire type are required for ease of navigation. Submittals exceeding these limits should be broken in a logical fashion into multiple volumes for separate review. Measures to reduce file size should not compromise legibility or any other factors affecting ease of review.

B. Upon award of Contract, submit complete list of lighting products to be furnished, with manufacturer and catalog designations, including current unit cost. Unit price shall be for equipment only and not include installation or miscellaneous electrical costs.

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

D. In addition to complying with requirements of Section 26 00 00 - General Electrical Requirements, submittals shall include the following:
   1. Manufacturer's product data
   2. Installation instructions
   3. Maintenance data
   4. Parts list for each luminaire accessory
   5. Photometric Data: photometric data for luminaire, including optical performance as follows:
      a. Coefficients of utilization
      b. Luminance table
      c. Candela distribution data
      d. Zonal lumens
      e. Area and roadway luminaires shall include Isocandela Charts, IES Roadway Distribution Classification and IES BUG (Backlight – Uplight – Glare) ratings.
   6. Driver schedule indicating manufacturer, type, and catalog number for each luminaire
   7. Driver cut sheet for each driver used, referencing luminaire type(s)
   8. Product color/finish
      a. Where specific finish or color is not specified and options exist, submit color or finish samples to Contracting Officer for selection.

E. Shop Drawings for equipment provided under this Section shall include the following:
   1. Overall submittal drawings indicating luminaire size, mounting (including ceiling type), light source, shielding, and voltage attributes, as well as manufacturer's product data, installation instructions, maintenance data, and parts list for each luminaire.
   2. Catalog cutsheets lacking sufficient detail will not be accepted.
   3. Detailed drawings of linear pendant mounted and suspended luminaires including dimensions, support spacing, suspension type, power feed type and locations, driver locations, wiring and controls configuration, luminaire joint locations and end plates. Provide canopy details that indicate coordination with the ceiling system provided.
   4. Detailed drawings for LED systems including LED color, color consistency, rated life, warranty, and scale plans with luminaire layout, number, type and location for drivers, and a complete bill of materials.
   5. Detailed drawings for continuous recessed or continuous surface mounted luminaires including dimensions, power feed locations, driver locations/quantity, luminaire joint locations, extension plates for end and corner sections and end plates as applicable.
   6. Submit documentation that indicates specified products have been tested, or will be tested, for compatibility with the lighting controls being procured and will perform as specified. Control devices or system shall be able to control luminaires with flicker free, continuous dimming, in range specified. Electrical Contractor, luminaire manufacturer and lighting control manufacturer shall be financially responsible for any incompatibilities.
   7. Detailed drawings for nonstandard/custom luminaires indicating dimensions, weights, method of field assembly, components, features, and accessories. Details shall be scaled to a legible size.

8. Detailed drawings for fiber optic systems including scaled plans with cable layout number and type of fiber bundles, illuminator quantity and location, and a complete bill of materials.
9. Drawings for site lighting shall include pole data with wind loading, complete dimensions and finish, pertinent physical characteristics and accessories including mounting details, driver type and location and any specified control options.
10. Photometric Data: Where indicated on luminaire schedule and Contract Drawings, supply complete photometric data for luminaire, including optical performance rendered by independent testing laboratory developed according to methods of the Illuminating Engineering Society of North America as follows:
    a. Coefficients of utilization
    b. Luminance table with data presented numerically, showing maximum luminaire luminance at shielding angles. Readings should be taken both crosswise and lengthwise in case of linear luminaire or luminaire with an asymmetric distribution.
    c. Candela distribution data, presented graphically and numerically, in 5° increments (5°, 10°, 15°, etc.). Data developed for up and down quadrants normal, parallel, and at 11-1/2°, 45°, 67-1/2° to source if light output is asymmetric.
    d. Zonal lumens stated numerically in 10° increments (5°, 15°, etc.) as above.
11. No variation from the general arrangement and details indicated on drawings shall be made on shop drawings unless required by actual conditions. All variations shall be marked on drawings submitted for approval.

F. Provide luminaires with factory or field finish as directed by Contracting Officer. Verify final finish requirements before releasing luminaires for fabrication.

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

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Luminaires:
    1. As shown on Luminaire Schedule

B. LED Drivers:
    1. Shall be manufacturer recommended compatible driver.
    2. All LED drivers shall be dimming type standard unless otherwise noted. Refer to construction documents for control per application.
    3. Manufacturers must be compatible with lighting control system(s) provided and control luminaires to specified minimum output per Luminaire Schedule and controls intent documents.
    4. LED Drivers "At power levels between 100% to 1%, shall perform within the frequency (Hz) and Modulation (%) of IEEE STD 1789-2015 level.

C. Emergency LED Battery Pack:
    1. Bodine, Dual-Lite, Iota or as specified in the Luminaire Schedule

D. LED Modules:
   1. Philips Lumileds or equal.

2.02 FABRICATION AND MANUFACTURER

A. Luminaires:
   1. Construction
      a. Luminaires shall bear label indicating circuit voltage. Labels shall not be visible from normal viewing angles.
      b. Luminaires shall be constructed with joints made by means of welded, brazed, screwed, or bolted construction methods.
      c. Housings shall be so constructed that all electrical components are accessible and replaceable without removing luminaires from their mountings.
      d. Surface temperatures of luminaires with integral drivers shall not exceed 90°C in 30°C ambient.
      e. Luminaires recessed in ceilings utilized as air handling plenums shall be certified as suitable for the purpose and conform to NEC Article 300.
      f. Miter cuts shall be accurate, joints shall be flush and without burrs.
      g. Troffers with doors shall have spring-loaded door cam latches unless otherwise noted for special environments and applications.
      h. Luminaires shall be free of light leaks and designed to provide sufficient ventilation of source to provide the photometric performance documented. Low voltage transformers and drivers shall be vented per manufacturer's specifications.
      i. Provide inscription for exit and stairway signs to conform to applicable codes. Provide battery back-up as specified.
      j. Verify types of ceiling construction with General Contractor prior to releasing luminaires for fabrication and delivery and provide luminaires adapted to ceiling construction used.
      k. Coordinate recessed luminaire mounting appurtenances, flanges and trims with construction of ceiling in which luminaire is to be recessed. Provide correct luminaire mounting assembly.
      l. Luminaire frames shall be manufactured of non-ferrous metal or be painted after fabrication.
   2. LED Luminaires are considered a lighting system with dependent components that must be evaluated as a complete system. Each LED luminaire includes a light emitting source, provisions for heat transfer, electrical control, optical control, mechanical support and protection, as well as aesthetic design elements. All LED luminaires shall:
      a. Be NRTL 3rd party tested to applicable UL standards. Where remote drivers are specified, all drivers shall also have UL listing or equivalent and comply with code requirements.
      b. Be tested to IESNA LM-79-19 testing using absolute photometry criteria.
      c. Be reported greater or equal to 70% lumen maintenance at 50,000 hours of operation.
      d. Be rapid cycle stress tested.
      e. Have integral LED modules with a minimum operating temperature of -20°C.
      f. Have modules that are capable of being easily replaced upon failure with a manufacturer provided replacement module without voiding the UL listing of the luminaire.
      g. Have driver housings easily accessible for ease of maintenance.
      h. Have a maximum operating temperature at LED junction to not exceed 90°C over the expected operating range of the luminaire.

i. Be RoHS compliant, lead and mercury free.

j. Have an LED operating frequency of + or – 120 Hz.

k. Must meet the appropriate Federal Communications Commission (FCC) requirements for FCC 47 CFR 15 (consumer use) and/or FCC 47 CFR Part 18 (industrial use)

l. Be Class A Sound rated.

m. Be supplied with power supply that complies with IEEE C62.41-1991.

n. Operate at 120 or 277 volts, ±10%.

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

3. Lenses, Reflectors and Diffusers

a. All lenses or louvers shall be removable but held so that normal motion will not cause them to drop out.

b. All glass used in luminaires shall be made from thermal shock resistant borosilicate glass.

c. Optical lenses shall be free from spherical and chromatic aberrations.

d. Acrylic lenses shall be 100% virgin acrylic material.

e. Diffuser materials shall be UV stabilized in applications exposed to sunlight.

f. Troffer lenses shall be 0.125” thick, unless otherwise noted.

g. Alzak reflectors and louvers shall be low iridescent equivalent to Coil Anodizers. All Alzak parabolic cones shall be guaranteed against discoloration for a minimum of ten years.

h. Reflector cones shall not have visible source flashing in the cone.

4. Optics and Adjustments

a. Adjustable Angle Luminaire: Luminaires with adjustment beam angle shall contain reliable angle locking devices.

5. Finishes

a. Provide luminaires with finish as shown in the luminaire schedule. Verify final finish requirements before releasing luminaires for fabrication.

b. Painted luminaires shall be painted after fabrication or “post painted”.

c. Ferrous parts and supports shall be rust proofed after fabrication.

d. For weatherproof or vaportight installations, painted finishes of luminaires and accessories shall be weather resistant using proper primers or galvanized and bonderized epoxy, so that entire assembly is completely corrosion resistant for service intended and rated for an outdoor life expectancy of not less than 20 years.

6. Wiring

a. Luminaires shall be completely wired at the factory and as required by code.

b. Internal wiring shall contain no splices.

c. Connections shall be made with insulated “wire nut” type mechanical connectors except that driver connections shall comply with NEC Article 410.

d. Luminaires shall be provided with flexible conduit, pigtails, and equipment for external connections.

e. Recessed luminaires installed in inaccessible ceilings shall be UL listed for through wiring with the junction box accessible from the luminaire opening.

f. Cords shall be fitted with proper strain reliefs and watertight entries where required by application.

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

2.03 LED SOURCES

A. Static white LED sources shall be:
    1. Minimum CRI of 85 unless otherwise noted on Luminaire Schedule
    2. Less than 5% flicker
    3. Within 0.004 on the CIE 1976 diagram for color spatial uniformity
    4. Within 0.007 on the CIE 1976 diagram for color maintenance over the rated lifetime of the source
    5. Binned within a 3-step MacAdam ellipse minimum, or as indicated in Luminaire Schedule
    6. Color temperature as noted on Luminaire Schedule
    7. Have a published life rating based on the point at which LED sources reach L70 lumen maintenance and tested in accordance with IES LM80-08 Approved Method: Testing Lumen Maintenance of LED light sources and IES TM-21-11: Projecting Long Term Lumen Maintenance of LED Light Sources
    8. L70 rated life shall be a minimum of 50,000 hours.

9. LED modules, unless otherwise noted, shall be provided by light fixtures manufacturer and integral to luminaire.
10. Screw-base LED replacement lamps, where required and listed on the luminaire schedule, shall meet dimming, output, CCT and CRI as specified. 25,000 hours is acceptable L70 rated life for these products.

2.04 DRIVERS

A. Drivers for use in cold or freezer rooms, parking structures, loading docks, and outdoors shall be low temperature type.
   1. Driver shall have lowest temperature rating available in standard manufacture for its type.

B. Drivers shall be located in luminaire they serve, unless otherwise noted.

C. LED Drivers and Power Supplies shall:
   1. Operate system LEDs within the current limit specification of the LED manufacturer.
   2. Be supplied with over-temperature protection circuitry.
   3. Be programmable via manufacturer-provided means to allow for LED replacement modules to be "tuned" to match the output of remaining adjacent modules in the event that some time has passed and there has been lumen depreciation.
   4. Be within a NEMA enclosure.
   5. Be equipped with knockouts to accommodate standard conduit sizes
   6. Have a Power Factor to be = or > than 0.9
   7. Dimmable LED drivers must be compatible with dimming system(s) provided and control luminaires per luminaire schedule and controls documentation.
   8. ETL certified, CBM and UL Listed, high power factor, and meet or exceed NEMA and ANSI Standards.
   9. Be Class A sound rated
   10. be Equipped with resetting thermal sensitive device.
   11. For operation at with input power of 60 Hz and voltage as scheduled.
   12. Meet or exceed all ANSI or NEMA standards
   13. Be Capable of operating LEDs with less than 5% flicker
   14. Be DMX compatible in Color changing LED luminaires.
   15. At power levels between 100% to 1%, shall perform within the frequency (Hz) and Modulation (%) of IEEE STD 1789-2015 level.

D. Emergency LED Drivers shall:
   1. Be UL 924 listed
   2. Operate LED luminaire at 10W minimum output for 90 minutes with efficacy equal to or greater than the normal power efficacy.
   3. Have high temperature nickel-cadmium battery. Field replaceable
   4. Be installed inside luminaires
   5. Have solid state charging
   6. Battery to be recharged within 24 hours
   7. Remote battery test switch

PART 3 - EXECUTION

3.01 INSTALLATION

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

B. Installation of Luminaires:
   1. Housing, glassware, reflectors and refractors shall be clean and free of chips, cracks and scratches.
   2. Install decorative luminaires, reflector cones, baffles, aperture plates, lenses, trims, and decorative elements of recessed luminaires after completion of ceiling tile, plastering, painting, and general cleanup is completed. Where luminaire location or construction does not permit sequential installation, all reflectors, lenses, flanges and other visible surfaces shall be carefully protected.
   3. Light leaks between ceiling trim of recessed luminaires and ceiling are not allowed.
   4. Locations
      a. Install luminaires at locations and heights as indicated.
      b. Do not scale electrical drawings for locations of luminaires.
      c. Architectural reflected ceiling plans show locations of luminaires.
      d. Where noted on the drawings, the exact location of luminaires shall be confirmed (in the field) with the Contracting Officer prior to installation.
      e. Where luminaires are to be concealed, or surface mounted in highly visible public spaces, a small sampling of luminaires shall be installed, adjusted and aimed for Contracting Officer's review approval, prior to installing remaining luminaire of same type.
      f. Mount all luminaires so as to maintain full range of motion.
      g. Install luminaires plumb, square, and level with ceilings and walls.
      h. Coordinate stem, rod, chain, or aircraft cable hanger lengths with job conditions. Provide extra length of adjustable supports where diffusers are mounted directly above light fixtures to facilitate air balancing efforts.
      i. Industrial type luminaires in unfinished areas, which are near obstructions such as ducts and pipes, shall be:
         1) Suspended so that bottom of luminaire is no higher than bottom of obstruction
         2) Located at height of lowest luminaire
         3) Minimum height: 8’-0”
         4) Shall not be located until locations of obstructions are determined.
         5) Where a minimum height of 8’-0” is unachievable, wall mounted luminaires shall be utilized.
   5. Support
      a. Support surface mount luminaires from building structure.
      b. Metal decking shall not be pierced for luminaire support.
      c. Provide luminaires and/or luminaire outlet boxes with hangers to support luminaire weight.
      d. Troffers shall be held in place by support clips.

e. Provide plaster frames for recessed luminaires in plaster ceilings.

f. Rigid metallic pipe stems shall be utilized for the support of pendant mounted luminaires, unless otherwise noted.

g. Stem hangers shall be equipped with aligner box covers or canopies so that stems hang vertically, irrespective of the angle of the surface they are mounted from.

h. Wherever a luminaire or its hanger canopy is attached to a surface mounted outlet box, a finishing ring shall conceal the outlet box.

i. Yokes, brackets and supplementary supporting members needed to mount luminaires to suitable ceiling members shall be furnished and installed by Contractor. Verify mounting hardware required prior to installation.

j. Recessed luminaires shall be supported with 12 ga wire hangers, 2 per luminaire, at diagonally opposite corners.

k. Troffers and luminaires over 55 lbs, such as 4x4 ft shall be supported with 12 ga wire hangers, 4 per luminaire, 2 at 45 degree diagonals, and two perpendicular to structure. Wire hangers and attachment to structure shall be capable of supporting 4 times luminaires weight.

l. In areas with seismic requirements, suspended or pendant mounted luminaires shall be able to swing 45 degrees in any direction without hitting an obstruction. In the event hitting an obstruction is unavoidable, guy wires will be used to secure the luminaire in place.

m. Surface luminaires installed in grid ceilings shall be supported by independent support clips and 12 ga wire.

n. Exit signs installed in grid ceilings shall be supported by electrical box hanger and additional 12 ga wire installed from box to structure.

o. Support surface mounted luminaires greater than 2 ft in length at a minimum of each additional 2 ft, or as recommended by manufacturer.

p. Brace suspended luminaires installed near ducts or other constructions with solid pendants or threaded rods.

q. Rigidly align continuous rows of luminaires.

r. Luminaire types with remote mounted driver shall have:

1) Proper support for driver weight.

2) Mounting distance from remote driver to luminaire per manufacturer's recommendations.

6. Mounting and Enclosures

a. Install flush mounted luminaires to eliminate light leakage.

b. For luminaires mounted adjacent to insulation, provide barrier to prevent insulation from coming in contact with luminaire, unless luminaire is approved for installation in contact with such insulation.

c. Provide approved fire rated enclosures around luminaires in fire rated ceilings.

7. Conduit and Wiring

a. Wire for connections to modules and auxiliaries shall be suitable for temperature, current, and voltage conditions.

b. Recessed luminaires shall have final connections made with flexible metal conduit, not in excess of 72”, with THHN conductors and green wire ground conductor.

c. Conduit shall be hidden from normal view in all possible cases. In public areas where surface mounted conduit must be used, Contractor shall install conduit as unobtrusively as possible. Contractor shall obtain field approval by the Contracting Officer for all exposed conduit runs prior to rough in.

C. Installation of Outdoor Pole Bases
   1. Contractor shall provide bases for luminaires.
   2. Pole base details shall be provided by the project structural engineer.
   3. Provide handhole for electrical connection within 4’-0” of pole base.
   4. Contractor shall:
      a. Rough-in conduits
      b. Coordinate spacing, base dimensions, heights, orientation of bases, etc. as necessary.
   5. Where square or rectangular poles or luminaire heads are used, Contractor shall verify orientation with Contracting Officer.

D. Pole Installation:
   1. Install luminaires, poles, hardware, etc., for complete system.
   2. Use web fabric slings (not chain or cable) to raise and set poles.

E. Grounding:
   1. Ground luminaires and metal poles according to Division 26 Section “Grounding and Bonding for Electrical Systems”.
   2. Poles:
      a. Install 10 ft driven ground rod at each pole.
   3. Nonmetallic Poles:
      a. Ground metallic components of lighting unit and foundations. Connect luminaires to grounding system with #10 AWG conductor.

3.02 SUBSTANTIAL COMPLETION

A. Quality Control:
   1. At Date of Substantial Completion, replace LED modules/LED luminaires which are not operating properly.
   2. Protection wrapping on lensed or louvered luminaires shall be removed before installation of furniture, but after finish work is complete.
   3. Deliver spare equipment to Contracting Officer.

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

C. Adjusting and Cleaning:
   1. Clean luminaires of handling marks, dust and dirt.

2. Cleaning and touch-up work shall be performed in accordance with luminaire manufacturer's recommendations.
3. Damaged luminaires or components shall be replaced with new.
4. Keep luminaires clean and protected for remainder of construction period.
5. Verify orientation of directional luminaires prior to installation.
    a. This includes wall washers, cove lighting, floodlights, exterior area lights and adjustable accent luminaires. Contractor shall provide electrician's services to aim, adjust, and focus luminaires, as required, at direction of Contracting Officer. These electricians shall be available at times designated by Contracting Officer and shall be provided at no extra charge to Government over base bid. Contractor shall provide equipment for luminaries' focus including ladders and mechanical lifting systems.
6. Program preset dimming system lighting levels.
7. Program ambient light sensors integral to luminaires for appropriate illumination levels as indicated in control narrative or in lighting control specifications.
8. Program occupancy sensors integral luminaires for appropriate time delay as indicated in control narrative or in lighting control specifications.
9. Exterior poles, bollards, bases and other exterior luminaires shall be painted to match factory color where finish has been damaged.
10. No light leaks shall be permitted at ceiling line from any visible part or joint.

D. Training
1. Contractor shall provide Owner with 1 complete hardcopy and (1) digital copy of Operations and Maintenance manuals.
    a. All "Approved as Noted" comments shall be corrected/picked-up in this record manual set.
    b. Each manual shall contain specific information pertaining to the equipment installed. Each manual shall contain at a minimum:
        1) Detailed as built shop drawings for all lighting equipment installed.
        2) Manufacturer's product cut sheets for all equipment installed keyed by type as to as built drawings.
        3) Manufacturer's complete installation instructions for all equipment installed keyed by type to as built drawings.
        4) Equipment maintenance requirements and schedules.
        5) Equipment manufacturer contacts.
        6) Equipment manufacturer warranties.
            a) Luminaires
            b) Drivers
            c) LED modules
2. Contractor shall provide qualified personnel onsite to provide a minimum of one day of training to Government Owner's representatives.
3. This training shall cover:
    a. Luminaire use and maintenance
    b. Architectural lighting system use and maintenance

END OF SECTION

DIVISION 27 -- COMMUNICATIONS

SECTION 27 10 00
STRUCTURED CABLING

PART 1 - GENERAL

1.01 SCOPE

A. This section details product and execution requirements for Structured Cabling for Communications Systems.

1.02 DESCRIPTION

A. Systems shall include cabling, termination hardware and active components, installed as indicated on drawings and specifications.

B. Cables and equipment shall be provided, tested, and terminated, including proper grounding and bonding.

1.03 REFERENCES AND STANDARDS

A. In addition:
   1. IEEE 802.3af and 802.3at Power-over-Ethernet Standards.

1.04 DEFINITIONS

A. In addition, the following definitions are applicable to communications environments and shall apply to this document and its companion sections for clarification and direction:
   1. Cable - assembly of 1 or more conductors or optical fibers within enveloping sheath, constructed so as to permit use of conductors singly or in groups.
   2. Interconnection - Connection scheme using connecting hardware for the direct connection of a cable to another cable without a patch cord or jumper

B. “10-gigabit” or “10G” performance criteria, if applicable, refers to support of 10GBASE-T application over 4-connector channel up to 100 meters and meeting requirements of TIA-568.2.

1.05 SUBMITTALS

A. In addition, Submit:
   1. Contractor Certification documents which document their participation in Installers Program operated by Manufacturer of Cabling or Termination Components used.
      a. Upon request, Certified Installer(s) assigned to Project shall be identified to Engineer.
   2. Meeting agenda for Pre-Construction Coordination Meeting

1.06 QUALITY ASSURANCE

A. General:
   1. Cable and Equipment Manufacturer(s) shall be company specializing in communications cable, accessories and/or equipment with minimum of 5 years documented experience in producing cable, accessories and/or equipment similar to those specified herein.

B. Contractor Qualifications:
   1. Qualified personnel utilizing state-of-the-art equipment and techniques shall complete cable and equipment installation and termination.
   2. Contractor shall have been in this business for minimum of 5 years and shall have successfully completed 4 projects 50% of magnitude of system specified in the following sections.

C. Contractor shall have necessary certifications to provide for Warranty as specified herein.
   1. Contractor shall be an active participant in Installers Program operated by Manufacturer of Cabling or Termination Components used.
      a. Contractor shall be participant in this program at time of Bidding and remain so throughout project.

1.07 WARRANTY

A. Warranty shall be direct from manufacturer(s) of cabling and connecting components to Owner.

PART 2 - PRODUCTS

2.01 GENERAL

A. Refer to individual Technical Sections.

2.02 POWER OVER ETHERNET

A. Connecting hardware shall comply with IEC 60512-99-001 for engaging and separating connectors under electrical load and connectors used in twisted pair communication cabling with remote power.

2.03 SYSTEM REQUIREMENTS

A. Structured cabling products shall be designed to work together as a fully-warranted system.

B. Acceptable Category 6A systems shall be:
   1. Belden REVConnect 10GX12 or equal.

PART 3 - EXECUTION

3.01 PRE-CONSTRUCTION COORDINATION MEETING

A. Prior to preparing and submitting submittals, Contractor shall arrange and conduct a pre-construction coordination meeting to review and coordinate Structured Cabling requirements.
   1. Attendees shall include:
      a. Owner’s project manager and Information Technology / Information Services representative(s)
      b. Construction Manager / General Contractor project manager and site superintendent / field foreman
      c. Division 26 project manager and site superintendent / field foreman
   2. Meeting agenda topics shall include:
      a. Coordinate division of work among trades.

3. Schedule meeting with minimum two weeks' notice.
    a. Publish agenda for meeting and distribute to invited attendees when meeting is scheduled.
4. Contractor shall take detailed notes during meeting and publish meeting notes within one week after meeting.
    a. Contractor shall distribute notes to invited attendees and Architect.

3.02 GENERAL

A. Refer to individual technical specification sections for detailed Cable Routing and Installation, Testing and Documentation requirements. The following apply to communications cabling and termination work.

B. Installation shall be per manufacturers' recommendations.

3.03 CABLE INSTALLATION

A. Run cabling in raceways provided, or as designated on floor plans, and support from building structure.

B. Cable shall be free of tension at both ends.
    1. In cases where cable must bear stress, provide Kellems grips to spread stress over longer length of cable.

C. Provide required installation tools to facilitate cable pulling without damage to cable jacket.

D. Keep cables clear of other trades work.

E. During pulling operation provide an adequate number of workers to allow cable observation at points of raceway entry and exit, as well as to feed cable and operate pulling machinery.

F. Pull cables in accordance with cable manufacturer's recommendations and ANSI/IEEE C2 Standards.

G. Pull cable by hand unless installation conditions require mechanical assistance.

H. Do not exceed recommended pulling tensions and bending radii.
    1. Where mechanical assistance is used, ensure that maximum tensile load for cable is not exceeded.
        a. This may be in form of continuous monitoring of pulling tension, use of "break-away" or other approved method.
    2. Replace cables bent or kinked to radius less than recommended dimension.
        a. Replacement shall be at no expense to Owner.

I. Install cables splice-free unless otherwise specified.

J. Avoid abrasion and other damage to cables during installation.
    1. Visually inspect cables for cuts, blisters and abrasions during installation.

K. Pulling lubricant may be used and shall:
    1. Be non-injurious to cable jacket and other materials used.
    2. Not harden or become adhesive with age.

L. Provide pull cord (200 lb minimum) with cable installed in conduit or innerduct.

3.04 FIELD TESTING

A. Cabling shall be 100% fault free unless otherwise noted. If any Link is found to be outside specification defined herein, identify and correct problem up to and including replacement of cable and associated termination(s). Then repeat applicable tests.

B. Test each cabling sub-system (e.g. backbone, horizontal, etc.) end-to-end.

C. Where sub-systems are to be interconnected or cross-connected by the contractor, test individual sub-system followed by a test of the connected links
   1. Performance and documentation requirements shall default to the lesser of the two connected systems if different.

D. Test instrument shall be configured using template for exact cable under test (e.g. by manufacturer product designation).
   1. If no template is available, enter cable parameters for the cable per manufacturer's product data.
      a. Nominal Velocity of Propagation (NVP) used for copper cable type under test shall be traceable to manufacturers' product data.
      b. Refractive Index used for fiber optic cable type under test shall be traceable to manufacturers' product data.
   2. Test results obtained using incorrect cable parameters will be rejected.

E. Test instrument shall be calibrated as defined by instrument manufacturer at least once every 12 months or as required by test instrument manufacturer if that results in more frequent calibration runs.
   1. Test instrument calibration date shall be present in test results documentation.

F. Refer to individual Technical Sections for system-specific guidelines regarding requirements for scheduling and performing compliance testing.

3.05 DOCUMENTATION

A. Refer to individual Technical Sections for system-specific guidelines regarding requirements for project Documentation.

B. Information added by Contractor to Record Drawings shall include:
   1. Backbone and horizontal cable routes
   2. Other detail necessary to document cable installation

3.06 OWNER TRAINING

A. Provide training for Owner's personnel on operation and maintenance of total system and each component.

B. Training to include:
   1. Overview of System Topology and General Concepts
   2. Overview of Product Used
   3. Overview of Equipment Room Layouts
   4. Overview of Labeling Formats
   5. Overview of Test Results and their meaning

6. Overview of Documentation

C. Training shall be held at Project Site and shall be conducted during normal working hours.

D. Training session duration shall be not less than one (1) h.
   1. Provide 1 such sessions.
   2. Coordinate with owner to schedule session(s). Provide adequate notification to allow owner to schedule staff.

E. Attendance shall be by owner staff and/or contract maintenance personnel.

F. Provide example course materials and instructor background in advance of training session(s).

G. Owner may videotape session(s) for use as future refresher materials for owner technical staff.

END OF SECTION

DIVISION 28 -- ELECTRONIC SAFETY AND SECURITY

SECTION 28 20 00
VIDEO SURVEILLANCE - AXIS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Network (IP) cameras.

B. Video management software.

1.02 RELATED REQUIREMENTS

A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

B. Section 26 05 29 - Hangers and Supports for Electrical Systems.

C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

D. Section 27 10 00 - Structured Cabling: Data cables for IP video surveillance system network connections.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NECA 303 - Standard for Installing and Maintaining Closed-Circuit Television (CCTV) Systems.

C. NFPA 70 - National Electrical Code.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate placement of cameras with structural members, ductwork, piping, equipment, luminaires, diffusers, fire suppression system components, and other potential conflicts.
   2. Coordinate work to provide power for cameras and equipment at required locations.
   3. Notify Contracting Officer of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Preinstallation Meetings:
   1. Conduct meeting with facility representative to review camera and equipment locations and camera field of view objectives.
   2. Conduct meeting with facility representative and other related equipment manufacturers to discuss video surveillance system interface requirements.

1.05 SUBMITTALS

A. See Section 01 33 23 - Submittal Procedures for submittal procedures.

B. Shop Drawings: Include plan views indicating locations of system components and proposed size, type, and routing of conduits and/or cables. Include elevations and details of proposed equipment arrangements. Include system interconnection schematic diagrams. Include requirements for interface with other systems.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets for each system component. Include ratings, configurations, standard wiring diagrams, dimensions, finishes, service condition requirements, and installed features.

D. Installer's qualification statement.

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

F. Field quality control test reports.

G. Project Record Documents: Record actual locations of system components and installed wiring arrangements and routing.

H. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

I. Executed warranty.

J. Specimen warranty.

K. Software: One copy of software not resident in read-only memory.

1.06 QUALITY ASSURANCE

A. Comply with the following:
   1. NFPA 70.
   2. Applicable TIA/EIA standards.

B. Maintain at project site one copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

D. Installer Qualifications: Company specializing in performing work of this section with minimum three years documented experience with video surveillance systems of similar size, type, and complexity; authorized manufacturer's representative.

E. Product Evaluation and Listing Organization Qualifications: Organization engaged in evaluation of products and services, including those recognized by OSHA as Nationally Recognized Testing Laboratories (NRTL), and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions and NECA 303.

B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 01 33 23 - Submittal Procedures for additional warranty requirements.

B. Provide manufacturer warranty equivalent to basis of design products covering repair or replacement due to defective materials or workmanship.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Axis Communications or equal.

B. Source Limitations: Where possible, furnish system components and accessories produced by single manufacturer and obtained from single supplier.

2.02 NETWORK (IP) CAMERAS

A. Provide cameras and associated accessories suitable for operation under service conditions at installed location. Provide additional components (e.g., enclosures, heaters, and blowers) as required.

B. Where not factory installed, provide additional components (e.g., lenses and mounting accessories) as necessary for complete installation.

C. Network (IP) PTZ Camera - Axis Communications P56 Series; Model P5676-LE (Outdoor, IR illumination); or equal.
   1. Maximum Video Resolution: 2688 x 512.
   2. Maximum Frame Rate: 50/60 fps at 50/60 Hz.
   3. Image Sensor Size: 1/2.9 inch.
   4. Minimum Illumination/Light Sensitivity (Color): 0.11 lux.
   5. Lens: 4.5-135 mm, F1.6-4.6; horizontal field of view of 57.0-2.1 degrees; autofocus, auto-iris.
   6. Pan/Tilt/Zoom: 360 degrees endless pan; 90 degrees tilt; 30x optical/12x digital zoom.
   7. Features: Zipstream, audio support (two-way), forensic capture wide dynamic range, local storage, Power over Ethernet (PoE), day and night functionality, built-in IR illumination, IP66/NEMA 4X/IK10 casing, four alarm inputs/outputs, image stabilization, focus recall.

2.03 VIDEO MANAGEMENT SOFTWARE

A. Unless otherwise indicated, provide all software and licenses required for fully operational system.

B. Video Management System - AXIS Camera Station Pro or equal.

1. Capacity: Supports unlimited number of cameras, servers, and clients; up to 4 monitors per graphics card.
2. Recording: Supports continuous, schedule, and event recording modes.
3. Video Search: Supports search by camera, date, and timeline; smart search, video scrubbing, and locking of prioritized recordings.
4. Features: H.264, H.265, MPEG-4, and Motion JPEG compression; dewarp support; PTZ control support; remote and mobile access via AXIS Camera Station Pro app; access control and cardholder management; object analytics.

2.04 ACCESSORIES

A. Camera Enclosures and Mounting Brackets:
   1. Where not factory installed, provide accessory camera enclosures suitable for operation under service conditions at installed location.
   2. Where not factory installed, provide accessory camera mounting brackets necessary for installation.

B. Provide components as indicated or as required for connection of video surveillance system to devices and other systems indicated.

C. Provide components as indicated or as required for system power and network connections.

D. Provide accessory controllers as indicated or as required for operator control.

E. Provide cables as indicated or as required for connections between system components.
   1. Data Cables for IP Network Connections: Unshielded twisted pair (UTP), minimum Category 6, complying with Section 27 10 00.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify field measurements.

B. Verify ratings and configurations of system components.

C. Verify that mounting surfaces are ready to receive system components.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to system where applicable.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install video surveillance system in accordance with NECA 1 (general workmanship) and NECA 303.

B. Install products in accordance with manufacturer's instructions.

C. Provide required support and attachment; see Section 26 05 29.

D. Wiring Method for NFPA 70 Class 2 and Class 3 Circuits: Unless otherwise indicated, use cables (not in conduit), where permitted by code.
   1. Use suitable listed cables in wet locations, including underground raceways.
   2. Use suitable listed cables for vertical riser applications.
   3. Use listed plenum rated cables in spaces used for environmental air.
   4. Install wiring in conduit for the following:
      a. Where required for rough-in.
      b. Where required by authorities having jurisdiction.
      c. Where exposed to damage.
      d. Where installed outside the building.
      e. For exposed connections from outlet boxes to cameras.
   5. Conceal cables unless specifically indicated to be exposed.
   6. Cables in the following areas may be exposed, unless otherwise indicated:
      a. Equipment closets.
      b. Within joists in areas with no ceiling.
   7. Route exposed cables parallel or perpendicular to building structural members and surfaces.
   8. Include service loop cable lengths to allow relocation of cameras within 30 ft of installed location.

E. Provide grounding and bonding; see Section 26 05 26.

F. Identify system wiring and components; see Section 26 05 53.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Prepare and start system in accordance with manufacturer's instructions.

C. Adjust cameras to provide desired field of view and produce suitable images under all service lighting conditions.

D. Program system parameters according to requirements of Owner.

E. Test for proper interface with other systems.

F. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

3.04 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.

B. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of four hours of training.
3. Instructor: Manufacturer's authorized representative.
4. Location: At project site.

3.06 PROTECTION

A. Protect installed system components from subsequent construction operations.

END OF SECTION

DIVISION 31 -- EARTHWORK

SECTION 31 10 00
SITE CLEARING

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. This Section specifies requirements for site clearing, including demolition of site structures.

B. The work includes:

1. Protection of existing vegetation to remain
2. Clearing and grubbing
3. Selective clearing and thinning
4. Site demolition of structures, retaining walls, signage, light standards, foundations, and appurtenances
5. Removal and abandonment of utilities
6. Filling or removal of underground tanks and piping
7. Disposal of material from clearing, grubbing, thinning, and demolition in approved off-site disposal areas
8. Filling of voids and excavations resulting from the work

1.2 RELATED REQUIREMENTS

A. Section 011000 – Summary of Work

B. Section 015000 - Temporary Facilities and Controls

C. Section 017340 - Execution

D. Section 017419 - Construction Waste Management and Disposal

E. Section 312300 – Earthwork, Unclassified Excavation

F. Section 312333 - Excavation, Backfilling, and Compaction for Pipes and Utility Trenches

1.3 INFORMATIONAL SUBMITTALS

A. See Section 013323 – Submittal Procedures

B. Site Plan: Showing:

1. Vegetation removal limits.
2. Areas for temporary construction and field offices.

C. All permits and notices authorizing site clearing and demolition.

D. Certificates of utility service severances.

E. Permits for transport and disposal of debris.

F. Demolition procedures and operational sequence.

1.4 **QUALITY ASSURANCE**

A. Clearing Firm: Company specializing in the type of work required.

1. Minimum of 10 years of documented experience.

PART 2 – PRODUCTS

2.1 **MATERIALS**

A. Tree Guard: Lumber shall be Yellow Pine, Douglas Fir or Spruce of the dimensions shown on plans. Nails shall be galvanized. No paint will be required. All work shall be done in a neat and workmanlike manner to the satisfaction of the Contracting Officer.

B. High Density Polyethylene (HDPE) mesh: Color to be orange.

C. Line Post/Stake: Line post/Stake shall be No. 4 rebar.

PART 3 – EXECUTION

3.1 **SITE CLEARING**

A. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

B. Tree protection measures shall be in place before site clearance can commence.

3.2 **EXISTING UTILITIES AND BUILT ELEMENTS**

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Protect existing structures and other elements that are not to be removed.

3.3 VEGETATION

A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, playing fields, lawns, and planting beds.

B. Do not begin clearing until vegetation to be relocated has been removed.

C. Do not remove or damage vegetation beyond the limits indicated on drawings.

1. 50 feet (12 m) outside the building perimeter.
2. 10 feet (3.1 m) each side of surface walkways, patios, surface parking, and utility lines less than 12 inches (305 mm) in diameter.
3. 15 feet (4.6 m) each side of roadway curbs and main utility trenches.
4. 25 feet (7.5 m) outside perimeter of pervious paving areas that must not be compacted by construction traffic.
5. Exception: Specific trees and vegetation indicated on drawings to be removed.
6. Exception: Selective thinning of undergrowth specified elsewhere.

D. Install substantial, highly visible fences at least 3 feet high (at least 1 m high) to prevent inadvertent damage to vegetation to remain:

1. At vegetation removal limits.
2. Around trees to remain within vegetation removal limits; locate no closer to tree than at the drip line.
3. Around other vegetation to remain within vegetation removal limits.

E. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum disturbance of the subsoil.

F. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.

1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.
2. Trees: Sell if marketable; if not, treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches (450 mm).
3. Existing Stumps: Treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches (450 mm).
4. Sod: Re-use on site if possible; otherwise sell if marketable, and if not, treat as specified for other vegetation removed.
5. Fill holes left by removal of stumps and roots, using suitable fill material, with top surface neat in appearance and smooth enough not to constitute a hazard to pedestrians.

G. Dead Wood: Remove all dead trees (standing or down), limbs, and dry brush on entire site; treat as specified for vegetation removed.

H. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to the Government.

3.4 DEBRIS

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 31 22 00
GRADING, FILLING AND COMPACTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General Agreement and Supplementary Conditions and Division 1 - General Requirements, apply to the work of this Section.

1.02 DESCRIPTION

A. Grading, filling, proofrolling, compaction testing, and placement and compaction of stone subbase. Removal of all obstructions, piles, foundations, structures and other materials etc. encountered during the course of construction shall be in accordance with Section 312300 of these Specifications.

B. Draining and/or pumping, if required, to keep excavation free from water.

C. Stockpiling on site fill material.

D. Laying out lines and grades by a surveyor for final grading.

E. Obtaining the services of an approved testing laboratory for compaction testing of fill material.

F. Cleaning up the site upon completion of Contract work.

RELATED WORK

A. Related work is described in the following sections of the specifications:

Section 31 23 19: Dewatering

Section 31 23 33: Excavation, Backfilling and Compaction for Pipes and Utility Trenches

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM).

ASTM C 117 - Test Method for Material Finer than No. 200 Sieve in Mineral Aggregates by Washing.

ASTM C 136 - Method for Sieve Analysis of Fine and Coarse Aggregates. ASTM D 422 - Test Method for Particle - Size Analysis of Soils.

ASTM D 698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb Hammer and 12 inches Drop.

ASTM D 1556 -Test Method for Density of Soil in Place by the Sand-Cone Method.

ASTM D 2922 -Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)·

ASTM D 3017 -Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)·

ASTM D 4318 -Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

1.04 **SUBMITTALS**

Submit 14 days prior to fill placement:

A. Proposed equipment to be used in compacting fill or backfill material.

B. If imported fill is used, provide gradation curves. When imported material is used, the contractor shall submit a ticket with each load of material delivered to the site indicating date and time loaded and delivered, source of material, amount in the load and class of material.

1.05 **QUALITY ASSURANCE**

A. The Contractor shall not perform proofrolling or final grading operations on soil which is too wet to be properly rolled or compacted as determined by the Contracting Officer.

B. Fill material for grading will be subject to the approval of the Contracting Officer.

PART 2. - PRODUCTS

2.01 **MATERIALS**

A. Fill shall be clean, free from deleterious debris or organic matter, with no more than 15 percent fines passing the No. 200 sieve, and the maximum dimension of the largest stone not exceeding 4 inches.

B. Select material shall be clean, free from debris and organic matter, with a maximum particle size of 3 in. and not more than 10% by weight passing the ASTM D1140 No. 200 sieve size.

PART 3. - EXECUTION

3.01 **PREPARATION AND LAYOUT**

A. Establish extent of excavation by area and elevation; designate and identify datum elevation.

B. Set required lines and levels.

C. Maintain benchmarks, monuments and other reference points.

3.02 **UTILITIES**

A. Existing utility systems and service lines to remain and those encountered during excavation, if damaged, shall be repaired at the Contractor's expense. Relocation of existing utility systems and service lines, to

accommodate the completion of the project, whether on or off the site, shall be the responsibility of the Contractor.

B. The Contractor shall contact utility companies for information pertaining to locations and construction of existing systems before starting excavation.

3.03 COMPACTION

A. Prior to placement of fill, the subgrade shall be proofrolled with minimum of two passes by the approved roller that is to be used for backfill placement.

B. Fill shall be compacted to achieve a density of at lest 95 percent of the maximum density as determined by Method D of ASTM D 698.

C. Fill shall be placed in maximum eight-inch loose lifts and compacted with a minimum of six passes with an approved vibratory roller.

D. Do not place and compact fill on frozen subgrade.

3.04 DEWATERING

A. Prevent surface water and subsurface water or groundwater from flowing into excavations and from flooding project site and surrounding area.

B. Do not allow water to accumulate in excavations. Provide and maintain pumps, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

C. Convey water removed from excavations and rainwater to collecting or run-off areas. Establish and maintain temporary drainage ditches and other diversions outside excavation limits. Do not use trench excavations as temporary drainage ditches.

3.05 MATERIAL STORAGE

A. Stockpile satisfactory excavated materials where directed. Place, grade and shape stockpiles for proper drainage.

B. Locate and retain soil materials away from edge of excavations.

C. Storage areas shall be subject to the approval of the Owner and/or the Contracting Officer.

D. All excess material not incorporated in the work shall become the property of the contractor and shall be disposed of off site.

3.06 FIELD TESTS

A. The Contractor shall engage the services of an approved testing laboratory to determine the in-place density of the soil after compaction is completed.

B. Compaction tests shall be performed at a frequency of one for every 250 square feet of excavated/backfilled area and street area shown on the Contract Drawings. Test methods may be either Sand-Cone (ASTM D 1556), or nuclear method determined by ASTM D 3017.

C. If fill has not been sufficiently compacted as determined by in-place density tests, the compaction effort shall be continued and moisture content shall be adjusted as necessary until the specified compaction is obtained.

3.07 **CLEAN UP**

A. All surplus materials furnished by the Contractor and all equipment and temporary structures shall be removed from the site by the Contractor. All dirt and rubbish shall be hauled off site and the construction site left clean to the satisfaction of the Contracting Officer.

END OF SECTION

SECTION 31 23 00
EARTHWORK, UNCLASSIFIED EXCAVATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General Agreement and Supplementary Conditions and Division 1 - General Requirements, apply to the work of this Section.

1.02 DESCRIPTION

A. This work shall consist of excavation, disposal, placement and compaction of all materials that are not provided for under another section of these specifications. Additional compensation for excavation of items encountered, regardless of material or description will not be considered.

B. The excavation shall consist of the excavation and disposal of all materials of any description, encountered in the course of construction unless otherwise specified in these specifications elsewhere. All the excavation shall be done within the limits required for construction.

1. Unclassified excavation shall consist of the excavation and disposal of all materials, of any description, encountered in the course of construction, unless otherwise specified in the contract.

2. Unclassified excavation also includes all obstructions, piles, pile caps, foundations, etc. encountered in the course of construction. Pile caps, foundations, structures and other materials encountered during the excavation shall be removed in their entirety, within the limits of the excavation and 2'0" below the subgrade.

3. Excavations within one foot of finished subgrade and below finished subgrade when cutting piles and removing foundations should be done with care to prevent disturbance to subgrade materials.

C. Excavation shall be done as required for construction of the project.

D. Rough grading and proofrolling of all subgrade within 1" of required subgrade elevation.

E. Draining and/or pumping, if required, to keep excavation free from water.

F. Disposing of off site all excavated material not suitable for backfilling, including rubbish and debris.

G. Laying out lines and grades by a Licensed Surveyor for final grading.

H. Cleaning up the site upon completion of Contract Work.

1.03 RELATED WORK

A. Related work is described in the following sections of the specifications
Section 31 23 33: Excavation, Backfilling, and Compaction for Pipes and Utility Trenches

1.04 REFERENCES

A. Perform all required work in accordance with the applicable rules and regulations and the Codes and Ordinances of Local, State and Federal Authorities including:
New York State Department of Transportation Standard Specifications (NYSDOTSS) Construction and Materials

1.05 SUBMITTALS

Submit for approval within 14 days after Notice to Proceed:

A. Proposed methods, equipment and sequence of operations for excavation.

1.06 QUALITY ASSURANCE

A. The Contractor shall not perform proof rolling or final grading operations on soil which is too wet to be properly rolled or compacted as determined by the Engineer.

PART 2. - PRODUCTS

2.01 MATERIALS

A. Fill material shall consist of granular material containing not more than 15% by weight of material passing the No. 200 sieve, and shall be free of organic matter and debris. The fill shall contain no particles exceeding 4 inches in the largest dimension.

B. Material previously excavated from the site shall not be re-used.

PART 3. - EXECUTION

3.01 PREPARATION AND LAYOUT

A. Establish extent of excavation by area and elevation; designate and identify datum elevation.

B. Set required lines and levels.

C. Maintain benchmarks, monuments and other reference points.

3.02 UNCLASSIFIED EXCAVATION

A. All excavation is unclassified and consists of removal and disposal of material encountered when establishing required subgrade elevations and/or cutting piles and removing materials encountered unless otherwise noted on the Contract Drawings.

B. Excavate to elevations required for installation of permanent construction in such a manner to minimize disturbance to subgrade below such elevations

C. Where existing pile caps, foundations or other existing construction are encountered, remove them in their entirety.

D. All debris, excess material, and all material unsuitable for fill, shall be disposed of offsite.

E. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations, limits or dimensions without specific direction of the Engineer. Unauthorized excavation, shall be at the Contractor's expense.

F. Fill shall be placed at a moisture content within 3% of the optimum moisture content for the material to be placed. Material that is too wet for placement shall not be used as backfill.

3.03 UTILITIES

A. Existing utility systems and service lines to remain and those encountered during excavation, if damaged, shall be repaired at the Contractor's expense. Relocation of existing utility systems and service lines, to accommodate the completion of the project, whether on or off the site, shall be the responsibility of the Contractor.

B. The Contractor shall contact utility companies for information pertaining to locations and construction of existing systems before starting excavation.

C. Utilities identified in the plans as “to be removed” or “to be abandoned” that are encountered during excavation shall be removed in their entirety at the direction of the engineer in accordance with specification 33 01 32 – Terminate and Demolish Existing Utilities.

3.04 SCHEDULING OF WORK TO MINIMIZE SOIL EROSION AND WATER POLLUTION

A. The Contractor shall prepare and submit to the Engineer for approval, schedules for all excavation, stripping, embankment, fill and grading operations connected with the project in or outside of the project limits. Earthwork shall not be started at a given location until the method and sequencing of all operations are established in accordance with approved plans and approved by the Engineer and per the Erosion Control Drawings.

3.05 DRAINAGE AND GRADING

A. The Contractor shall provide and maintain slopes, crowns and ditches on all excavation and embankments to insure satisfactory surface drainage at all times. Ditches and other drainage facilities necessary to remove ponded water shall be constructed as soon as practical to have the work area dry during the progression of work. All existing culverts and drainage systems to remain shall be maintained in satisfactory operating condition throughout the course of the work. If it is necessary to interrupt existing surface drainage, sewers or under-drainage, then temporary drainage facilities shall be provided until the permanent drainage work is complete.

B. Any portion of an embankment or subgrade which has, in the opinion of the Engineer, been damaged by the Contractor's equipment during the course of construction, shall be repaired and recompacted by the Contractor to the satisfaction of the Engineer

C. Where seepage causes instability of cutslopes, excavation and backfill or other corrective measures shall be performed as ordered by the Engineer. Excavation for the installation of slope protection may be necessary at any time and location throughout the duration of the contract and may not necessarily coincide with the Contractor's performance of the general excavation work.

3.06 COMPACTION

A. General Requirements

It shall be the Contractor's responsibility to properly place and compact all materials in all sections and to correct any deficiencies resulting from insufficient or improper compaction of such materials throughout the contract period. The Contractor shall determine the type, size and weight of compactor best suited to the work at hand, select and control the lift (layer) thickness, exert proper control over the moisture content of the material, and other details necessary to obtain satisfactory results. During the progression of the work, the Engineer will inspect the Contractor's operations and will permit the work to continue where the following requirements are met:

1. Prior to backfilling, the subgrade shall be proofrolled with a minimum of two passes by the approved roller that is to be used for fill placement.

B. Backfill shall be placed in maximum eight inch lifts and compacted with a minimum of three passes with an approved vibratory roller. Backfill shall be compacted to achieve a density of at least 95 percent of the maximum density as determined by method D of ASTM D698.

C. Overlap passes a minimum of six inches.

D. In areas where use of roller is not practical, place fill in maximum four inch lifts and compact with approved pneumatic mechanical tampers, or plate vibrators.

E. Do not place and compact fill on frozen subgrade.

3.07 DEWATERING

A. Prevent surface water and subsurface water or ground water from flowing into excavations and from flooding project site and surrounding area.

B. Do not allow water to accumulate in excavations. Provide and maintain pumps, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

C. Convey water removed from excavations in accordance with Specifications 31 23 19 – Dewatering.

3.08 MATERIAL STORAGE

A. The Contractor shall schedule and progress the construction in a manner that will minimize the requirements for storage of excavated materials. If approved by the Owner, the Contractor may stockpile satisfactory excavated materials where directed. Place, grade, and shape stockpiles for proper drainage.

B. Locate and retain soil materials away from the edge of excavations.

C. Storage areas shall be subject to the approval of the Engineer

D. All excess material not incorporated in the work shall be legally disposed of off-site by the Contractor in accordance with applicable standards and regulations of agencies with jurisdiction and as specified by the Owner.

END OF SECTION

SECTION 31 23 19
DEWATERING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General Agreement and Supplementary Conditions and Division 1 - General Requirements, apply to the work of this Section.

1.02 DESCRIPTION

A. Provide dewatering for excavations, installing water mains, storm sewers, drains and other sewers wherever required.

B. The Contractor shall obtain approvals and dispose of ground water as per N.Y. Cityand State regulations. Pumping of ground water onto the site is not permitted.

1.03 APPROVALS AND PERMITS

A. Obtain necessary approvals and permits to dispose of dewatered water.

1.04 RELATED WORK

A. Related work is described in the following sections of the specifications:

Section 31 23 00: Earthwork, Unclassified Excavation

Section 31 23 33: Excavation, Backfilling and Compaction for Pipes and Utility Trenches

PART 2. - PRODUCTS

NOT USED

PART 3. - EXECUTION

3.01 METHOD

A. The method of dewatering shall be designed by the Contractor so that construction can be performed in the "dry" including placing of concrete, utilities and/or bedding for the slab/utility trenches.

B. Dewatered water shall be disposed of through proper means, far enough from the trench to avoid hazardous conditions.

END OF SECTION

SECTION 31 23 33

EXCAVATION, BACKFILLING AND COMPACTION FOR PIPES AND UTILITY TRENCHES

PART 1. - GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General Agreement and Supplementary Conditions and Division 1 - General Requirements, apply to the work of this Section.

1.02 DESCRIPTION

A. 1. The excavating, backfilling and compaction for pipes and utility trenches.

2. Removal of all obstructions, piles, foundations, structures etc. encountered during the course of construction in trenches. Pile caps and foundations in their entirety for the full width of the trench and/or excavation.

3. Excavations within one foot of finished subgrade and below finished subgrade when cutting piles and removing foundations should be done with care to prevent disturbance to subgrade materials.

B. To furnish and deliver select fill/backfill, place and compact select fill/backfill in the excavated trench for sewers and water mains as shown on the plans in accordance with the specifications.

C. Excavation to the lines, grades and limits shown on the Contract Drawings.

D. Draining and/or pumping, if required, to keep excavation and trenches free from water.

E. Stockpiling on site and disposing off site excess suitable excavated granular material, disposing off site of excavated material not suitable for backfilling, including rubbish and debris.

F. Laying out lines and grades, by survey, for drainage pipe installation and final grading.

G. Backfilling and compaction of stone bedding and select fill/backfill material to the lines and grades indicated on the Contract Drawings.

H. Protection of existing utilities and structures to remain that are exposed during excavation.

I. Cleaning up the site upon completion of Contract work.

J. All temporary sheeting work shall meet or exceed requirements of the New York State Department of Labor, Industrial Code Rule 23 and Title 29 Code of Federal Regulations Part 1926, Safety and Health Regulations for Construction (OSHA). All temporary sheeting work shall meet the latest version of the NYC Building Codes.

1.03 RELATED WORK

A. Related work is described in the following sections of the specifications

Section 31 23 00: Earthwork, Unclassified Excavation

Section 33 01 00: Maintaining and Protecting Existing Privately Owned Utilities
Section 33 12 20: Type K Copper Tubing

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM)

ASTM C 117 - Test Method for Material Finer than No. 200 Sieve in Mineral Aggregates by Washing.

ASTM C 136 - Method for Sieve Analysis of Fine and Coarse Aggregates. ASTM D

422 - Test Method for Particle-Size Analysis of Soils.

ASTM D 698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb Hammer and 12-in. Drop.

ASTM D 1556 -Test Method for Density of Soil in Place by the Sand-Core Method.

ASTM D 2922 -Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods. (Shallow Depth)

ASTM D 3017 -Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods. (Shallow Depth)

ASTM D 4318 -Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

B. Standard NYCDEP Sewer Specifications, NYCDEP Water Main Specifications, and applicable Standards Drawings.

1.05 SUBMITTALS

Submit 21 days prior to commencement of trench excavation:

A. Where sheet piling or sheeting is required, submit detailed shop drawings and design calculations of the sheeting and bracing system to the Engineer for review. Shop drawings and calculations shall be prepared by a Professional Engineer licensed in the State of New York who has a minimum of five years of experience in the design of soil retaining structures. The shop drawings shall be sealed and signed by a Professional Engineer.

Submit 14 days prior to installation of stone bedding:

A. Gradation curves for the stone bedding to be used in supporting drainage structures.

Submit 14 days prior to placement of backfill:

A. Proposed equipment to be used in compacting trench select fill/backfill material

B. If imported select fill is used, provide gradation curves. When imported material is used, the Contractor shall submit a ticket with each load of material delivered to the site indicating date and time loaded and delivered, source of material, amount in the load and class of material. This will not be basis for payment.

Submit 14 days prior to installation of stone subbase:

A. Compaction test results of backfill material used in trench backfilling.

1.06 QUALITY ASSURANCE

A. The select fill/backfill material for backfilling trenches will be subject to the approval of the Engineer.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Bedding/Fill Materials for Sewers and Private Utilities:

Work and materials shall be in accordance with the NYCDEP Standard Sewer Specifications and NYCDEP Standard Drawings, except that private utility fill material shall be subject to the requirements of the affected private utility company.

1. Pipe bedding for ductile iron pipe catch basin connections, sewers and house connections shall be crushed stone complying with the requirements of Standard Sewer Specification (SSS) Sections 2.25 and 4.12. Bedding beneath pile caps for sewer pipe and manholes on piles shall be stone ballast per SSS Section 2.25.

2. Trench backfill within the sewer or utility trench up to an elevation 2 feet above the pipe shall be select granular fill per Standard Sewer Specification Sections 2.24 and 4.06.

3. Trench backfill within the sewer or utility trench from 2 feet above the pipe up to pavement subgrade shall be Clean Backfill or approved re-fill material, complying with the provisions of Standard Sewer Specification Sections 2.24 and 5.29.

4. Filter fabric wrap shall be Mirafi 140 or equal.

B. Bedding/Fill Materials for Other Pipes and Utilities

a. Stone Bedding: Crushed limestone or trap rock conforming to the following gradation determined in accordance with ASTM C 136 and C 177:

Sieve Size	Total Passing Percent by Weight
2½ inch	100
1 inch	60 – 100
3/4 inch	45 - 85
3/8 inch	30 - 60
No. 10	14 - 30

No. 40	3 - 15
No. 200	0 - 3

Stone bedding placed within 5-feet of finished grade shall be free of all concrete and concrete products, asphalt pavement, brick and glass.

Recycled concrete aggregate shall not be acceptable.

b. Select Fill/Backfill shall be clean, natural sand of no clay contents and having a gradation where 100% will pass a 1-inch square opening sieve and all will be retained on a No. 200 sieve, and shall in all other respects conform to the requirements of ASTM D1073, Fine Aggregate for Bituminous Paving mixtures.

C. Sheeting

a. The Contractor has an option to use wood or metal sheeting. Each type of sheeting planned for use in the project area has to be pre-approved.

b. For excavations greater than five (5') feet in depth, sheeting and shoring shall be designed by NYS licensed professional engineer in accordance with NYC Building Code. The Contractor shall submit sheeting and shoring plan and details for approval by the Engineer. Upon approval, the contractor shall file for and obtain DOB permit prior to excavation. No Excavation work requiring sheeting shall commence until approvals and permits are obtained. The Contractor may proposed a stepped or sloped excavation in lieu of sheeting and shoring, provided that it is done at no additional cost to the city and shop drawings and stability analysis are submitted for approval prior to excavation.

PART 3. - EXECUTION

3.01 GENERAL REQUIREMENTS

A. Prior to excavation, investigation shall be made by the Contractor to determine the exact locations of existing underground structures and utilities. The Contractor shall notify all affected utility companies in the area a minimum of 3 working days before commencing work.

B. Contractor shall excavate with extreme caution when excavating near or above locations of known or suspected pipe and utilities.

C. Do not traverse paved areas with tracked vehicles or equipment such as carry-all scrapers which may damage such pavement unless protected to the satisfaction of the Engineer.

3.02 EXCAVATION

A. Open cut from surface, as shown on the Contract Drawings, to elevations required for installation of pipes.

B. Existing foundations, pile caps, or other existing construction shall be removed in its entirety within the limits of the excavation and 24" below subgrade.

C. Comply with Sections 4.02, 4.03 and 4.04 of the Standard Water Main Specifications and

the Standard Sewer Specifications.

3.03 SHEETING AND SHORING

A. Where required for protection of adjacent utilities and structures or where required for performance of the Work, secure the sides of excavations against movement as follows:

1. Install sheet piling or sheeting held in place by waling and bracing members. Top of sheeting shall extend at least six inches above ground.

2. Do not excavate below the bottom of sheet piling or sheeting except as necessary to install sheeting.

3. Comply with all Local, State and Federal regulations having jurisdiction.

B. Trenches may be widened to provide stable slopes or protected by use of a portable trench shield in lieu of sheeting.

C. Comply with Section 4.05 of the Standard Water Main Specifications and the Standard Sewer Specifications.

D. The type of sheeting and bracing shall conform to the approved drawings and to the satisfaction of the Engineer. The approval by the Engineer of a method to be used does not relieve the Contractor of his responsibility for protection and safety. Unless otherwise directed, all temporary sheeting and bracing shall be removed prior to backfilling.

E. When sheeting is used in trenches or excavations for structures of less than five (5') feet in depth, the cost of such sheeting and bracing, unless ordered left in place, shall be included in the price bid for the item "Unclassified Excavation" (see specification Section "Shoring") and payment will be made for such excavation to the maximum payment lines shown on the Plans and in accordance with the Standard Details.

3.04 EXISTING STRUCTURES AND UTILITIES

A. Structures and utilities which are to remain shall not be disturbed without consent of Engineer and representatives of affected utilities. Brace and shore structures and utilities when exposed to prevent damage. Any damage shall be immediately reported to the affected utility company and the Engineer. The Contractor will be responsible for making repairs to the satisfaction of the Engineer and the utility company.

B. Any interference between the existing utilities to remain and the proposed installation not shown on the Contract Drawings shall be immediately reported to the Engineer and the utility company. The Contractor shall be responsible for relocating the affected existing utilities as approved by the Engineer and the utility company.

C. Perform excavation around and adjacent to existing structures, pipes and conduits which are to remain in place, without damage to or movement of existing construction. When excavation is to be performed under such structures pipes and conduits, support them in a manner as approved by the Engineer and the utility company to ensure uninterrupted operation of the supported items.

3.05 ABANDONED UTILITIES

A. Close open ends of abandoned underground utilities with sufficiently strong closures to withstand pressures which may result after closing.

B. Close open ends of metallic conduit and pipe with threaded galvanized metal caps or plastic plugs, or other suitable method for the type of material and size of pipe. Do not use wood plugs.

C. Close open end of concrete and masonry utilities with not less than eight inches thick brick masonry bulkheads, constructed to completely fill the opening.

3.06 DEWATERING

A. The Contractor shall provide and maintain at his own expense ample means and equipment such as pumps, drains and sumps for dewatering and properly disposing of water entering the trenches, and other parts of the work.

B. Prior to placement of any permanent construction or backfilling any excavated area, lower the water table in said area to one foot below the elevation of the required subgrade and maintain this condition until the construction or pavement is placed thereon.

C. Dewatering shall be done in an approved manner such that the subgrade can be trimmed, foundation materials, pipe or concrete placed in the dry, without disturbing bearing materials, and water from the excavation shall be disposed of in such manner that will cause no injury to property or inconvenience to the public.

D. Dewater in a manner to prevent the loss of ground due to the migration of soil fines into the dewatering system.

3.07 STORING MATERIALS AND CARE OF STRUCTURES

A. All excavated and other materials shall be so placed as not to endanger the work, and so that free access may be had at any time to all parts of the trench and to all hydrants and gates on pipes in the vicinity, and shall be kept neatly in piles, so as to inconvenience as little as possible public travel or the adjoining tenants.

B. Storage areas shall be subject to the approval of the Owner and/or the Engineer.

3.08 ALIGNMENT AND GRADE

A. Finished trench bottoms shall be true and even and shall be maintained to lines and grades established by the plans. Trench bottoms for gravity sewer or drainage pipes shall be checked for alignment and grade before laying pipe.

3.09 STONE BEDDING

A. Stone bedding shall be required for all ductile iron water and sewer pipe and manholes and shall meet the gradation requirements in Part 2 of this Section. Bedding shall have a minimum compacted thickness as shown on the Contract Drawings. Bedding material shall be compacted in lifts per Section 5.21A of the Standard Water Main Specifications

and Sections 4.12, 5.13 and 5.16 of the Standard Sewer Specifications.

B. Stone bedding shall be placed in filter fabric as shown on the plans, the standard drawings, and as approved by the Engineer.

3.10 BACKFILL AND COMPACTION

A. Backfill for sewers and water mains shall be placed and compacted in lifts per Section 4.06 of the Standard Water Main Specifications and the Standard Sewer Specifications.

B. Other backfill shall be placed and compacted in eight-inch loose lifts. Compact surface with a minimum of six passes of an approved vibratory steel roller operated at a speed not to exceed 3 miles per hour and at the optimum operating frequency recommended by the manufacturer.

C. Overlap passes of roller a minimum of six inches.

D. Subgrade, excavated surfaces, existing surfaces, backfill and fill shall be compacted to achieve a density of at least 95 percent of the Standard Proctor maximum density as determined by ASTM D 698.

E. Moisture content of backfill and fill material shall be within a range of plus or minus two percent of optimum.

E. Trench backfill material shall be as specified in Part 2 of this Section.

1) a) For sewer and other utility work, trench backfill up to an elevation 2 feet above the top of pipe or utility shall be Select Granular Fill, compacted in lifts per Standard Sewer Specification Section 4.06.
   b) Trench backfill from 2 feet above the sewer pipe/utility up to pavement subgrade shall be Clean Backfill or approved re-fill material, compacted in lifts per Standard Sewer Specification Sections 4.06 and 5.29.

G. In areas where use of roller is impractical, backfill material shall be placed and compacted in four inch loose lifts equally on both sides of the pipe. Each layer shall be compacted with an approved mechanical tamper in a manner so as not to disturb the line and grade of pipe.

H. Do not place fill or backfill on frozen subgrade.

I. The surface of filled or backfilled areas which are to receive pavement or on which a structure is to be placed, shall be within plus or minus 1/2 inch of the elevations shown on the Contract Drawings and shall be free of depressions or projections greater than 1/2 inch when tested with a 16 foot straight edge. The surface of filled areas at other locations shall be within plus or minus one inch of elevations shown on the Contract Drawings unless a closer tolerance is necessary to meet requirements of other Sections of the specifications or the Contract Drawings.

3.11 BACKFILL METHODS

A. 1. Where shown on the Contract Drawing, imported clean select fill/backfill shall be placed in the space to be wrapped with filter fabric.

2. The select fill/backfill shall be compacted to a minimum of 95% of the standard Maximum Proctor Density.

3. Tamping for all select fill/backfill shall be performed by mechanically powered equipment designed for that purpose, except in the immediate area of underground facilities where such tamping may be impractical. The select fill/backfill within the immediate area of such facilities shall be wetted and lightly hand-tamped to assure the specified density. The immediate area shall be considered to be a maximum of eighteen (18) inches around the underground facility. The Contractor shall provide sufficiently wetted lifts with as many strokes as required to achieve the specified density.

B. Trench Backfill

All trenches and excavation shall be backfilled immediately after the pipes and structures are built and inspected.

C. Method for Depositing All Backfill

1. Sewers and water mains for which permission to backfill has been given, shall be covered for a depth of at least two (2) feet over the top of the sewer or one (1) foot over the top of water mains before the completion of each day's work. This select fill/backfill shall be deposited on all sides of the sewer in layers not exceeding six (6) inches in depth and solidly compacted by mechanical tamping or other approved means in such a manner as to avoid damage to the sewer and to achieve the required density.

2. The remainder of the trench up to pavement subgrade shall be backfilled with Clean Fill or approved re-fill material, deposited in successive layers not exceeding two (2) feet in depth. Each succeeding layer shall be compacted. The trench which has been completely backfilled shall be further compacted by the use of an 8-10 ton heavy rubber-tired truck or other approved equipment.

D. Backfilling Around Sheeting

1. When sheeting is withdrawn, all cavities remaining in or adjoining the trench shall be solidly filled. When sheeting is to be left in place, all cavities behind such sheeting shall be solidly filled.

2. Backfill shall proceed simultaneously with the withdrawal of sheeting and as each layer is compacted in accordance with the procedure or procedures described above. Withdrawal of sheeting below levels previously backfilled is prohibited.

3.12 FIELD TESTS

A. The Contractor shall engage the services of an approved testing laboratory to determine the in-place density of the soil after compaction is completed. All proctor analyses of soils and in-place density testing shall comply with Section 7.12 of the NYCDOT Highway

Specifications.

B. Density tests are to be performed as directed at trench subgrade, at various lifts of compacted trench backfill and at pavement subgrade. The minimum number of field density tests to be performed shall be in accordance with Section 4.06 of the Standard Sewer Specifications and the Standard Water Main Specifications.

C. If fill and backfill have not been sufficiently compacted as determined by in-place density tests, the compaction effort shall be continued, and moisture content shall be adjusted as necessary until the specified compaction is obtained.

END OF SECTION

SECTION 31 25 00
EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General Agreement and Supplementary Conditions and Division 1 - General Requirements, apply to the work of this Section.

1.02 DESCRIPTION

A. Contractor to prepare and submit a Storm Water Pollution Prevention Plan (SWPPP) and an Erosion and Sediment Control Plan for NYSDEC review and approval.

B. Furnish and install the erosion/sedimentation controls required during construction.

C. Provide erosion and sediment control structures including but not limited to silt fence, seed free straw bales, temporary swale, sediment basin, curb drop inlet, earth dike, pipe slope drain, stabilized construction entrances, dust control, etc. The Contractor shall provide additional erosion control measures if directed by the Engineer.

D. Comply with State, County and City regulations for erosion and sediment control during construction and to protect the uncovered soil from erosion.

1.03 SUBMITTALS

A. Storm Water Pollution Prevention Plan (SWPPP)

B. Submit Erosion Control Plan.

C. Submit shop drawings for sediment control structures.

a. The Engineer's acceptance stamp on shop drawings shall not relieve the Contractor of responsibility for any error or for furnishing material of the proper size, quantity or quality.

D. Material certificates for silt fence and filter cloth.

1.04 REFERENCES

A. Guidelines for Urban Erosion and Sediment Control, NYSSCS.

B. Reducing the impact of storm water runoff, NYSSCS.

1.05 PERMITS

A. The Contractor shall obtain all necessary permits for disposing of storm water.

1.06 RELATED WORK

A. Related work is described in the following section of the specifications:

Section 31 23 00: Earthwork, Unclassified Excavation
Section 31 23 33: Excavation, Backfilling and Compaction for Pipes and Utility Trenches

PART 2. - PRODUCTS

2.01 MATERIAL

A. Silt Fence

1. Silt Fence Fabric: The fabric shall meet the following specifications unless otherwise approved by the appropriate erosion and sediment control plan approval authority.

Fabric Properties	Minimum Acceptable Value	Test Method
Grab Tensile Strength (lbs)	90	ASTM D1682
Elongation at Failure (%)	50	ASTM D1682
Mullen Burst Strength (PSI)	190	ASTM D3786
Puncture Strength (lbs)	40	ASTM D751 (modified)
Slurry Flow Rate (gal/min/sf)	0.3	
Equivalent Opening Size	40-80	US Std Sieve CW-02215
Ultraviolet Radiation Stability (%)	90	ASTM G-26

B. Seed free straw bales

C. Stakes: Wooden stakes shall be 2" x 2" x 4 to 5 feet long.

PART 3. - EXECUTION

3.01 INSTALLATION

A. Silt Fence shall be installed as specified below.

1. Dig a small trench 6 to 12 inches deep.

2. Woven wire fence to be fastened securely to fence posts with wire ties or staples.

3. Unroll prefabricated silt fence, position the post in the back at 8 feet Center to Center in the back of the trench (down hill side), and drive the post 12 to 18 inches deep.

4. Lay the bottom 6 to 12 inches of the fabric into the trench to prevent undermining by storm water runoff.

5. Filter cloth to be fastened securely to woven wire fence with ties spaced every 24" at top and mid section.

6. When two sections of filter cloth adjoin each other they shall be overlapped by six inches and folded.

7. Maintenance shall be performed as needed and material removed when "bulges" develop in the silt fence.

8. Backfill trench and compact.

B. Seed free straw bales shall be placed as specified below.

1. Bales shall be placed in a row with ends tightly abutting the adjacent bales.

2. Each bale shall be embedded in the soil a minimum of 4".

3. Bales shall be placed parallel to the contour or as shown.

4. Bales shall be securely anchored in place by stakes or re-bars driven through the bales. The first stake in each bale shall be angled toward previously laid bale to force bales together.

5. Stakes or rebar shall be 12 to 2 feet in the ground.

6. Inspection shall be frequent and repair or replacement shall be made promptly as needed.

7. Bales shall be removed when they have served their usefulness so as not to block or impede storm flow or drainage.

C. Curb drop inlet shall be provided wherever diverted runoff from disturbed area shall be conveyed to existing or new inlets as specified below.

1. Filter fabric shall have an equivalent opening size of 40-85.

2. Wooden frame shall be constructed of 2" x 4" construction grade lumber.

3. Wire mesh across throat shall be a continuous piece 30-inch minimum width with a length 4 feet longer than the throat. It shall be shaped and securely nailed to a 2" x 4" weir.

4. The weir shall be securely nailed to 2" x 4" spacers 9 inches long spaced no more than 6 feet apart.

5. The assembly shall be placed against the inlet and secured by 2" x 4" anchors 2 feet long extending across the top of the inlet and held in place by sandbags or alternate weights.

D. The plan shall include a stabilized construction entrance at all the entrance and exit points of the construction site as specified below.

1. Filter cloth shall be to the fabric properties shown below:

Fabric Properties	Light Duty Roads Grade Subgrade	Heavy Duty Haul Roads Rough Graded	Test Method
Grab Tensile Strength (lbs)	200	220	ASTM D1682
Elongation at Failure (%)	50	60	ASTM D1682
Mullen Burst Strength (lbs)	190	430	ASTM D3786
Puncture Strength (lbs)	40	125	ASTM D751 (modified)
Equivalent Opening Size	40-80	40-80	US Std Sieve CW-02215
Aggregate Depth (in)	6	10	--

2. Stone Size: Use 2" stone, or reclaimed or recycled concrete equivalent.

3. Length: Not less than 50 feet (except on a single residence lot where a 30 foot minimum length would apply).

4. Thickness: Not less than six (6) inches.

5. Width: Twelve (12) foot minimum, but not less than the full width at points where ingress or egress occurs. Twenty-four (24) foot if single entrance to site.

6. Filter Cloth: Will be placed over the entire area prior to placing of stone.

7. Surface Water: All surface water flowing or diverted toward construction entrances shall be piped across the entrance. If piping is impractical, a mountable berm with 5:1 slopes will be permitted.

8. Maintenance: The entrance shall be maintained in a condition, which will prevent tracking or flowing of sediment onto public rights-of-way. All sediment spilled, dropped, washed or tracked onto public rights-of-way must be removed immediately.

9. When washing Is required, it shall be done on an area stabilized with stone and which drains into an approved sediment trapping device.

10. Periodic inspection and needed maintenance shall be provided after each rain.

E. Dust Control.

1. To prevent surface and air movement of dust from disturbed soil surfaces that may cause offsite damage, health hazards, and traffic safety problems shall be implemented as follows:

a. Vegetative Cover: Buffer areas of vegetation should be left where practical.

b. Mulch: To cover disturbed areas by mulch (including gravel mulch).

c. Sprinkling: The site may be sprayed until the surface is wet.

3.02 MANUFACTURER

Silt Fence
Suggested manufacturer or equal:

Carthage Mills 1821
Summit Road
Cincinnati, Ohio 45237
PH 513 761-4141
FAX 513 761-1222

3.03 FIELD QUALITY CONTROL

A. The Contractor shall not commence site disturbance work until:

1. Erosion and Sediment Control Plan has been approved by the Engineer.

2. Erosion and Sediment Control measures have been installed to the satisfaction of the Engineer.

END OF SECTION

DIVISION 32 -- EXTERIOR IMPROVEMENTS

SECTION 32 01 00
SAWCUTTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General Agreement and Supplementary Conditions and Division 1 - General Requirements, apply to the work of this Section.

1.02 DESCRIPTION

A. This work shall consist of sawcutting existing pavement to remain as required to install new utilities and/or construct new paving, curbing, fencing etc.

1.03 RELATED WORK

A. Related work is described in the following sections of the specifications:

Section 31 23 33: Excavation, Backfilling and Compaction for Pipes and Utility Trenches

Section 33 01 00: Maintaining and Protecting Existing Privately Owned Utilities

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 METHOD

A. The existing pavement shall be saw cut with a straight saw cut edge at the locations and limits shown on the plans.

B. Sawcutting shall be done in a workmanlike manner and to the satisfaction of the Engineer.

END OF SECTION

SECTION 32 01 17.63
RESTORATION OF STREET PAVEMENT

PART 1 GENERAL

1.1 DESCRIPTION

A. Section includes restoration of all pavements and pavement base removed or disturbed in the street for the execution of work, in accordance with the plans, specifications, and directions of the Contracting Officer.

1.2 STANDARDS

A. NYC DPR Standard Specification for Asphalt Pavement Full Depth, except that the Top Course shall be NYS Type 6.

1.3 SUBMITTALS

A. Contractor shall submit proposed asphalt mix and sources of the aggregate to the Contracting Officer for approval.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 SAWCUTTING

A. The Contractor shall sawcut all pavement edges as required for the execution of the work. All saw cutting shall be executed with accurate, neat, and straight lines.

B. Sawcutting shall be done with approved power saws specifically designed and manufactured for such purposes. Workmen shall wear all necessary safety clothing and eye protection while operating sawcutting equipment.

C. All pavements shall be marked and approved before cutting.

3.2 BACKFILLING AND RESTORATION

A. Backfill shall be properly tamped to accurate subgrades prior to paving.

B. Pavement restorations, including the base, shall be the same as surrounding pavements in all respects. All restoration of street pavements shall be in accordance with the requirements and specifications of the

Department of Transportation of the City of New York. The Contractor shall do all work necessary to connect the restored pavement to existing work.

C. All asphalt work shall conform to the NYC DPR Standard Specification for Asphalt Pavement Full Depth, except that the Top Course shall be NYS Type 6. Concrete shall conform to the Average Concrete Specification.

3.3 MAINTENANCE AND PROTECTION OF TRAFFIC

A. The Contractor will be responsible for furnishing and erecting barricades at points of hazard, maintaining and directing traffic during street pavement restoration. All work shall be done in a timely manner.

END OF SECTION

SECTION 32 11 00
BASE COURSES (PAVEMENT)

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies requirements for the preparation of the subgrade for and placement of granular subbase and base materials for pavement areas.

B. The work includes:

1. Fine grading and compaction of pavement subgrade.

2. Furnishing, placing, and compacting of subbase and base materials.

1.2 RELATED SECTIONS

A. Other specification Sections which directly relate to the work of this Section include:

1. Section 312300 – Earthwork, Unclassified Excavation

1.3 QUALITY ASSURANCE

A. Quality Assurance shall be performed in accordance with the requirements of Section 312300 – Earthwork, Unclassified Excavation

PART 2 - PRODUCTS

2.1 GRAVEL

A. Gravel shall conform to the requirements of Section 312300 – Earthwork, Unclassified Excavation

2.2 DENSE GRADED CRUSHED STONE SUBBASE AND BASE

A. Dense graded crushed stone shall conform to the requirements of Section 312300 – Earthwork, Unclassified Excavation.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

A. All subsurface utility construction shall be completed before fine grading is begun.

B. The pavement and curb subgrade shall be fine graded to the location, elevations and cross slope shown on the Drawings, using gravel for final adjustments.

C. Subgrades in in-situ soils in excavation areas and in embankment areas shall be compacted during fine grading to 90 percent of maximum dry density in conformance with Section 312300 – Earthwork, Unclassified Excavation.

3.2 SUBBASE MATERIAL PLACEMENT

A. Subbase material shall not be placed until the Contracting Officer has approved the fine grading, compaction, and condition of the subgrade.

B. Subbase material shall be placed and spread on the approved subgrade in layers not exceeding eight inches (8") in thickness by approved self-spreading equipment. Any displacement of the compacted subgrade material by the equipment shall be restored to the required grade and recompacted before placement of the subbase material.

C. Subbase material shall be compacted to 95 percent of maximum dry density in conformance with Section 312300 – Earthwork, Unclassified Excavation.

D. The surface of the subbase material shall be fine graded to the location, elevations, and cross slope shown on the Drawings during final layer compaction operations.

3.3 BASE MATERIAL PLACEMENT

A. Base material shall not be placed until the Contracting Officer has approved the fine grading, compaction, and condition of the subbase material.

B. Base material shall be spread on the approved subbase in layers not exceeding four inches (4") in thickness by approved self-spreading equipment. Any displacement of the subbase material by equipment shall be restored to the required grade and recompacted before placement of the base material.

C. Base material shall be compacted to 95 percent of dry density in conformance with Section 312300 – Earthwork, Unclassified Excavation.

D. The surface of the base material shall be fine graded to the proposed location, elevations, and cross slope shown on the Drawings during final layer compaction operations.

3.4 STATE AND LOCAL REFERENCE STANDARDS

A.

Building Code	New York City Building Code
DEC	New York State Department of Environmental Conservation
DEP	New York City Department of Environmental Protection
DOT	New York City Department of Transportation
DPR	New York City Department of Parks and Recreation

END OF SECTION

SECTION 32 13 13
CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Exhibits, and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete paving.
2. Foundation material for concrete paving.

B. Related Requirements:

1. For subgrade removal, fill placement, compaction tolerances, and subgrade surface condition requirements prior to foundation material and concrete placement:
   a. Section 312200 “Grading, Filling, and Compaction”
   b. Section 312300 “Earthwork, Unclassified Excavation”

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. This meeting shall include status of submittals and shop drawings, review and coordination mock-ups, overview of underground utility locations and, where applicable structural loading, use of equipment and work operations adjacent to existing trees and existing or proposed planting areas to avoid soil compaction and contamination.
2. Review methods and procedures related to concrete paving, including but not limited to, the following:
   a. Concrete mixture design.
   b. Quality control of concrete materials and concrete paving construction practices.
   c. Mock-Ups.

3. Attendance shall include:

a. Construction Manager.

b. Engineer.

c. General Contractor.

d. Paving installer, including field supervisor.

e. Manufacturer's representative of exposed concrete paving system surface retarder.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For a qualified installer of concrete pavement, a ready-mix concrete manufacturer, and a testing agency.

B. Material Certificates: For the following, from the manufacturer:

1. Cementitious materials.

2. Admixtures.

C. Curing compounds. Material Test Reports: For each of the following:

1. Concrete Design Mix report: Submit a design mix report prior to the production and delivery of concrete for review and approval. Design Mix Report dated more than one (1) year from the submittal date will be rejected.

a. Submit the design mix report, including but not limited to the following information:

1) Date of design mix report,

2) Name and address of concrete mixing company,

3) name and address of laboratory,

4) Name of project,

5) Water/cement (w/c) ratio,

6) Type and sieve analysis of aggregates,

7) Type of cement,

8) Type and amount of fly ash or slag used,

9) Percentage of Portland cement replacement by fly ash or slag,

10) Types of admixtures used,

11) Amount of water used,

12) Air content and slump of design mix,

13) Three (3) day curing strength,

14) Seven (7) day curing strength

15) Twenty-eight (28) day curing strength.

2. Foundation Material: Provide name of the supplier, material and sieve analysis showing compliance with the requirements.

D. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Concrete Paving Installer Qualifications: An employer of workers with at least 5 years of experience and who have successfully completed concrete installations similar in material, design, and extent to that indicated for Project.

B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

C. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

1.8 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.

2. Do not use frozen materials or materials containing ice or snow.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover GFRP reinforcement with water-soaked burlap, so its temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE WORK, GENERAL

A. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

2.2 FOUNDATION MATERIAL FOR CONCRETE PAVING

A. A straight run of single size aggregate and shall consist of either three-quarter (3/4”) inch stone in accordance with ASTM C33, free from organic or other deleterious material.

1. Foundation Material may contain no more than five (5%) percent of fines, defined as aggregates passing a No.4 sieve or smaller.

2. The Magnesium Sulfate Soundness loss after ten (10) cycles shall be eighteen (18%) percent or less, as per ASTM C88. Coarse aggregate may be one of the following:

a. Broken Stone or gravel.

b. Recycled Material consisting of at least ninety-five (95%) percent by weight of the following:

1) Recycled Portland Cement Concrete Aggregate or

2) Recycled Portland Cement Concrete Aggregate mixed with Stone Gravel.

2.3 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

B. Use flexible or uniformly curved forms for curves with a radius of 100 feet (30.5 m) or less. Do not use notched and bent forms.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.4 CONCRETE MATERIALS

A. Concrete: Conform to N.Y.C. Dept. of Transportation class B-32, Type II A, air entrained, moderate sulphate resistant. The batch shall contain a minimum of six (6) bags of cement per cubic yard of concrete, maximum of six and one quarter (6 ¼) gallons of water per bag, a maximum of three (3") inch slump, and a minimum compressive strength of 3,200 psi. Large aggregate shall be limited to one (1") inch.

1. Air Entrained Portland Cement: Comply with ASTM Specification for Portland Cement, Designation C150. It shall be Type II A, Moderate Sulfate Resistant.

a. A maximum of fifty (50 %) percent of Portland Cement content may be substituted with Fly Ash or Ground Granulated Blast Furnace Slag. Fly Ash shall conform to the requirements for Class F as defined by ASTM C618 — "Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete". Ground Granulated Furnace Blast Slag (GGBFS) shall conform to the requirements for Grade 100 or 120 slag as defined by ASTM C989 — "Standard Specification for Slag Cement for Use in Concrete and Mortars". Portland Cement substitutions that demonstrate the same or similar properties as Fly Ash/GGBFS shall be accepted pending Engineer's review and approval.

B. Water: Potable and complying with ASTM C94/C94M.

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.

2.6 RELATED MATERIALS

A. Joint Fillers, Backer rods, Sealant.

2.7 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.

2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.

B. Concrete Mixtures: Normal-weight concrete.

1. Compressive Strength (28 Days): 3,200 psi.

2. Maximum W/C Ratio at Point of Placement: 0.50.

3. Slump Limit: 3 inches plus or minus 1 inch.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.

2. For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.

3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrade surfaces for compliance with requirements for dimensional, grading, and elevation and compaction tolerances and other conditions affecting performance.

1. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding. Correct deficiencies in accordance with the following sections:

a. 312200 “Grading, Filling, and Compaction”

b. 312300 “Earthwork, Unclassified Excavation”

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF FOUNDATION MATERIAL FOR CONCRETE PAVING

A. Place Foundation Material on compacted subgrades free of mud, frost, snow, or ice.

1. Place Foundation Material 6 inches (150 mm) or less in compacted thickness in a single layer.

2. Place Foundation Material that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.

3. Compact foundation material at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D698 or ASTM D1557.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Provide tie bars at sides of paving strips where indicated.

2. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 30 feet unless otherwise indicated.

2. Extend joint fillers full width and depth of joint.

3. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.

4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.

5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving:

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

   a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.

2. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

3.5 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from the subbase surface before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

H. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

I. Screed paving surface with a straightedge and strike off.

J. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed-water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.6 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch (1.6 to 3 mm) deep with a stiff- bristled broom, perpendicular to the perimeter fencing gate.

3.7 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb./sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.

   b. Continuous water-fog spray.

   c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture- retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.8 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 (ACI 117M) and as follows:

1. Elevation: 3/4 inch (19 mm).

2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).

3. Surface: Gap below 10-feet- (3-m-) long; unleveled straightedge not to exceed 1/2 inch (13 mm).

4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches (13 mm per 300 mm) of tie bar.

5. Lateral Alignment and Spacing of Dowels: 1 inch (25 mm).

6. Vertical Alignment of Dowels: 1/4 inch (6 mm).

7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches (6 mm per 300 mm) of dowel.

8. Joint Spacing: 3 inches (75 mm).

9. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.

10. Joint Width: Plus 1/8 inch (3 mm), no minus.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 1000 sq. ft. or fraction thereof of each concrete mixture placed each day.

2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C231/C231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when it is 80 deg F (27 deg C) and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven days and two specimens at 28 days.

a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

D. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer.

G. Concrete paving will be considered defective if it does not pass tests andinspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.10 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Engineer.

B. Drill test cores, where directed by Engineer, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with Portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 32 14 23
ASPHALT UNIT PAVING

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Asphalt block pavers.

B. Adhesive.

C. Primer.

D. Joint Filler.

E. Polymeric sand joint filler.

F. Surface Wax.

1.2 REFERENCE STANDARDS

A. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar 2018.

1.3 ACTION SUBMITTALS

A. Samples: Submit two samples of each paver size, illustrating style, size, color range, and surface texture of units being provided. Owner to make final selection for paver colors.

B. Layout: Contractor shall submit paver layout plan for approval by Owner.

1.4 INFORMATIONAL SUBMITTALS

A. Product Data: Provide characteristics of paver unit, dimensions, special shapes, and adhesive.

B. Product Data: Provide characteristics of polymeric sand, including base material, additive(s), compressive strength, and color.

C. Manufacturer's Installation Instructions: Indicate substrate requirements, and installation methods.

D. Maintenance Data: Provide data for the Government continuing maintenance of the paver surface, replacement of paver units, and surface wax maintenance requirements.

E. Maintenance Materials: Provide the following for the Government's use in maintenance of project.

1. See Section 016700 - Product Requirements, for additional provisions.

2. Extra Pavers: 10 of each type and size.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Asphalt Block Pavers:

1. Hanover Architectural Products, Inc; 12” Asphalt Block: www.hanoverpavers.com or equal.

2. Substitutions: See Section 016700 - Product Requirements.

2.2 MATERIALS

A. Asphalt Pavers: Fibrous asphaltic block; 5 by 12 inch size, 3 inch thick; color to match existing pavers.

B. Adhesive: Neoprene modified asphaltic type, recommended by paver manufacturer.

C. Joint Filler: Portland cement and clean sand.

D. Polymeric Sand: Fine sand complying with ASTM C144 combined with polymer binders for creating semi-solid joints between pavers.

1. Material: Granite.

2. Additive(s): Portland Cement.

3. Compressive Strength: 750 pounds per square inch (5 MPa).

4. Adhesion by Tensile Load: 100 pounds per square inch (0.7 MPa).

5. Color: Beige.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that substrate is level, smooth, capable of supporting pavers and imposed loads, and ready to receive work of this section.

B. Verify gradients and elevations of substrate are correct.

C. Verify dry weather forecast without rain for a minimum of 24 hours with temperatures above 55 degrees Fahrenheit (13 degrees Celsius).

D. Verify that pavers are completely dry prior to polymeric sand installation.

E. Contractor shall remove, store and reinstall pavers replaced under the Hangars 1 & 2 project. These pavers shall be removed neatly to allow for smooth reinstallation.

F. Pavers adjacent to those to remain shall be removed by hand. No existing pavers to remain shall be sawcut.

3.2 PREPARATION

A. Apply primer to surface of substrate in accordance with manufacturer's instructions.

B. Wear clothing and equipment to protect from excessive exposure to polymeric sand.

3.3 INSTALLATION

A. Apply adhesive and pavers in accordance with manufacturer's instructions.

B. Place paver units in herringbone pattern, from straight reference edge.

C. Place half units or special shaped units at edges and interruptions. Maintain tight joints.

D. Machine roll units to level surface.

E. Sweep a dry mixture of one part Portland cement and three parts sand into paver joints.

F. Spread polymeric sand uniformly over surface. Use a push broom to fill joints and remove excess while not sweeping long distances. Sweep all excess with a fine bristle brush and remove residues with a leaf blower.

G. Using a sprayer set to shower, apply water on specific areas between 100 square feet (10 m) and 500 square feet (50 m) to a depth of 1 1/2 inches (4 cm). Complete one section at a time and avoid flooding the pavers.

H. Fog spray surfaces with water to ensure wetting of joint filler.

I. Sweep excess filler from surface of pavers.

J. Paver installation shall meet all requirements in accordance with DPR.

3.4 CLEANING

A. Do not clean pavers until pavers and mortar are dry.

B. Clean soiled surfaces using cleaning solution. Do not harm pavers, joint materials, or adjacent surfaces.

C. Use non-metallic tools in cleaning operations.

D. Rinse surfaces with clean water.

E. Broom clean paving surfaces. Dispose of excess sand.

F. See Section 017419 for construction waste management and disposal.

3.5 PROTECTION

A. Do not permit traffic over unprotected paver surface.

B. Protect paver surface with sheets of plywood.

C. Do not permit traffic for 48 hours after pavement placement.

3.6 MAINTENANCE

A. See Sections 017340 and 017700 - Execution and Closeout Procedures, for additional requirements relating to maintenance service.

END OF SECTION

SECTION 32 16 13
CONCRETE CURB

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General Agreement and Supplementary Conditions and Division 1 - General Requirements, apply to the work of this Section.

1.02 DESCRIPTION

A. Construct concrete curbs as shown on the plan in accordance with plans and where applicable N.Y.C.D.O.T. Standard Highway Specifications.

1.03 RELATED WORK

A. Related work is described in the following sections of the specifications:

1. Section 31 23 00: Earthwork, Unclassified Excavation

1.04 SUBMITTALS

A. Concrete design mix report, including the range of water-cement ratios within which the concrete will be manufactured and the method of mixing to be employed.

B. Material certificates for concrete ingredients.

C. Product data for admixtures and curing compounds.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cement: Air Entraining Portland Cement shall comply with the ASTM Specification for Portland Cement, Designation C150.

B. Concrete: Concrete shall conform to N.Y.C. Department of Transportation Class B-32, Type IIA, air entrained, moderate sulphate resistant. The batch shall contain a minimum of six (6) bags of cement per cubic yard, a one and one-half (1 1/2") to four (4") inch slump, and compressive strength of 3,200 psi. Large aggregate shall be limited to one (1") inch.

C. Steel Bar Reinforcement: Reinforcement shall meet the requirements of the N.Y.C. Building Code and the latest ASTM specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement", Designation A-615 and in accordance with the item "Steel Bar Reinforcement". Reinforcement shall be of the sizes and dimensions shown on the plans.

D. Bond Breaker: If bituminous fiber material is used, a bond breaker such as one-half inch (1/2") wide polyethylene tape or five-eighths inch (5/8") diameter expanded polyethylene foam backer rod shall be installed as recommended by the manufacturer. A bond breaker will not be required for a premolded foam joint, but sealant is always required.

E. Sealant: A bond breaker and a non-sag multi-component polyurethane-based elastomeric sealant shall be installed in prepared expansion joints. The Contractor shall apply Sikaflex - 2C, NS sealant, by Sika Corp., Lyndhurst, NJ, or equal. Color of sealant shall be concrete gray. Asphalt cement will not be approved as a sealant.

F. Expansion Joint: The expansion joint material shall be a premolded bituminous fiber joint filler.

PART 3 - EXECUTION

3.01 METHOD

A. Curb shall be constructed in independent sections and shall have smooth plane ends separated by expansion joints of the size shown on the project details. Steel bar reinforcement between expansion joints shall be secured to chairs of the proper height to hold them in position while concrete is poured. Distance between supporting chairs shall not greater than five (5') feet apart. Reinforcing bars at expansion joints shall be bent to the horizontal and the ends wrapped with tar paper held by duct tape. Expansion joint locations to align with concrete sidewalk expansion joints.

B. When fence posts are to be erected in concrete curb, sleeves shall be installed in the correct location, where shown on the plans. Sleeves shall be structurally rigid, cut to the required lengths and firmly set in the form in a vertical position.

C. All forms shall be set true to line and grade and held rigidly in position. They shall be either of metal or of acceptable planed and matched lumber, and of such construction that a smooth surface shall be provided. After the forms are erected and reinforcing steel is set in place, all contact surfaces within forms shall be moistened. Concrete shall be placed in horizontal layers of uniform thickness, with each layer thoroughly consolidated before placement of the next layer. Thickness of each layer shall not exceed eighteen (18") inches with reinforced members. Stiff concrete mixes (low slump) shall be consolidated either by hand tools or by mechanical vibrators in accordance with Section B. The concrete shall be worked thoroughly around the reinforcement and around the pipe sleeves. In the use of internal vibrators, care shall be taken to avoid separation of aggregate and to avoid hitting the forms sufficiently to cause damage. Exposed concrete surfaces shall have a float finish. Surfaces shall be finished smooth and true by means of wooden or steel floats and have edges, including those of joints, rounded or chamfered.

D. Forms shall be left in place for a minimum of three (3) days or until the concrete has set sufficiently so that, in the opinion of the Engineer, they can be removed without damage to the curbing. The curbing shall immediately upon removal of the forms be wetted and rubbed down to a smooth and uniform surface by means of carborundum or other abrasive blocks. For this work, a competent and skilled finisher shall be employed. The Contractor shall do all the necessary work to join the new curb to the existing in a neat and workmanlike manner to the satisfaction of the Engineer.

3.02 MATERIAL TESTING

A. When quantities exceed thirty (30) cubic yards in a single day, or at the direction and discretion of the Engineer, the Contractor shall furnish necessary concrete test cylinders to the Engineer at no cost to the Owner.

3.03 PROTECTION

A. The Contractor shall protect the curbing and keep it in first class conditions until the completion of his operation at the site. Any curbing which is damaged at any time previous to the final acceptance of the work shall be removed and replaced with satisfactory curbing at the Contractor's expense.

END OF SECTION

DIVISION 33 -- UTILITIES

SECTION 33 01 00

MAINTAINING AND PROTECTING EXISTING UTILITIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General Agreement and Supplementary Conditions and Division 1-General Requirements, apply to the work of this Section.

1.02 DESCRIPTION

A. Maintain and protect all existing utilities that are to remain throughout the duration of the project. Coordinate and construct relocated facilities as specified under this section.

1.03 RELATED WORK

A. Related work is described in the following sections of the specifications:

Section 31 23 33: Excavation, Backfilling and Compaction for Pipes and Utility Trenches

1.04 SUBMITTALS

A. Material certificates of clean trench backfill which shall meet Specification 31 23 23.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Trench backfill shall be in accordance with Select Fill/Backfill as specified in Section 31 23 33.

PART 3. - EXECUTION

3.01 METHOD

A. Utilities, including electric, sewers, water mains, etc. exist in the project area. The Contractor shall maintain and protect those utilities that are to remain throughout the duration of the project. Any damage done to those facilities shall be repaired by the Contractor at their own expense.

B. The Contractor shall maintain continuous service to all on-site users of electric, storm sewers, and water service, etc. throughout construction.

C. Any relocation of utilities that may be required for the construction of the project shall be done in accordance with the standards and specifications. The Contractor shall notify the Utility companies well in advance of the intended work.

END OF SECTION

SECTION 33 01 32
TERMINATE AND DEMOLISH EXISTING UTILITIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General Agreement and Supplementary Conditions and Division 1 - General Requirements, apply to the work of this Section.

1.02 DESCRIPTION

A. This section describes the Termination and Demolition of Existing Utilities as shown on the plans in accordance with the specifications and the directions of the Owner's Representative. The demolition shall include piping, structures, foundations, and any other related materials encountered.

B. All existing utilities where encountered that are not proposed for reuse shall be removed within the limits of trench excavation, capped, and abandoned in place.

C. Existing utilities should be out of service before demolition is started.

D. The Contractor shall obtain the necessary permits and shall notify the Owner one (1) week before demolition.

1.03 RELATED WORK

A. Related work is described in the following sections of the specifications:

Section 31 23 33: Excavation, Backfilling and Compaction for Pipes and Utility Trenches
Section 33 12 20: Type K Copper Tubing

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 METHOD

A. All work shall be performed in accordance with the plans and requirements of the appropriate city agency or private utility companies.

END OF SECTION

SECTION 33 11 16
INSTALLATION OF WATER MAINS AND APPURTENANCES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 - General Requirements, apply to this Section.

1.02 DESCRIPTION

A. Install water mains and appurtenances of sizes shown on the plans, according to NYCDPR standard drawings and specifications.

1.03 SUBMITTALS

A. Submit in writing methods and procedures for performing leakage tests.

1.04 RELATED WORK

A. Related work is described in the following sections of the specifications.

Section 33 12 20: Type K Copper Tubing

PART 2 - PRODUCTS

2.01 MATERIAL

A. Refer to the Sections listed in "Related Work" for material specification information for water mains.

PART 3 - EXECUTION

3.01 METHOD

A. The Contractor shall install all water mains in the project area in accordance with NYCDPR standard specifications.

B. The restoration of the paved or unpaved surfaces shall be done to meet existing pavement surface.

3.02 CLEANING AND DISINFECTING PIPE

Prior to starting work, the Contractor will be required to show the Contracting Officer that the Contractor has the equipment and materials available for cleaning and disinfecting pipe and maintaining it clean during the laying process, all as herein specified.

A. Cleaning Pipe:

Pipes or fittings delivered to the site of the work must be stored in a fashion which would prevent the entrance of surface drainage, excavated material, or other foreign matter into the pipe.
Prior to laying any pipe and fittings, the interiors must be thoroughly flushed with clean water of sufficient

volume and pressure from a hose to ensure the removal of all foreign matter that may have been introduced during the storage period. After all visible dirt or other foreign material has been removed from the pipe and fittings but before they are installed, the Contractor must thoroughly spray the inside surfaces of all pipes and fittings with a one percent (1%) hypochlorite solution. The hypochlorite solution application and cleaning must be repeated as often as required to keep the pipes and fittings free of dirt or foreign matter.
After each pipe and fitting has been sprayed with the hypochlorite solution, the ends of the pipe or fitting must be sealed by means of an approved type of wooden or rubber plug, which must be thoroughly cleaned and washed with the same hypochlorite solution before being inserted into the ends of the pipe or fitting. The plugs must not be removed until the pipe or fitting is lowered into the trench ready for immediate socketing of the joint. If the plugs have been removed prior to this time, the Contractor must then repeat the processing of cleaning and disinfecting the pipe, and inserting the plugs.

B. Disinfection Of Pipe:

After the main has been laid, but prior to being put into service, it must be thoroughly disinfected with chlorine concentration as follows:

- 25-PPM; 24-hour contact time (dry lay)
- 100-PPM; 3-hour contact time (dry lay)
- 300-PPM; 15-minute contact time (relay)

DRY LAYS - (i.e., main is isolated from distribution system and does not have to be put into service immediately) The required chlorine solution must be injected through a tap inserted in the line for that purpose by the Contractor, the point of application to be at one end of the pipe section with the bleed at the opposite end.

Chlorine residual must be monitored at the bleed end to determine if the proper chlorine concentration is reached. When the proper concentration is reached, the required contact period must begin.

When using 100-PPM solution for three (3) hours, if the concentration goes below 50-PPM during disinfecting, chlorine must be added to bring the concentration back to 100-PPM.

When using 25-PPM solution for twenty-four (24) hours, the chlorine residual must be checked at the end of twenty-four (24) hours. If the residual is less than 10-PPM, the above procedure must be repeated.

After the mains are sufficiently disinfected they must be thoroughly flushed. Samples will then be obtained and tested. The main will not be put into service until such time that the test results have been found acceptable.

RELAYS OR WETLAYS - (i.e., main must be put into service as soon as possible) Chlorine powder must be distributed uniformly in the main during installation of the pipe to obtain the 300-PPM concentration.

This solution must have a minimum contact time of fifteen (15) minutes and be thoroughly flushed before putting the main into service and opening the service lines. This should be accomplished by having the one and one-half (1-1/2) inch tap used for flushing opened only slightly during the first fifteen (15) minutes followed by complete flushing of the system of all excess chlorine. In all cases, this flushing must not be less than fifteen (15) minutes after the tap is fully open.

At tie-ins where flushing cannot be accomplished without the possibility of a heavy concentration of chlorine entering the distribution system, disinfecting procedures may be altered at the discretion of the Contracting Officer. However, all new pipes must be thoroughly cleaned and sprayed with a one percent (1%) hypochlorite solution prior to installation and flushed thoroughly.

3.03 FIELD TESTS

The Contractor shall perform leakage tests on installed water mains in accordance with NYCDPR Standards.

END OF SECTION

SECTION 33 11 17
FILTER FABRIC FOR UTILITY PIPES AND MANHOLES

PART 1. - GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General Agreement and Supplementary Conditions and Division 1 - General Requirements, apply to the work of this Section.

1.02 DESCRIPTION

A. Furnish and deliver filter fabric in accordance with the specifications.

B. Install filter fabric around the stone bedding and sand fill for sewers and underdrains as shown on the plans.

1.03 SUBMITTAL

A. Product Data

Submit manufacturer's material certificate, specifications and recommendations for installation.

1.04 RELATED WORK

A. Related work is described in the following sections of the specifications:

Section 31 23 33:	Excavation, Backfilling and Compaction for Pipes and Utility Trenches
Section 33 41 07:	High Density Polyethylene Pipe for Storm Sewers
Section 33 42 00:	Precast Concrete Drainage Structures

PART 2. - PRODUCTS

2.01 MATERIAL

A. For NYC DEP Facilities:

1. Filter fabric for water main trenches shall be Mirafi 500X or approved equal, per NYCDEP Standard Sewer and Water Main Specification (SWMS) Section 65.31 and as shown on Standard Drawing No. 94292-B-Z.

2. Filter fabric or sewer trenches for ductile iron pipe connections from catch basins and ductile iron house connections shall be Mirafi 140 or approved equal, per NYCDEP Sewer Design Standard Dwg. No. SE-61.

B. For Other Utilities:

Highly permeable nonwoven fabric with the following specifications.

Property	Test Method	Unit	Minimum Value
Grab Tensile	ASTM-D-4632	lbs	120
Grab Elongation	ASTM-D-4632	% min	50
Mullen Burst	ASTM-D-3786	psi	300
Puncture	ASTM-D-3787 (mod)	lbs	90
Trapezoidal Tear	ASTM-D-4533	lbs	50
U.V. Resistance (Strength Retained)	ASTM-D-4355	lbs	70
Equivalent Opening Size	CW02215	U.S. Sieve Number	70 min.
Permittivity	ASTM-4491	Sec-1 gal/min/ft^2	0.7

C. The fabric rolls should have minimum roll average property values at least 95%.

D. The packaging and labeling of the filter fabric shall be according to ASTM procedures.

PART 3. - EXECUTION

2.02 **INSTALLATION**

A. The filter fabric shall be installed as shown on the plans, the manufacturer's instructions and specifications, Bureau of Water supply and Wastewater Collection Standard Drawings and the NYCDEP Standard Sewer and Water Main Specifications.

Suggested manufacturer or approved equal:

Amoco Fabrics and Fibers Company

900 Circle 75 Parkway

Suite 300

Atlanta, Georgia 30330

END OF SECTION

SECTION 33 12 16
WATER MAIN VALVES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General Agreement and Supplementary Conditions and Division 1 - General Requirements, apply to the work of this Section.

1.02 DESCRIPTION

A. To furnish and deliver various sizes of water main valves as shown on the plans and conform with N.Y.C. D.P.R. Water Supply standard specifications.

1.03 STORAGE

A. All valves shall be stored properly as specified in N.Y.C.D.P.R. standards.

1.04 RELATED WORK

A. Related work is described in the following sections of the specifications.

Section 31 23 33: Excavation, Backfilling and Compaction For Pipes and Utility Trenches

Section 33 11 16: Installation of Water Mains and Appurtenances

Section 33 11 17: Filter Fabric for Utility Pipes & Manholes

Section 33 12 20: Type K Copper Tubing

1.05 SUBMITTALS

A. The contractor shall submit Shop Drawings and Catalog Cuts when required, in accordance with the requirements of the General Conditions, Section C, Special Requirements, Article 11.

PART 2 - PRODUCTS

2.01 CAST IRON VALVE BOXES

A. Box: 5 ¼" diameter valve boxes shall be Bingham & Taylor Fig. No. 4908 (2-piece Sliding Type Adjustable Valve Box) with a Fig No. 4904-L locking cover, or approved equal. The cover shall have the designation "WATER" cast thereon. The boxes shall extend within the limits called for on the plans.

B. Setting: The valve boxes shallbe set plumb, as shown on the pans, on a footing of brick laid in cement mortar, supported on a foundation of broken stone. The entire area surrounding the valve box shall be fully compacted after setting.

C. Brick: The brick shall be made from clay or shale, well burned, of a quality approvedby the Engineer. The mortar shall be composed of one part Portland Cement and two partssand.

D. Broken Stone: The broken stone shall be clean broken traprock, or other approved stone, all of which shall pass a one-inch square opening screen and retained on a 5/8 inch square opening screen.

2.02 **PLUG VALVES**

A. Plug Valve: Valves two inches (2") and under shall be of the cylindrical Plug Type with a closed bottom and a top seal, fully enclosed one-quarter (1/4) turn check, straight through flow way which is resistant to turbulation of the flow stream, one piece cast bronze cylindrical plug and “T” head that aligns with the ports to provide a visual check of valve position, inside screw ends with I.P. threads, as is manufactured by Mueller Co. No. H-10283, or approved equal. Adaptors are required for connecting to copper tubing.

B. Operating Key: An approved operating key of proper size for each valve shall be furnishedby the Contractor, except that the Contractor need not furnish more than two (2) keys for each type of valve, regardless of the quantity of valves called for in the contract. For plug valves two inches (2") and under, the operating key shall be Mueller Co. No. H-10322, or approved equal.

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 33 12 20
TYPE K COPPER TUBING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General Agreement and Supplementary Conditions and Division 1 - General Requirements, apply to the work of this Section.

1.02 DESCRIPTION

A. Under this item the Contractor shall cap, furnish, install, connect, and reconnect the water pipe of the size shown in accordance with the plans, specifications, and directions of theContracting Officer.

1.03 RELATED WORK

A. Related work is described in the following sections of thespecifications:

- Section 31 23 33: Excavation, Backfilling, and Compaction for Pipes and Utility Trenches
- Section 33 11 16: Installation of Water Mains and Appurtenances

PART 2 - PRODUCTS

2.01 PIPE

A. The water service pipe shall be rigid (drawn) temper type "K" copper tubing in straight lengths meeting the specification for ASTM designation No. B88.

2.02 FITTINGS

A. Fittings shall be approved wrought copper and bronze solder-joint pressure fittings (ANSI B 16.22), Di-Electric fittings as required.

2.03 JOINTS

A. Joints shall be made by soldering, using 95-5 tin antimony solder. From the curb valve to the water tap, joints shall be of the "flared" type.

2.03 CAP WATER LINE

A. The contractor shall cap existing water lines in accordance with the plans, specifications, and directions of the Contracting Officer. All work shall be completed in accordance with the NYCDPR specifications and requirements.

B. Material: Where shown on the plans or as directed by the Contracting Officer, the existing water main shallbe capped. The cap shall be threaded and of the same material as the pipe which is to becapped.

PART 3 - EXECUTION

3.01 METHOD

A. The pipe shall be laid true to line and grade with a cover as indicated on the plans or as directed by the Contracting Officer. When the foundation is good firm earth, the earth should be pared or molded to give full support and if necessary, a layer of fine sand or other suitable material should be placed. The same means of securing firm foundation should be adopted in case the excavation has been made deeper than necessary, in which case the Contractor shall furnish the gravel at his own expense.

B. Where the bottom of the trench is in rock, fresh fill, soil of low bearing power or other situations where special foundations are required, the Contractor shall provide such foundation in accordance with the written order of the Contracting Officer. The work shall be paid for at the unit prices bid for the materials used in the work.

3.02 FIELD TESTS

A. The Contractor shall not backfill over any pipe until ordered by the Contracting Officer. The pipe system shall be tight and show no leaks when filled with water, sealed and subjected to an internal hydrostatic pressure of 100 psi for thirty minutes. Temporary caps shall be placed where required to permit making the tests where valves are not available. The tests shall be made in the presence of the Contracting Officer.

END OF SECTION

SECTION 33 41 01
FLEXIBLE PIPE CONNECTORS FOR STORM SEWERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract documents, including General Agreement and Supplementary Conditions and Division 1 - General Requirements, apply to the work of this Section.

1.02 DESCRIPTION

A. Provide all labor, materials, and equipment necessary for the following:

a. Furnish and deliver flexible pipe connectors for manholes, catch basins, and drainage structures.

b. Install flexible pipe connectors at all connections between pipes and sewer structures (storm and sanitary) in accordance with the specifications and as directed by the Engineer.

1.03 SUBMITTAL

A. Submit manufacturer's catalog cut, specifications and method of installation for entering precast manholes and other concrete structures.

1.04 RELATED WORK

A. Related work is described in the following sections of the specifications:

Section 33 41 07: High Density Polyethylene Pipe for Storm Sewers

Section 33 42 00: Precast Concrete Drainage Structures

PART 2 - PRODUCTS

A. Connectors

The rubber connector shall meet all material and performance requirements of ASTM Standard C-923 titled, "Resilient Connectors between Reinforced Concrete Manhole Structures and Pipes."

PART 3 - EXECUTION

3.01 METHOD

A. The flexible connector shall be installed in accordance with manufacturer's recommendations and specifications.

Suggested manufacturers or equal:

ALOK Products, Inc.

P.O. Box 1647

Tullytown, PA 19007

1-800-822-ALOK

END OF SECTION

SECTION 33 41 07
HIGH DENSITY POLYETHYLENE PIPE FOR STORM SEWERS

PART 1. - GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General Agreement and Supplementary Conditions and Division 1 - General Requirements, apply to the work of this Section.

1.02 DESCRIPTION

A. This section describes the type of high-density polyethylene (HDPE) pipe to be used for storm sewers. HDPE shall be used where shown on plans.

1.03 STORAGE

A. All pipes and fittings shall be stored in accordance with N.Y.C.D.E.P. Standard Specifications.

1.04 RELATED WORK

A. Related work is described in the following sections of the specifications:

Section 33 11 17: Filter Fabric for Utility Pipes & Manholes

Section 33 41 01: Flexible Pipe Connectors for Storm Systems

Section 33 42 00: Precast Concrete Drainage Structures

1.05 SUBMITTALS

A. Certificates of compliance with referenced standards.

B. Catalog cuts of piping and fittings.

PART 2. - PRODUCTS

2.01 MATERIAL

A. HDPE pipe shall meet ASTM F2648.

B. HDPE pipe shall have smooth interior and annular exterior corrugations.

C. Pipe shall be joined using a bell and spigot joint. The joint shall be soil-tight and gaskets for diameters 12- through 60-inch, shall meet the requirements of ASTM F477. For diameters 4- through 10- inch, the joint shall be soil-tight using an engaging dimple connection.

D. Fittings shall conform to ASTM F2306. Bell and spigot connections shall utilize a welded bell and valley or saddle gasket meeting the soil-tight joint performance requirements of ASTM F2306.

PART 3. - EXECUTION

3.01 INSTALLATION

A. Corrugated pipe shall be installed as shown on the plans.

B. Installation shall be in accordance with ASTM D2321 and manufacturer-recommended installation guidelines, with the exception that minimum cover in trafficked areas for 4- through 48-inch diameters shall be one foot.

C. Do not place pipes until trench bottoms have been inspected and approved by the Engineer, nor until trenches are free from water.

D. Lay all pipes true to line and grade as indicated on the Drawings and in a manner to make all surfaces at the invert and throughout the full length of the pipe aligned and smooth. Install pipes with full and uniform support and eliminate irregularities in trench bottoms by placing suitable and approved materials.

END OF SECTION

SECTION 33 42 00
PRECAST CONCRETE DRAINAGE STRUCTURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General Agreement and Supplementary Conditions and Division 1 - General Requirements, apply to the work of this Section.

B. LIABILITY:

When using precast concrete drainage structures, the Contractor accepts full and complete responsibility for the location of knock-out holes that allow for the entrance of drainage pipes. All pipe invert dimensions shall be verified in the field by the contractor prior to ordering precast drainage structures. No additional compensation shall be paid for any discrepancies that may occur.

1.02 DESCRIPTION

A. Under this item, the Contractor shall build or provide PRECAST CONCRETE DRAINAGE STRUCTURE in accordance with the plans, specifications, and directions of the Engineer.

1.03 RELATED WORK

Section 31 23 00:	Earthwork, Unclassified Excavation
Section 31 23 33:	Excavation, Backfilling and Compaction for Pipes and Utility Trenches
Section 33 41 01:	Flexible Pipe Connectors for Storm Systems
Section 33 41 07:	High Density Polyethylene Pipe for Storm Sewers

1.04 SUBMITTALS

Shop Drawings showing all invert elevations must be submitted for approval, prior to use of the precast drainage structures. Precast drainage structures shall meet the requirements of NYCDEP or NYCDPR as applicable.

PART 2 - PRODUCTS

2.01 PRECAST CONCRETE:

The use of factory precast concrete drainage structures may be substituted for brick masonry at no additional cost to the Owner. Payment shall be made on a cubic yard basis of precast concrete at the same price bid for brick masonry

2.02 LADDER RUNGS FOR PRECAST CONCRETE DRAINAGE STRUCTURES:

Ladder rungs for precast drainage structures shall be constructed of copolymer polypropylene plastic, as manufactured by M.A. Industries Peachtree City, GA (PFS-1-DF (Straight-Legged) Manhole Step), or equal. The cost of these ladder rungs shall be included in the cubic yard unit cost for precast concrete.

PART 3 – EXECUTION

3.01 **INSTALL PRECAST CONCRETE DRAINAGE STRUCTURE AS SHOWN ON THE DRAWINGS.**

END OF SECTION

SECTION 33 46 14
UNDERDRAINS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General Agreement and Supplementary Conditions and Division 1 - General Requirements, apply to this Section.

1.02 DESCRIPTION OF WORK

A. The work includes the constructing of underdrain installations in accordance with the details shown on the plans and at locations designated by the Engineer, in accordance with the requirements of these specifications

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's material certificate, specifications, and installation instructions.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Underdrain Pipe: Underdrain pipe shall meet the following requirements for the type of pipe specified in the contract documents:

1. Perforated High Density Polyethylene (HDPE) Underdrain Pipe. Perforated HDPE underdrain pipe and fittings shall conform to ASTM F2648.

2. Pipe sizing: as shown in construction drawings.

B. Fittings: Fittings shall conform to ASTM F2306. Bell and spigot connections shall utilize a welded bell and valley or saddle gasket meeting the soil-tight joint performance requirements of ASTM F2306.

C. Cleanouts: cleanouts shall be supplied at all locations shown in the contract documents and as directed by the Engineer.

PART 3 - EXECUTION

3.01 UNDERDRAIN INSTALLATION

A. Underdrain pipes shall be installed in accordance with the manufacturer’s installation instructions.

B. All subbase material shall be properly prepared prior to underdrain pipe installation.

END OF SECTION

SECTION 33 49 10
UTILITY CASTINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General Agreement and SupplementaryConditions and Division 1 - General Requirements, apply to the work of this Section.

1.02 DESCRIPTION

Under these items, the Contractor shall furnish and install NYC Parks Manhole or Catch Basin Covers along with frames, including locking bolts and keys, as shown on DPR Standard Details.

1.03 RELATED WORK

Section 33 42 00 – Precast Concrete Drainage Structure

1.04 SUBMITTALS

A. Foundry Certificates for each type of material certifying either gray for manhole covers or ductile iron grade for catch basin covers and H-20 loading test shallbe submitted. Submittal shall be on the pattern holder's letterhead

PART 2 - PRODUCTS

2.01 MANHOLE COVERS AND CATCH BASIN GRATES

Manhole Covers shall be of gray iron per ASTM A48, latest revision, class 30 or better. Catch Basin Covers shall be ductile iron ASTM A536, latest revision, Grade 65-45-12 or better. Covers shall be Model No. 4129 0018 and catch basin frame Model No. 41260018 as manufactured by Campbell Foundry Co., Harrison, NJ or equal. All covers shall be suitable for highway traffic, meeting the requirements for H-20 loading per AASHTO M306-10.

2.02 BOLT & KEY

Each cover shall be furnished with two (2) locking bolts, and two (2) keys, similar to the *Intimidator Man-Lock,* as manufactured by McGard, Inc., Orchard Park, N.Y., or equal. Keys shall be turned over to Owner at the Final Inspection.

2.03 WATERTIGHT MANHOLE COVER

Watertight Manhole Covers shall be of gray iron per ASTM A48, latest revision, class 35B or better. Covers shall be heavy duty pressure type manhole frame and bolted lid Model No.

R6460 as manufactured by Neenah Foundry, Neenah, WI or equal. All covers shall be suitable for highway traffic, meeting the requirements for H-20 loading per AASHTO M306-10.

PART 3 - EXECUTION

3.01 METHOD

A. The Covers shall be installed on frames as shown on the Standard Detail Sheet. Immediately prior to the final inspection the Contractor shall clean cover surfaces that show evidence of loose mill scale, non-adherent rust, peeling paint and other deleterious matter in accordance with SP-2, Hand Tool Cleaning, a method generally confined to wirebrushing, sandpaper, hand scrapers or hand impact tools. Unless otherwise direct by the Engineer, covers shall be painted with two (2) coats of black silicone alykd paint, such as Steel Masters 9500 manufactured by Sherwin Williams, or equal.

END OF SECTION

SECTION 33 60 00
STORMWATER TREATMENT DEVICE

PART 1 – GENERAL

1.1 This item shall govern the furnishing and installation of the Cascade Separator® by Contech Engineered Solutions LLC, complete and operable as shown and as specified herein, in accordance with the requirements of the plans and contract documents.

1.2 The Contractor shall furnish all labor, equipment and materials necessary to install the storm water treatment device(s) (SWTD) and appurtenances specified in the Drawings and these specifications.

1.3 The manufacturer of the SWTD shall be one that is regularly engaged in the engineering design and production of systems deployed for the treatment of storm water runoff for at least five (5) years and which have a history of successful production, acceptable to the Engineer. In accordance with the Drawings, the SWTD(s) shall be a Cascade Separator™ device manufactured by:

Contech Engineered Solutions LLC
9100 Centre Pointe Drive
West Chester, OH, 45069
Tel: 1 800 338 1122

or equal.

1.4 Related Sections

Section 312319 – Dewatering

Section 312333 – Excavation, Backfilling, and Compaction of Pipes and Utility Trenches

1.5 All components shall be subject to inspection by the engineer at the place of manufacture and/or installation. All components are subject to being rejected or identified for repair if the quality of materials and manufacturing do not comply with the requirements of this specification. Components which have been identified as defective may be subject for repair where final acceptance of the component is contingent on the discretion of the Engineer.

1.6 The manufacturer shall guarantee the SWTD components against all manufacturer originated defects in materials or workmanship for a period of twelve (12) months from the date the components are delivered to the owner for installation. The manufacturer shall upon its determination repair, correct or replace any manufacturer originated defects advised in writing to the manufacturer within the referenced warranty period. The use of SWTD components shall be limited to the application for which it was specifically designed.

1.7 The SWTD manufacturer shall submit to the Engineer of Record a "Manufacturer's Performance Certification" certifying that each SWTD is capable of achieving the specified removal efficiencies listed in these specifications. The certification shall be supported by independent third-party research

1.8 No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the Engineer of Record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to

coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

PART 2 – MATERIALS

2.1 Housing unit of stormwater treatment device shall be constructed of pre-cast or cast-in-place concrete, no exceptions. Precast concrete components shall conform to applicable sections of ASTM C 478, ASTM C 857 and ASTM C 858 and the following:

- Concrete shall achieve a minimum 28-day compressive strength of 4,000 pounds per square-inch (psi);
- Unless otherwise noted, the precast concrete sections shall be designed to withstand lateral earth and AASHTO H-20 traffic loads;
- Cement shall be Type III Portland Cement conforming to ASTM C 150;
- Aggregates shall conform to ASTM C 33;
- Reinforcing steel shall be deformed billet-steel bars, welded steel wire or deformed welded steel wire conforming to ASTM A 615, A 185, or A 497.
- Joints shall be sealed with preformed joint sealing compound conforming to ASTM C 990.
- Shipping of components shall not be initiated until a minimum compressive strength of 4,000 psi is attained or five (5) calendar days after fabrication has expired, whichever occurs first.

2.2 Internal Components and appurtenances shall conform to the following:

- Hardware shall be manufactured of Type 316 stainless steel conforming to ASTM A 320;
- Support brackets shall be manufactured of 5052 aluminum
- Fiberglass components shall conform to applicable sections of ASTM D-4097
- Polypropylene copolymer components shall conform to a tensile strength of 3,600 psi (ASTM D-638), and Izod impact value of "no break" (ASTM D-256).
- Access system(s) conform to the following: Manhole castings shall be designed to withstand AASHTO H-20 loadings and manufactured of cast-iron conforming to ASTM A 48 Class 30.

PART 3 – PERFORMANCE

3.1 The SWTD shall be sized to either achieve an 80 percent average annual reduction in the total suspended solid load or treat a flow rate designated by the jurisdiction in which the project is located. Both methods should be sized using the OK-110 particle distribution having particles ranging from 53 microns to 212 microns with a d50 of around 110 microns.

3.2 The SWTD shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage capacity provided by the sump chamber shall be in accordance with the volume listed in Table 1. The boundaries of the sump chamber shall be limited to that which do not degrade the SWTD's treatment efficiency as captured pollutants accumulate. In order to not restrict the Owner's ability to maintain the SWTD, the minimum dimension providing access from the ground surface to the sump chamber shall be 16 inches in diameter.

3.3 The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills and have a capacity listed in Table 1 of the required unit.

3.4 The SWTD shall convey the flow from the peak storm event of the drainage network, in accordance with required hydraulic upstream conditions as defined by the Engineer. If a substitute SWTD is proposed, supporting documentation shall be submitted that demonstrates equal or better upstream hydraulic

conditions compared to that specified herein. This documentation shall be signed and sealed by a Professional Engineer registered in the State of the work. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.

PART 4 – EXECUTION

4.1 The contractor shall exercise care in the storage and handling of the SWTD components prior to and during installation. Any repair or replacement costs associated with events occurring after delivery is accepted and unloading has commenced shall be borne by the contractor.

4.2 The SWTD shall be installed in accordance with the manufacturer's recommendations and related sections of the contract documents. The manufacturer shall provide the contractor installation instructions and offer on-site guidance during the important stages of the installation as identified by the manufacturer at no additional expense. A minimum of 72 hours notice shall be provided to the manufacturer prior to their performance of the services included under this subsection.

4.3 The contractor shall fill all voids associated with lifting provisions provided by the manufacturer. These voids shall be filled with non-shrinking grout providing a finished surface consistent with adjacent surfaces. The contractor shall trim all protruding lifting provisions flush with the adjacent concrete surface in a manner, which leaves no sharp points or edges.

4.4 The contractor shall removal all loose material and pooling water from the SWTD prior to the transfer of operational responsibility to the Owner.

TABLE 1: Storm Water Treatment Device Storage Capacities

Cascade Model	Minimum Sump Storage Capacity (yd^3)	Minimum Oil Storage Capacity (gal)
CS-3	0.41	59.0
CS-4	0.70	141.0
CS-5	1.09	269.3
CS-6	1.57	475.9
CS-8	2.79	1128.0
CS-10	4.36	2203.2
CS-12	6.28	3807.1

END OF SECTION

APPENDICES

Environmental Protection

Rohit Aggarwala
Commissioner

Anastasios Georgelis, P.E.
Deputy Commissioner

Bureau of Water and
Sewer Operations

59-17 Junction Blvd.
Flushing, NY 11373

Tel. (718) 595-3088
PARIS@dep.nyc.gov

12/18/2024

GHD
Owen Parkinson
1806 Summit Avenue, Suite 300
Richmond, VA 23230

To Whom It May Concern:

The hydrant flow test you requested in the vicinity of 3159 Flatbush Ave , Brooklyn was performed on 12/17/2024 at 10:49:00 AM with the following results:

The static pressure taken on a 12 inch water main which is fed from two direction on the east side of FLATBUSH AV 1st hydrant north of AVIATION RD NORTH was 50 pounds per square inch. The residual pressure at this point was 42 pounds per square inch when 1,000 gallons of water per minute were flowing from the west side of FLATBUSH AV 2nd hydrant north of AVIATION RD NORTH.

The theoretical minimum and maximum pressure at the static hydrant is 49.8 psi and 60.6 psi respectively. The equivalent gradients in NAVD88 datum are 130 feet and 155 feet.

This Department cannot guarantee that this pressure will be maintained in the future because a change may be needed in conformity with good engineering practices.

If you have any questions regarding engineering, and application status, please call (718) 595-7135.

Very truly yours,

Urszula Krajewski
Water Distribution Engineer
City Wide Hydraulic Testing Unit

File: FT2024-2357

MATTEO | FERRAN
STRUCTURAL ENGINEERS

FIELD REPORT – STRUCTURAL PROBES

Date:	April 29, 2025	**Date(s) on site:**	April 23, 2025
Attention:	Anne Kopf	**Project name:**	NPS GATE Floyd Bennett Field Hangars 3+4
Company:	Quinn Evans Architects	**MFSE Proj. #:**	23-086.1
Weather:	Sunny, mid 60s (F)	**Location:**	3159 Flatbush Ave Brooklyn, NY 11234
Submitted by:	N. Ferran, E. Bowers	**Present on site:**	N. Ferran & E. Bowers (MFSE), D. Follett (Quality Restoration Works)
Cc:	Charles Thompson		

Matteo Ferran Structural Engineers PLLC (MFSE) performed a site visit on April 23, 2025 to observe structural probes made by Quality Restoration Works, LLC, and based on probe documents, labeled SP1 through SP-5, issued on May 21, 2024. Observations are summarized below and field notes are attached to this report.

OBSERVATIONS	PHOTOS
Probe SP-01: Column Base (Hangar 3) MFSE requested a probe at one of the hangar column bases due to observed cracking in the concrete slab on grade surrounding the column (Figure 1). It was hypothesized that the cracking in the slab could potentially be caused by corrosion of the column and/or base plate below the slab surface. When steel corrodes, it expands volumetrically in a process called rust jacking, exerting large pressures on surrounding materials. This can cause cracking, spalling, and/or displacement of the surrounding materials. Removing the concrete that encased the column base would allow for observation of the below grade condition of the column. The base condition of one of the columns, the fifth from the north on the Hangar 3 east interior elevation, was exposed while MFSE was onsite (Figure 2). Refer to the attached probe sketches / field notes for the location in plan. The west side of the column base within Hangar 3 was exposed; the east side on the lean-to side was not.	 Figure 1: View of typical column base prior to hazmat remediation (photo taken 7/13/2023).

From the top of the floor slab, the column extends approximately 15” down to the top of the steel base plate (Figure 3). The column is connected to the plate by an angle that has a 4” horizontal leg, 6” vertical leg, and ½” thickness. There are (2) vertical anchor bolts in the horizontal leg, and the vertical leg is connected to the column flange with (8) rivets in two rows. The base plate extends 1” beyond the horizontal leg of the angle. This column base condition appears to conform with the existing hangar drawings.

For approximately 8” above the top of slab and 6” below, the column flange shows corrosion and associated delamination of the steel. A compressible joint was applied at the interface between the column and the slab; when it was removed during the excavation it took some of the rust with it (Figure 4). The remaining 4” +/- of flange above the angle is clean of rust and corrosion, as are the angle, connectors, and base plate. The original orange paint on these elements is still visible. The good condition of the column base suggests that the cracks observed near this location are likely the result of settlement of the hangar slab, rather than corrosion of the column steel.

Beyond the concrete column encasement, the slab was observed to be approximately 6” thick atop a sand fill. The location of the crack was at the transition between the 6” slab and the thickened edge at the column encasement.

Figure 2: View of hangar column base probe.

Figure 3: View of portion of column and base connection below the slab.

Figure 4: Compressible joint filler with adhered rust from column flange.

Probe SP-02: Girder at Lean-to Roof (Hangar 4)

The bearing condition of one of the lean-to girders was exposed by removing the surrounding brick masonry at the pocket (Figure 5). The investigated girder was the fourth from the north on the Hangar 4 Lean-to west interior elevation (see probe sketches / field notes, attached, for plan location).

The girder was measured to be a 20-7/8” deep I-beam with an 8”-wide flange. It bears on a 12”-wide bearing plate extending 2” beyond the girder on each side. The girder extends approximately 11” into the 3-wythe brick wall, meaning that the outer layer of brick covering the girder end is not a full wythe thick. There are (2) 3” tall anchoring angles attached to the girder web; they are located approximately 2-½” from the top and bottom flanges (Figure 6).

The girder web and flanges exhibit significant corrosion and delamination, particularly within the bearing pocket. Similarly, the anchoring angles are corroded, with the upper angle in worse condition than the lower one. The

Figure 5: View of Hangar 4 lean-to girder bearing.

bearing plate, as seen from below (Figure 7) is also corroded and shows signs of delamination at the edge.

The roof of the lean-to slopes down towards the parapet at this exterior wall and is heavily deteriorated, resulting in conditions favorable to water penetrating into the wall construction. Over time, this has caused the steel within the wall to corrode and expand volumetrically, damaging the surrounding brick masonry and causing mortar joints and cracks to open. In addition, the exterior facade of this lean-has an abundance of plant growth; it is likely that roots have further expanded the masonry joints, exacerbating the condition.

Given the extent of deterioration observed at this probe, it is assumed that all of the lean-to girder bearing pockets will need to be opened up as part of the rehabilitation work. Minimally, girder ends will need to be cleaned of all rust and scale and coated with zinc-rich, rust-inhibiting paint, and then masonry will need to be rebuilt. Where material loss exceeds calculated thresholds, reinforcement of the steel section at the bearings will be required. Where the steel bearing plate is corroded, the bearing plate itself will need to be replaced with a hot-dipped galvanized plate. This will require shoring of the affected girders.

Figure 6: Measurement of anchorage angles at girder web. Note web delamination.

Figure 7: Delamination at girder bottom flange and corrosion of the bearing plate.

Probe SP-03: Lintel Bearing at WPA Infill Building (South Facade)

The lintels at the south façade of the WPA Infill Building were presumed to be in poor condition based on previous visits to the site. Cracking and

out-of-plane displacement was observed at the bearing ends and rust jacking along the length of the lintels at the outer horizontal leg was causing the lintels to deflect vertically (Figure 8).

The lintel bearing at one of the lower windows on the WPA Infill Building's south facade was uncovered during the probe investigation (Figure 9). The lintel is composed of three steel angles (Figure 10). The angle closest to the outside face is approximately an L5x3x1/4, with the long leg vertical. The toe of the horizontal leg points towards the exterior of the building. The center angle is oriented the same way as the outer angle, but it is placed about an inch higher in the wall; it is approximately an L5x3x3/4, LLV, although delamination made it difficult to determine the exact member thickness. The inner angle is the same size and elevation within the wall as the center angle, but its orientation is flipped (the toe of the horizontal leg points towards the interior). All three angles have approximately 1" clear space between them horizontally.

As mentioned above, the lintel members are significantly corroded. Delamination is visible on all three angles at the bearing, and the outer angle horizontal leg is delaminated along its entire length above the window opening (Figure 8).

It is assumed that all lintels on this portion of the façade will require full replacement of the outer angle lintel. For the inner two angles, it may be possible to expose, clean and coat the angles with rust-inhibiting, zinc-rich paint on their exposed surfaced and bearing ends provided the section loss observed does not exceed calculated thresholds. Conservatively, it should be assumed that all three angles will require replacement with new hot-dipped galvanized steel angles.

Figure 8: Rust jacking at lintel angle horizontal leg.

Figure 9: General view of the probe at the lintel bearing.

Figure 10: The three angles that compose the lintel.

Probe SP-04: Column in South Facade Pilaster

A steel column within one of the south facade pilasters (to the east of the Hangar 4 doors) was exposed during the probe investigation (Figure 11). The masonry at this location is in poor condition, with a large vertical crack near the pilaster edge at the interior column flange location. The goal of the probe was to determine whether corrosion and expansion of the column flange was causing the displacement of the masonry.

Figure 11: Probe at vertical crack along pilaster.

There is rust pack and delamination visible on the interior flange face and the column web, which were packed tight with brick masonry. (Figure 12). The exterior face of the column flange was less corroded than anticipated, given the condition of the interior face and the condition of the exterior masonry.

It appears that the condition of the column flange may not be the cause of the separation in the pilaster masonry joint. Rusting at the connection or pocketing of the Hangar 4 truss bottom chord may be what is causing this separation and will likely require structural repairs during the rehabilitation work (Figure 13).

Note: We recommend that extreme caution be taken when conducting further work at this location due to the instability of the masonry at the pilaster. The mortar joint has opened further at this location than what was observed during previous site visits (Figure 14).

Figure 12: Column flange interior face and column web rust and delamination.

Figure 13: Connection of hangar truss bottom chord at interior of pilaster (photo courtesey D. Follett).

Figure 14: Opening of mortar joint at probe.

Probe SP-05: WPA Infill Building North Facade

This section of the north facade of the WPA Infill building had been exhibiting delaminating brick and significant cracking within the brick panel over the west upper window. Brick was removed from the exterior face of masonry to expose the bearing of one of the roof purlins (Figure 15). The channel purlin bears on an approximately ½" thick bearing plate that extends approximately 2 inches beyond the channel flange in width. There is a 3" tall anchoring angle connected to the purlin web. The anchoring angle, purlin end and base plate are all only approximately 2 inches from the exterior face of masonry, less than a full brick thickness.

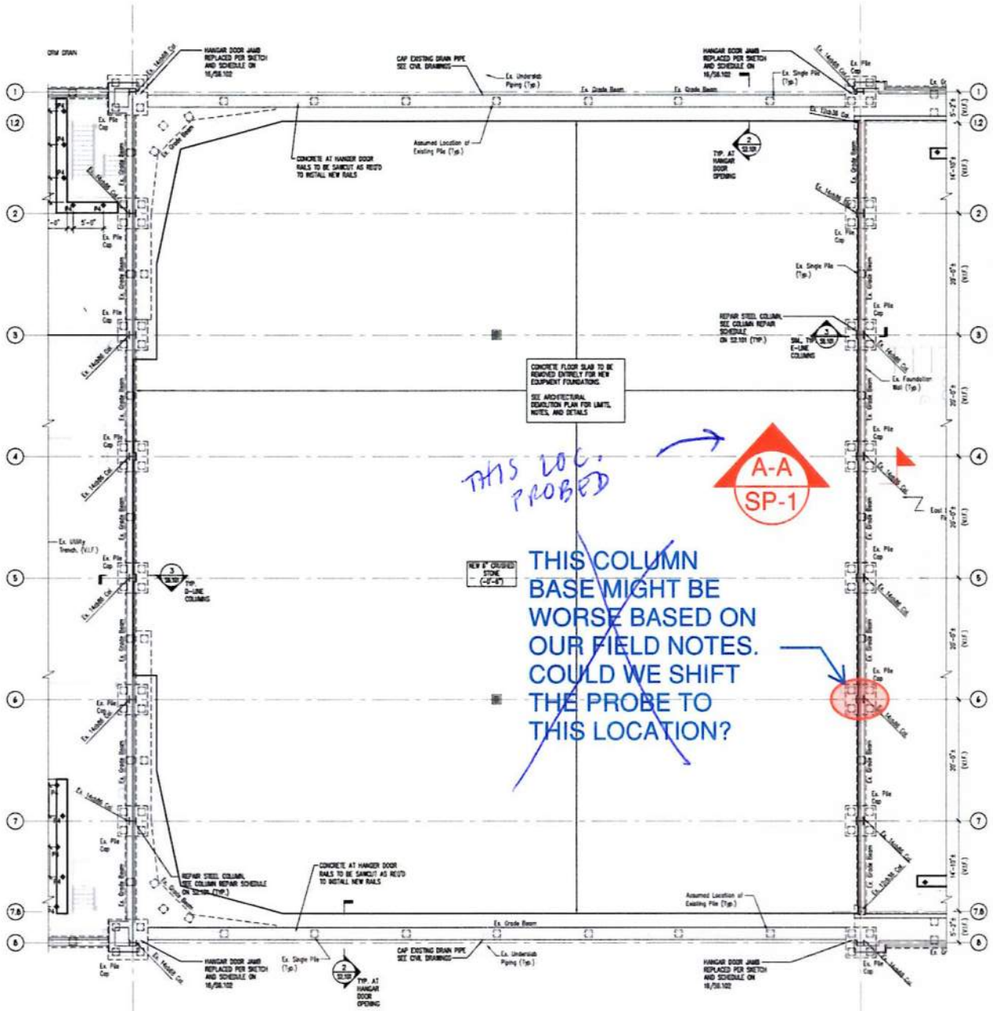
All exposed elements were observed to be corroded and delaminating. The expansion of these elements due to rust jacking have caused the displacement and cracking of the surrounding brick masonry.

Figure 15: Purlin bearing condition at north facade.

While standing on the rolling scaffold, the top of the adjacent window opening was observed. The top of the soldier course above the window lintel was measured to have moved outward approximately 1 inch (Figure 16). This is likely due to rust jacking of the vertical leg of the lintel supporting the outer brick wythe. It appears that the mortar used in this construction was stronger than the brick, as the mortar at the location of the displacement remained largely intact and the brick face broke off and moved outward with the soldier course. It is assumed that the outer lintel will minimally require replacement, similar to the south façade.

If you should have any questions or concerns related to the content of this report, please feel free to contact us at (703) 350-4151.

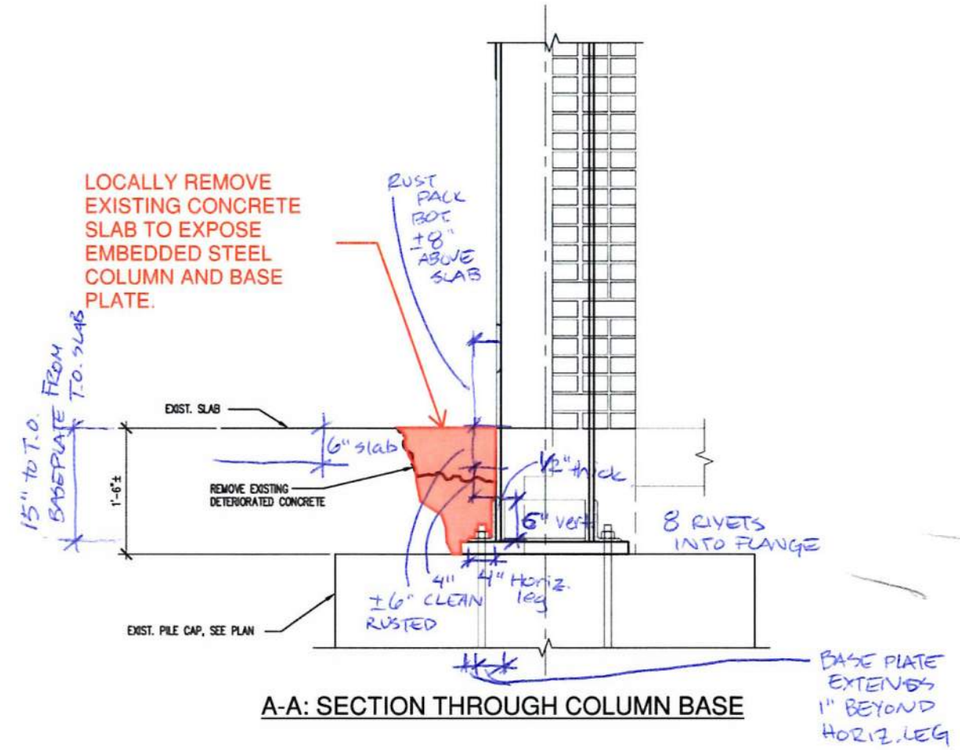
Figure 16: Brick displacement above lintel.



PARTIAL PLAN AT HANGAR FIRST FLOOR LEVEL / FOUNDATION

(FROM 2015 AS-BUILT DRAWINGS FOR HANGARS 1&2)

NOTE: THIS IS HANGAR 3



A-A: SECTION THROUGH COLUMN BASE

PHOTO 1: CRACKED SLAB AT COLUMN BASE

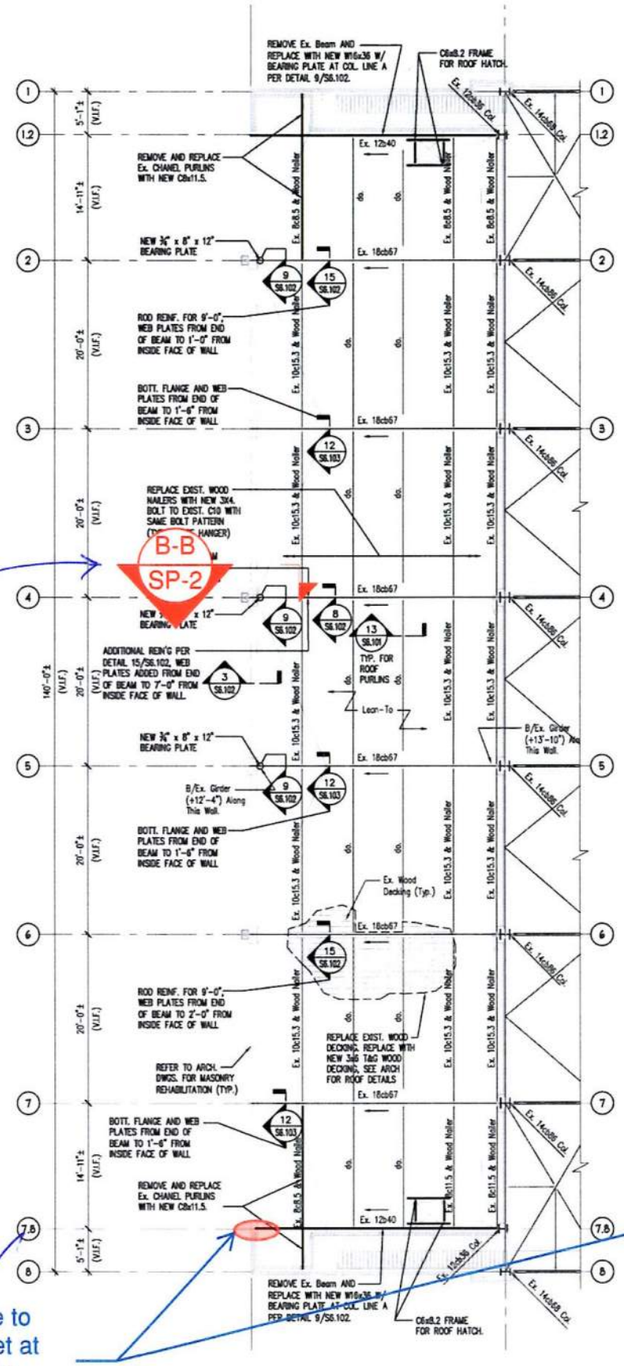
Project Number: 23-086.1

SP-01

Date: 05/21/2024 | Submission: Probe Drawings

Project Title: NPS GATE – Rehabilitate Hangars 3 and 4 at Floyd Bennett Field (PD&CD) Brooklyn, NY

MATTEO | FERRAN STRUCTURAL ENGINEERS
210 N. LEE ST. SUITE 210
ALEXANDRIA, VA 22314
T: (703) 350-4151
MATTEOFERRAN.COM



THIS LOCATION PROBED

Can we relocate to this beam pocket at Hangar 4? Photo added on right.

PARTIAL PLAN AT LEAN-TO ROOF FRAMING

(FROM 2015 AS-BUILT DRAWINGS FOR HANGARS 1&2)

Connections @ hangar wall

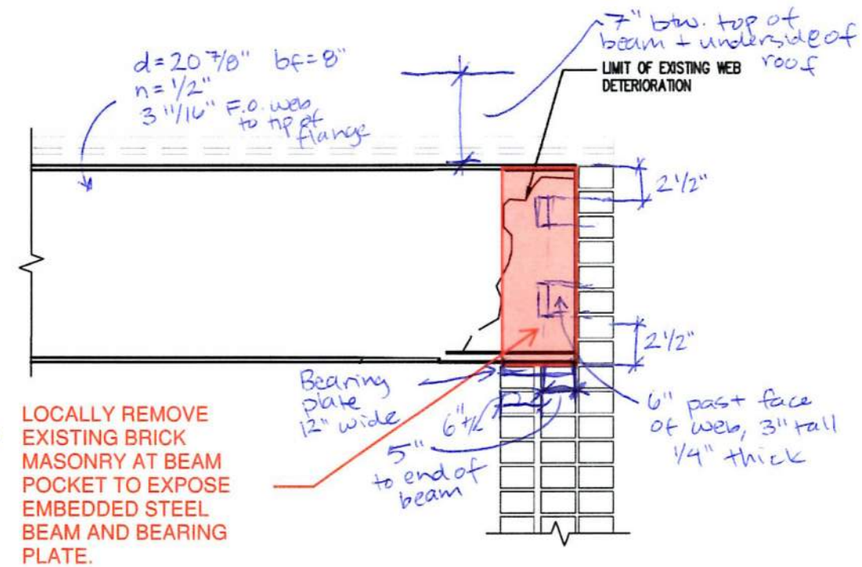
Beam: d = 10" ± x = 3"
t_f = 5/16"
b_f > 5"

Nailer: 2 3/4" x 4"

Purlin: 6 1/4" down from that
b_f = 2 1/2"

Angle bracing purlin to T.O. GIRDER beam: 4" tall, 3" wide, 3/8" ±

(10") Beam flanges coped @ column + (2) 1/2" shim plates installed btw. col. flange & BM web



LOCALLY REMOVE EXISTING BRICK MASONRY AT BEAM POCKET TO EXPOSE EMBEDDED STEEL BEAM AND BEARING PLATE.

B-B: SECTION THROUGH LEAN-TO ROOF GIRDER BEARING

EXTERIOR VIEW OF INTERIOR PROBE FOR REFERENCE (LOCATE AT HANGAR 4 LEAN-TO WHERE MASONRY REPAIRS HAVE NOT BEEN PERFORMED).

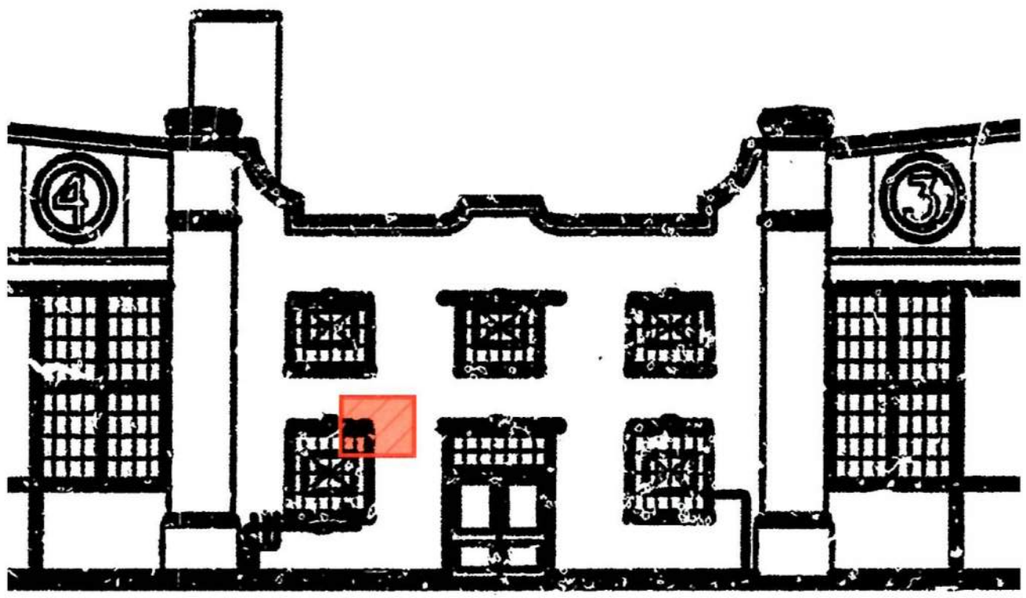
PHOTO 2: EXTERIOR VIEW OF HANGAR 3 LEAN-TO FOR REFERENCE

Date: 05/21/2024 | Submission: Probe Drawings | Project Number: 23-086.1

Project Title: NPS GATE – Rehabilitate Hangars 3 and 4 at Floyd Bennett Field (PD&CD) Brooklyn, NY

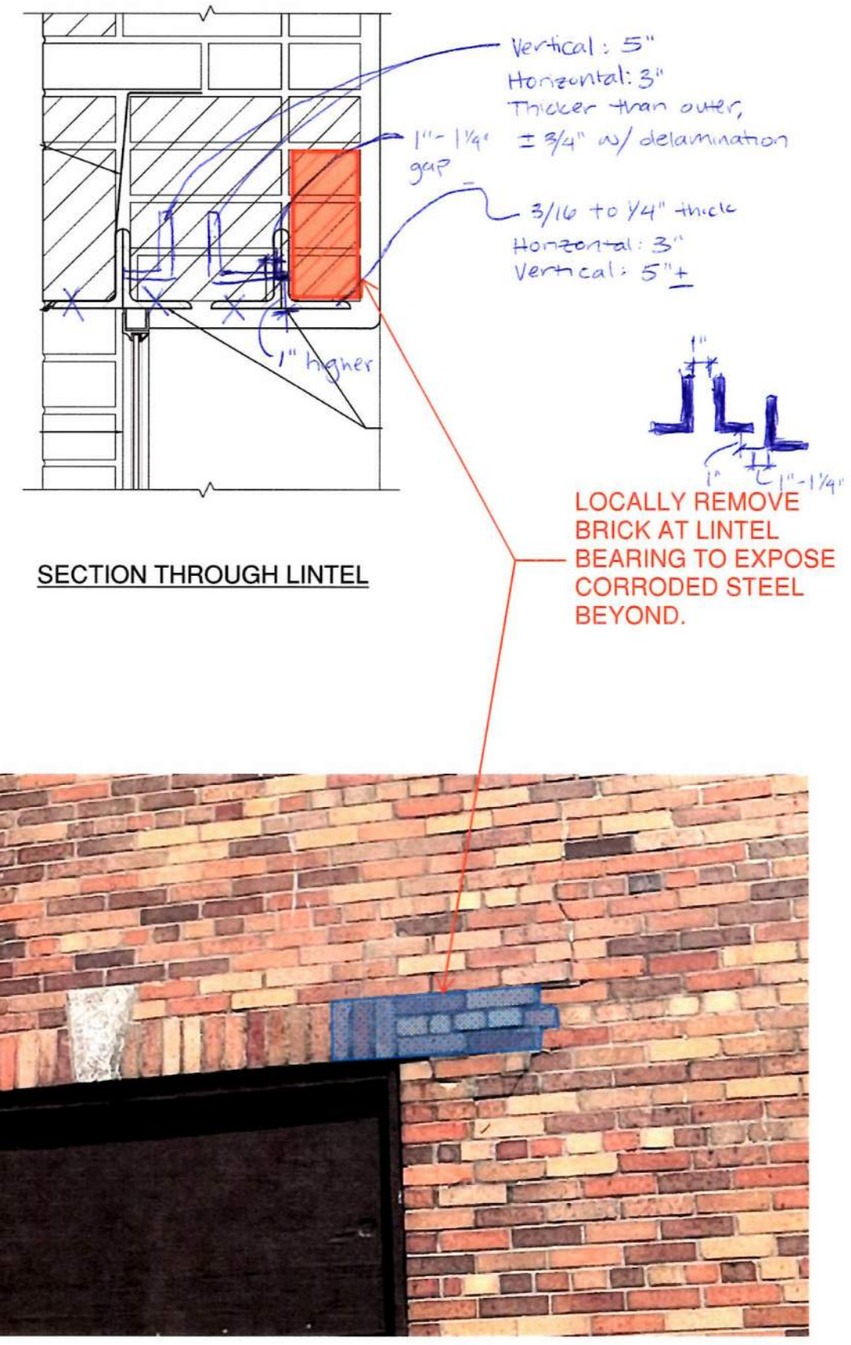
SP-02

MATTEO | FERRAN STRUCTURAL ENGINEERS
210 N. LEE ST. SUITE 210 ALEXANDRIA, VA 22314 T: (703) 330-4151 MATTEOFERRAN.COM



PARTIAL SOUTH ELEVATION AT WPA INFILL BUILDING

(FROM 2003 EXTERIOR REHAB DESIGN DEVELOPMENT DRAWINGS FOR HANGARS 3&4)



SECTION THROUGH LINTEL

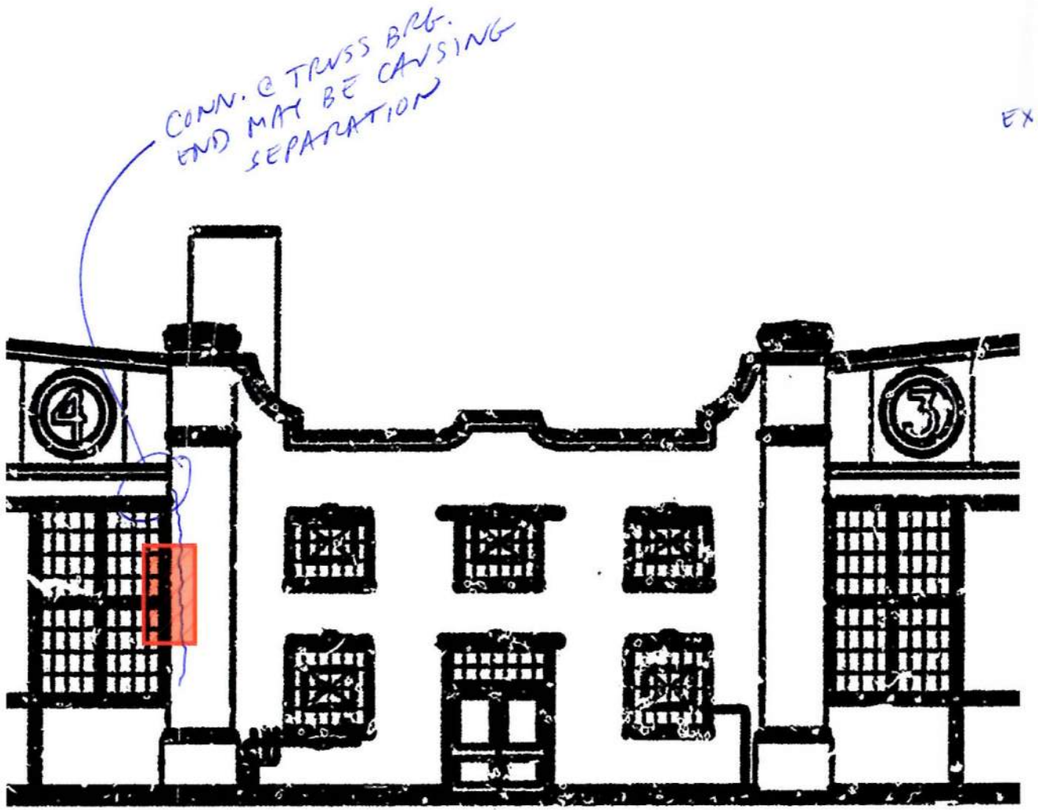
PHOTO 3: CRACKED AND DISPLACED BRICK AT CORRODED LINTEL BEARING

Date: 05/21/2024 | Submission: Probe Drawings | Project Number: 23-086.1

Project Title: NPS GATE – Rehabilitate Hangars 3 and 4 at Floyd Bennett Field (PD&CD) Brooklyn, NY

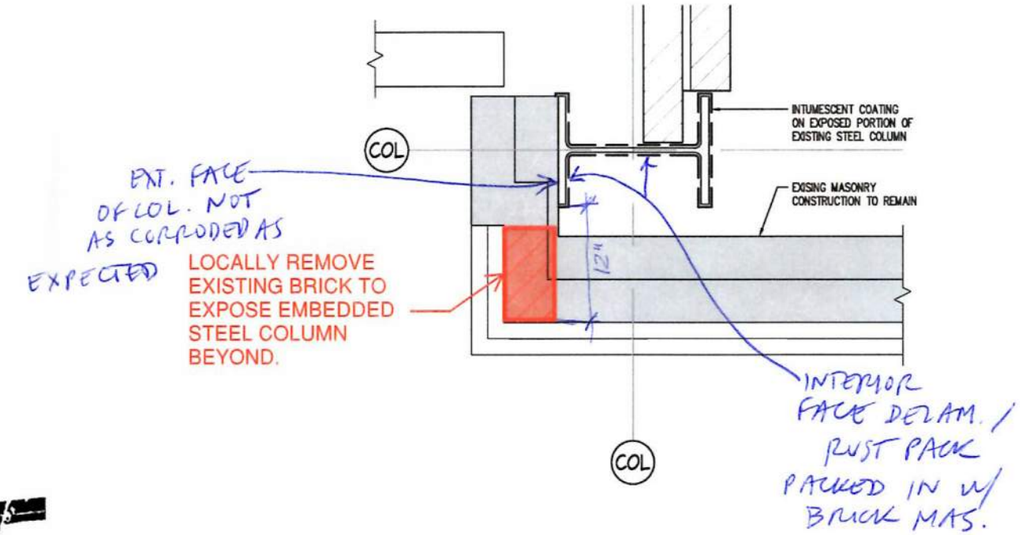
SP-03

MATTEO | FERRAN STRUCTURAL ENGINEERS
210 N. LEE ST. SUITE 210
ALEXANDRIA, VA 22314
T: (703) 350-4151
MATTEOFERRAN.COM



PARTIAL SOUTH ELEVATION AT WPA INFILL BUILDING

(FROM 2003 EXTERIOR REHAB DESIGN DEVELOPMENT DRAWINGS FOR HANGARS 3&4)



PLAN VIEW OF COLUMN

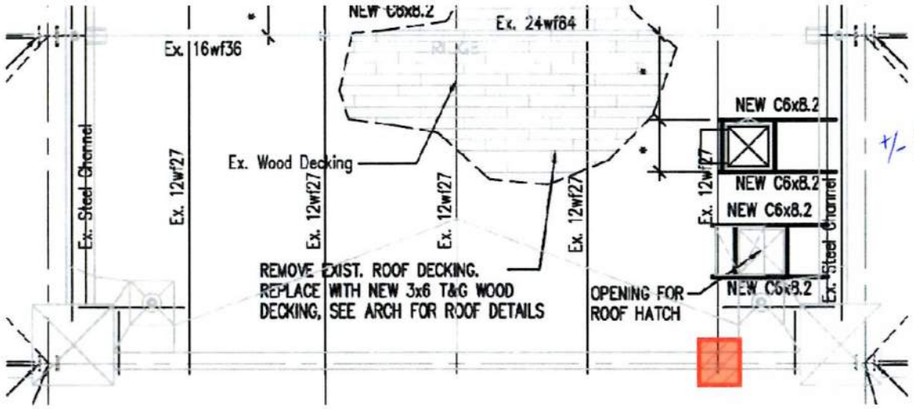
PHOTO 4: CRACKED AND DISPLACED BRICK AT CORRODED EMBEDDED COLUMN

Date: 05/21/2024 | Submission: Probe Drawings | Project Number: 23-086.1

Project Title: NPS GATE – Rehabilitate Hangars 3 and 4 at Floyd Bennett Field (PD&CD) Brooklyn, NY

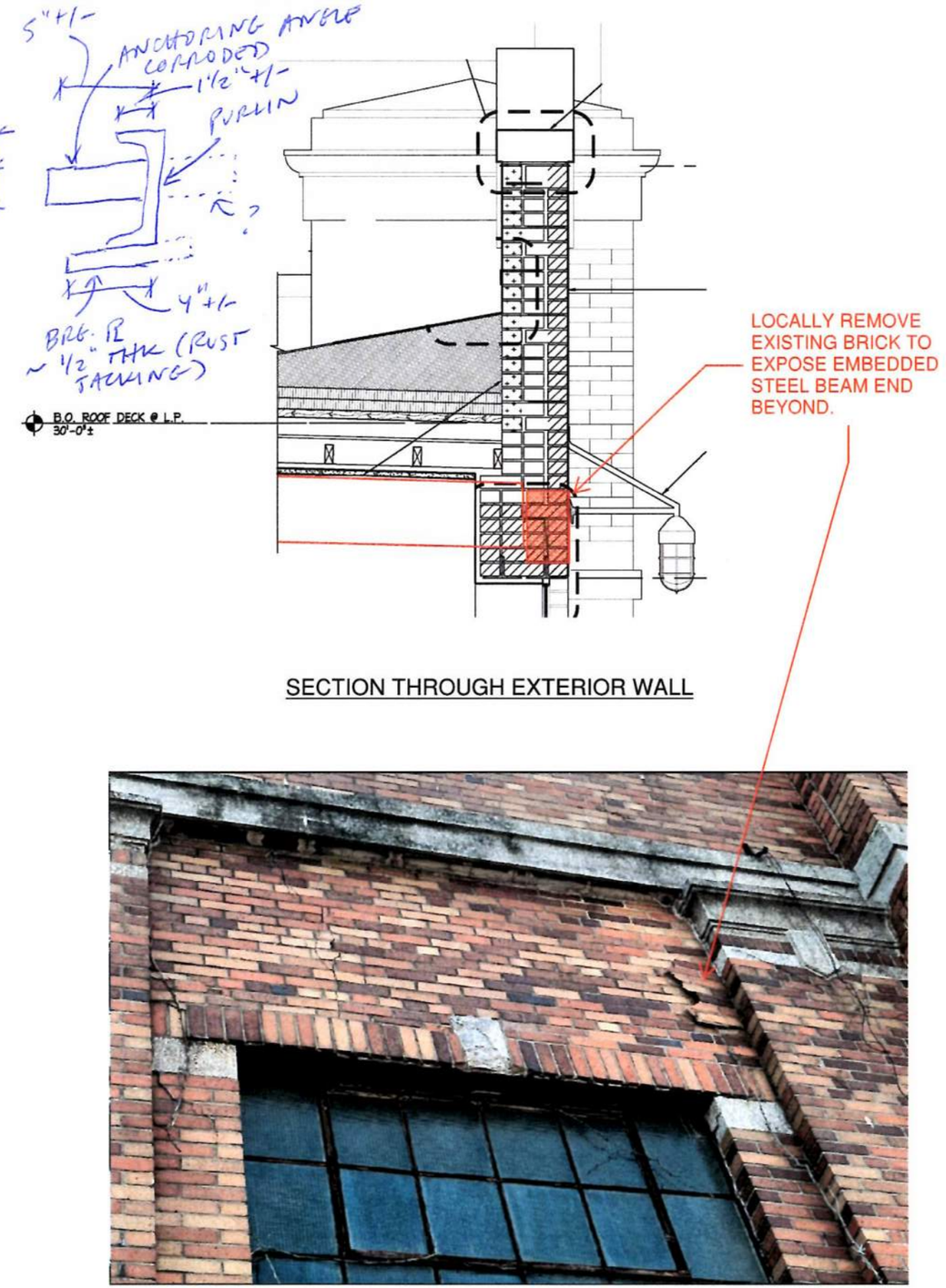
MATTEO | FERRAN STRUCTURAL ENGINEERS
210 N. LEE ST. SUITE 210 ALEXANDRIA, VA 22314 T: (703) 350-4151 MATTEOFERRAN.COM

SP-04

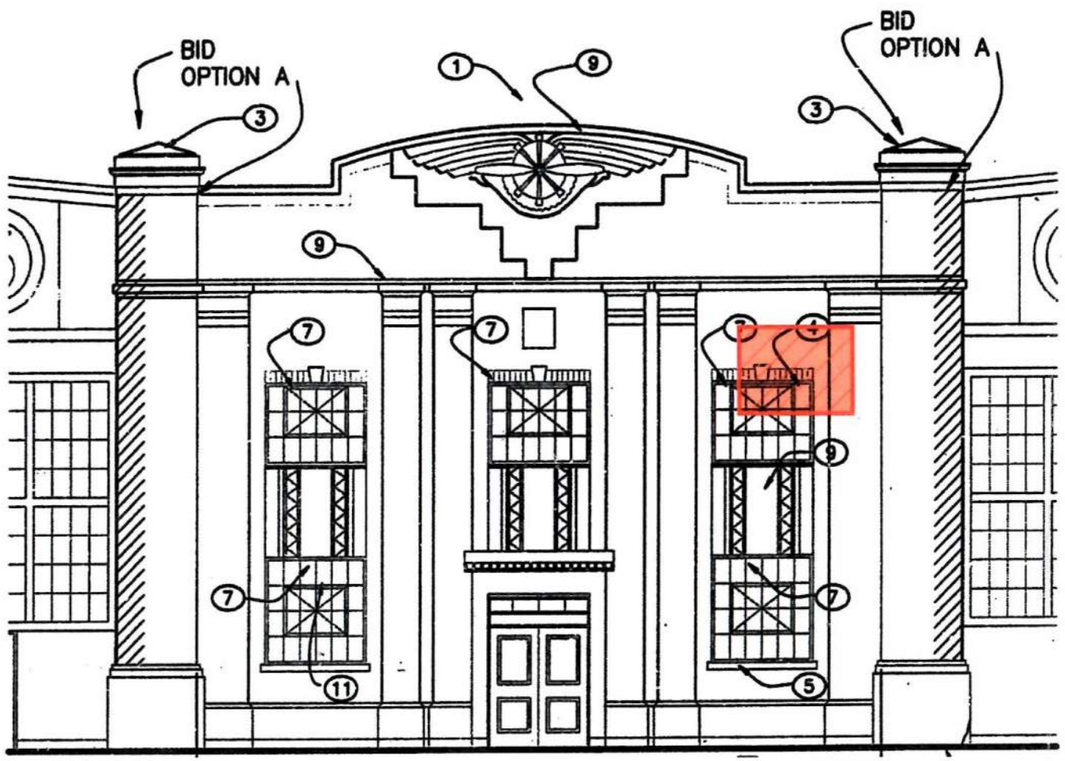


PARTIAL ROOF FRAMING PLAN AT WPA BUILDING

(FROM 2015 AS-BUILT DRAWINGS FOR HANGARS 1&2)



SECTION THROUGH EXTERIOR WALL



PARTIAL NORTH ELEVATION AT WPA INFILL BUILDING

(FROM 2003 EXTERIOR REHAB DESIGN DEVELOPMENT DRAWINGS FOR HANGARS 3&4)

PHOTO 5: DELAMINATING BRICK AT EMBEDDED BEAM END

Date: 05/21/2024 | Submission: Probe Drawings | Project Number: 23-086.1

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SP-05

MATTEO | FERRAN
STRUCTURAL ENGINEERS
210 N. LEE ST. SUITE 210
ALEXANDRIA, VA 22314
T: (703) 350-4151
MATTEOFERRAN.COM

Hangars 3 and 4 at Floyd Bennett Field

Environmental Hazardous Materials Survey_Rev.03

Prepared by: Shaun McEvoy - NY Asbestos License 03-18547 and Scott Walczyk

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Executive Summary

GHD conducted a hazardous materials building survey (Survey) at the National Park Service Hangars 3 and 4 at Floyd Bennett in Jamaica Bay, New York to evaluate and sample potential hazardous materials. GHD evaluated and sampled potential asbestos containing material (ACM), paint chips, polychlorinated biphenyls (PCBs), and lead wipe sampling that are anticipated to be encountered during future rehabilitation of the Hangars 3 and 4. This report documents the results of the survey work conducted.

Asbestos

Potential ACM observed in the areas to be disturbed as part of the Rehabilitation of Hangars 3 and 4 were collected for asbestos analysis. Analysis of the 121 ACM samples collected identified eight (8) materials containing greater than 1.0% asbestos. In addition, presumed asbestos-containing pipe insulation was observed in a pipe trench under the floor. The presumed asbestos was not sampled and is presumed to be asbestos containing and friable.

Paint Sampling

Paints in and around the hangar building were sampled for lead content analysis.

Of the forty-seven (47) paint chip samples collected, thirty-four (34) samples detected lead at concentrations greater than 0.5% by weight and therefore are considered Lead-based paint (LBP) by the United States Environmental Protection Agency (EPA).

Lead-containing paint (LCP), as defined by paint containing detectable lead below the LBP level, was present in all samples collected, as detailed in this Report.

PCB Sampling

Based on the proposed scope of Rehabilitation, glazing and sealants were sampled and analyzed for PCBs for waste characterization purposes. Of the fourteen (14) collected samples, four (4) detected PCBs below the Toxic Substances Control Act (TSCA) disposal restriction limit. The remaining ten (10) collected PCB samples did not record detectable levels of PCBs.

Based on the results, there are no PCB glazing or sealant disposal restrictions.

Sludge Waste Sampling

A black sludge like material was observed to be present in the trench located in the boiler room. A sample of this material was collected and analyzed for Toxic Characteristic Leaching Procedure (TCLP) waste characteristics.

Out of the three (3) samples collected cadmium was detected in two samples, lead was detected in all three samples and pentachlorophenol was detected in one sample. No VOCs were detected. Other than as outlined previously, no other metals or SVOCs were detected. The EPA hazardous waste standard for cadmium is 1.0 mg/L; for lead is 5.0 mg/L; and for pentachlorophenol is 100 mg/L. Only one sample (03) detected lead above the hazardous waste level with a detection of 7.5 mg/L. Therefore, the sludge in location 03 is a D008 characteristically hazardous waste.

Lead Wipe Sampling

Wall and floor surfaces around the interior of the building were sampled for detection and analysis of lead dusts. Of the ten (10) of the one hundred (100) cm^2 collected samples, nine (9) detected lead at a concentration greater than 1 $\mu g/cm^2$, two of which exceeded 100 $\mu g/cm^2$. The remaining sample detected lead at a concentration of 0.92 $\mu g/cm^2$.

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1. Introduction

GHD is pleased to submit this report documenting the results of the hazardous materials building survey (Survey) conducted at Hangars 3 and 4 (Hangars) at Floyd Bennett Field, located in Jamaica Bay, New York. The building materials sampled in this report are anticipated to be encountered during future rehabilitation of the Hangars. This report documents the results of GHD conducted sampling and information provided by the NPS.

2. Asbestos Survey

GHD conducted an asbestos survey to identify potential asbestos containing materials (ACM) that may be present in the Hangars. For the purposes of the asbestos survey the Hangars were divided into six (6) functional spaces.

- Functional Space 001 (FS001): Hangar 3. 135’ x 150’
- Functional Space 002 (FS002): Hangar 4. 135’ x 150’
- Functional Space 003 (FS003): Hangar 3 administration office area. 150’ x 30’.
- Functional Space 004 (FS004): Hangar 4 administration office area. 150’ x 30’.
- Functional Space 005 (FS005): Boiler Room. 50’ x 40’.
- Functional Space 006 (FS006): Shooting Range: 50’ x 105’.

FS003 and FS004 included several individual offices that were in severe states of disrepair and could not be fully accessed. GHD collected 121 ACM samples throughout the Hangar complex between October 9 and October 11, 2023.

Mr. Shaun McEvoy, New York Asbestos Inspector (License Number 03-18547), identified potential ACM in areas of the building.

As a result of the visual inspection, the following potential ACM were identified for sample collection:

1. Sealant compounds
2. Thermal system insulation (TSI)
3. Tile flooring
4. Roofing material
5. Miscellaneous ACM

TSI samples were not collected in areas labeled as Asbestos Free or where the inspector determined the TSI to be fiberglass, foam glass, rubber, or other non-asbestos containing building material (ACBM).

Following collection between October 9 and October 11, 2023, the samples were properly packaged, labeled, and transported under chain of custody (COC) to EMSL Analytical, Inc. (EMSL) in Depew, NY. EMSL is a licensed asbestos laboratory and is accredited in New York (Certificate # 11606) under AIHA certification ID 288166, to perform asbestos analysis via Polarized Light Microscopy (PLM) in accordance with the New York State (NY) ELAP 198.1 method.

Analysis of the samples collected identified sixteen (16) samples of eight (8) homogeneous materials (HM) across three (3) functional spaces containing greater than 1.0% asbestos:

FS003:

- HM 041: 9" x 9" floor tile, dark brown. Located in the Hangar 3 admin area, under 12”x 12” floor tile (Sample IDs 045A and 045B).

FS004:

- HM 006: Gray roof felt material. Located at the edge of the Hangar 4 admin area roof (Sample IDs 006A and 006B).
- HM 007: Gray roof sealant: Located at the edge of the Hangar 4 admin area roof (Sample IDs 008A and 008B).
- HM 048: 12" x 12" floor tile, light gray. Located in the Hangar 4 admin area, south end (Sample IDs 055A and 055B)

FS006:

- HM 014: Dark gray caulk. Located on the shooting range roof, around exterior windows (Sample IDs 016A and 016B)
- HM 019: Dark gray roof sealant. Located on shooting range roof, in the northeast corner (Sample IDs 022A and 022B)
- HM 023: 9" x 9" floor tile, dark gray. Located in the shooting range, 2nd floor bathroom (Sample IDs 027A and 027B)
- HM 023-1: Mastic under 9" x 9" floor tile. Located in the shooting range, 2nd floor bathroom (Sample IDs 027A-1 and 027B-1)

Additionally, four (4) samples of two (2) materials were found to be associated with ACM but were not ACM themselves.

- HM 041-1: Mastic under 9" x 9" floor tile, dark brown. Located in the Hangar 3 admin area, under 12”x 12” floor tile. (Sample IDs 045A-1 and 045B-1)
- HM 048-1: Mastic under 12" x 12" floor tile, light gray. Located in the Hangar 4 admin area, south end (Sample IDs 055A-1 and 055B-1)

Sample notes are included as **Appendix I**, sample collection locations are presented on **Appendix II**. The asbestos laboratory analytical reports are included as **Appendix III**. The results of asbestos samples from the Site are summarized on **Table 1** through **Table 6.**

2.1 Presumed Asbestos

Presumed asbestos-containing pipe insulation was observed in the north/south pipe trench under the building. The material was observed to be on the piping and also on the trench floor and should be assumed to be friable. No testing was performed on this material. The exact quantity is unknown but it is assumed to be the length of the trench. The location of the material is presented in **Appendix II**.

3. Paint Chip Sampling

GHD conducted a paint survey to identify potential lead-based paint (LBP) across the Site. GHD collected thirty-six (36) samples within the interior and exterior of the Hangars between October 9 and October 11, 2023. An additional eleven (11) samples within the interior and exterior of the Hangars were collected on March 13, 2024.

Following collection, the samples were properly packaged, labeled, and transported under COC to EMSL in Carle Place, New York. Paint chips were analyzed by EMSL via EPA Methods 3051A and 7000B. EMSL is accredited in New York (Certification ID 11469) to perform Flame Atomic Absorption Spectrophotometry of paint chips for lead analysis.

Out of the forty-seven (47) paint chip samples collected, thirty-four (34) contain lead at concentrations greater than 0.5% total weight and therefore are considered LBP by the United States Environmental Protection Agency (EPA).

The remaining samples collected detected lead at concentrations less than 0.5 % wt and as such are considered as lead containing paint (LCP) per the Occupational Safety and Health Administration (OSHA). Contractors performing renovations in areas where LCP are present shall be notified of the presence of LCP and instructed to follow OSHA regulations (i.e., 29 CFR 1910.1025 and 1926.62) and other applicable regulations regarding working with LCP.

Sample notes are included as **Appendix I**, sample collection locations are presented on **Appendix II**. The paint chip laboratory analytical report is included as **Appendix IV**. The results of paint chip samples from the Site are summarized on **Table 7.**

4. PCB Sampling

GHD collected fourteen (14) samples for polychlorinated biphenyls (PCBs) from sealants and caulking throughout the interior and exterior of the Hangars between October 9 and October 11, 2023. Following collection, the samples were properly packaged, labeled, and transported under COC to Test America in Savannah, Georgia. PCBs were analyzed by Test America via EPA Methods 8082A. Test America is accredited in New York (Certification ID 10670).

Out of the fourteen (14) collected samples four (4) contained PCBs. The Toxic Substances Control Act (TSCA) disposal restriction limit is 50 parts per million (ppm). The four (4) PCB containing samples fall below the TSCA limit meaning no disposal restrictions are required.

Sample notes are included as **Appendix I** and sample collection locations are presented on **Appendix II**. The PCB sampling laboratory analytical report is included as **Appendix V**. The results from the Site are summarized on **Table 8.**

5. Sludge TCLP Sampling

On March 13, 2024, three samples of the black sludge material present in the boiler room trench were collected for Toxic Characteristic Leaching Procedure (TCLP) waste characteristic analysis. Following collection, the samples were properly packaged, labeled, and transported under COC to EMSL in Cinnaminson, New Jersey. EMSL transferred the samples to ALS in Middletown, Pennsylvania for analysis. All samples were treated with EPA Method 1311 TCLP prior to subsequent analysis. Metals were analyzed by ALS via EPA Method 6010C, mercury was analyzed by ALS via EPA Method 7470A. Volatile Organic Compounds (VOCs) were analyzed by ALS via EPA Method 8260C. Semi-Volatile Organic Compounds (SVOCs) were analyzed by ALS via EPA Method 8270E. Moisture and percent solids were analyzed by ALS via Method S2540G-11. ALS is accredited in New York (Certification ID 11759).

Out of the three (3) samples collected cadmium was detected in two samples, lead was detected in all three samples and pentachlorophenol was detected in one sample. No VOCs were detected. Other than as

outlined previously, no other metals or SVOCs were detected. The EPA hazardous waste standard for cadmium is 1.0 mg/L; for lead is 5.0 mg/L; and for pentachlorophenol is 100 mg/L. Only one sample (03) detected lead above the hazardous waste level with a detection of 7.5 mg/L. Therefore, the sludge in location 03 is a D008 characteristically hazardous waste.

Sample notes are included as **Appendix I** and sample collection locations are presented on **Appendix II**. The TCLP sampling laboratory analytical report is included as **Appendix VI**. The results from the Site are summarized on **Table 9.**

6. Visual Mold Inspection

As part of the hazardous materials survey, an inspection was conducted for visual mold growth in the project work area. Visual mold growth and standing water was noted in locations throughout the Hangars and in select locations withing the administrative spaces.

Precautions and proper personal protective equipment (PPE) should be in place prior to the cleaning and removal of observed visual mold to prevent exposure to potential airborne mold spores.

7. Lead Wipe Sampling

On September 30, 2024, Scott Walczyk of GHD collected surface wipe samples from ten (10) locations throughout the area designated as the Shooting Range, which included the former shooting range and adjacent Hangars 3 and 4 to characterize lead dust in the area. GHD used moistened cotton gauze (ghost wipes) and uniform 10 x 10 centimeter (cm) square wipe sample templates for each wipe sample. GHD followed method protocols which included handling each sample with a clean pair of nitrile gloves. All surface wipe samples were placed inside the laboratory supplied containers, labelled, and shipped to SGS Galson, an AIHA accredited laboratory, in East Syracuse, NY and analyzed for Lead via NIOSH Method 9102.

Pertinent information (i.e., Site conditions, visual observations, job activities, etc.) was recorded in field notes which are found in **Appendix I**. The laboratory results from the wipe samples are summarized in **Table 10**. Copies of the complete laboratory reports are included as **Appendix VII**.

Tables

Table 1
Summary of Asbestos Analytical Results
NPS
Functional Space 001 - Hangar 3
Brooklyn, NY
October 2023

Homogenous Material #	Material Description	Sample Location	Sample ID	PLM Analytical Results	TEM Analytical Results	ACM? (Yes/No)	Friable? (Yes/No)
030	White Caulk	Exterior of windows on north wall	034A	Inconclusive: NAD	No asbestos detected	No	NA
			034B	Inconclusive: NAD	No asbestos detected		
032	White Caulk	Exterior of windows on south wall	036A	Inconclusive: NAD	No asbestos detected	No	NA
			036B	Inconclusive: NAD	No asbestos detected		
035	White Caulk	Interior of windows on south wall	039A	Inconclusive: NAD	No asbestos detected	No	NA
			039B	Inconclusive: NAD	No asbestos detected		
036	Gray pipe wrap	Southeast corner of Hangar 3	040A	No asbestos detected	Not analyzed	No	NA
			040B	No asbestos detected	Not analyzed		

Notes:

NA - Non Applicable
ACM - Asbestos Containing Material (a material containing >1% asbestos)
NAD - No Asbestos Detected
TEM - Transmission Electron Microscopy
PLM - Polarized Light Microscopy
Positive Stop - Sample was not analyzed due to the fact that a previous sample of the same Homogenous Material contained >1% asbestos.
Friable ACM - any material containing more than 1 percent asbestos as determined using PLM, that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.
Nonfriable ACM - any material containing more than 1 percent asbestos as determined using PLM, that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.
* = sample result indicated "< 1% asbestos"

Table 2
Asbestos Analytical Results
NPS
Functional Space 002 - Hangar 4
Brooklyn, NY
October 2023

Homogenous Material #	Material Description	Sample Location	Sample ID	PLM Analytical Results	TEM Analytical Results	ACM? (Yes/No)	Friable? (Yes/No)
020	Top roof layer, black	Roof of Hangar 4, under aggregate	023A	Inconclusive: NAD	No asbestos detected	No	NA
			023B	Inconclusive: NAD	No asbestos detected		
021	Underlying roof material, black	Roof of Hangar 4	024A	Inconclusive: NAD	No asbestos detected	No	NA
			024B	Inconclusive: NAD	No asbestos detected		
022	Underlying roof felt, brown	Roof of Hangar 4	025A	Inconclusive: NAD	No asbestos detected	No	NA
			026B	Inconclusive: NAD	No asbestos detected		
-	Composite of HMs 020, 021, 022	Roof of Hangar 4	026A	Inconclusive: NAD	No asbestos detected	No	NA
			026B	Inconclusive: NAD	No asbestos detected		
031	Light gray caulk	Around exterior windows, north side	035A	Inconclusive: NAD	No asbestos detected	No	NA
			035B	Inconclusive: NAD	No asbestos detected		
033	Light gray caulk	Around exterior windows, south side	037A	Inconclusive: NAD	No asbestos detected	No	NA
			037B	Inconclusive: NAD	No asbestos detected		
042	Light gray caulk	Around interior of windows, north side	046A	Inconclusive: NAD	No asbestos detected	No	NA
			046B	Inconclusive: NAD	No asbestos detected		

Notes:

NA - Non Applicable
ACM - Asbestos Containing Material (a material containing >1% asbestos)
NAD - No Asbestos Detected
TEM - Transmission Electron Microscopy
PLM - Polarized Light Microscopy
Positive Stop - Sample was not analyzed due to the fact that a previous sample of the same Homogenous Material contained >1% asbestos.
Friable ACM - any material containing more than 1 percent asbestos as determined using PLM, that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.
Nonfriable ACM - any material containing more than 1 percent asbestos as determined using PLM, that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.
* = sample result indicated "< 1% asbestos"

Table 3
Asbestos Analytical Results
NPS
Functional Space 3 - Hangar 3 Administration Area
Brooklyn, NY
October 2023

Homogenous Material #	Material Description	Sample Location	Sample ID	PLM Analytical Results	TEM Analytical Results	ACM? (Yes/No)	Friable? (Yes/No)
037	Dry wall material	Throughout interior of Hangar 3 admin area	041A	No asbestos detected	Not Analyzed	No	NA
			041B	No asbestos detected	Not Analyzed		
038	Lower plaster layer	Above drywall ceiling, Hangar 3 admin area	042A	No asbestos detected	Not Analyzed	No	NA
			042B	No asbestos detected	Not Analyzed		
039	12" x 12" floor tile, crème colored	South end of Hangar 3 admin area	043A	Inconclusive: NAD	No asbestos detected	No	NA
			043B	Inconclusive: NAD	No asbestos detected		
039-1	Mastic under 12" x 12" floor tile	South end of Hangar 3 admin area	043A-1	Inconclusive: NAD	No asbestos detected	No	NA
			043B-1	Inconclusive: NAD	No asbestos detected		
040	White caulk	Interior windows, east wall of Hangar 3 admin area	044A	Inconclusive: NAD	No asbestos detected	No	NA
			044B	Inconclusive: NAD	No asbestos detected		
041	9" x 9" floor tile, dark brown	South end of Hangar 3 admin area, under 12" x 12" floor tile	045A	17% Chrysotile	Not Analyzed	Yes	No
			045B	11% Chrysotile	Not Analyzed		
041-1	Mastic under 9" x 9" floor tile	South end of Hangar 3 admin area, under 12" x 12" floor tile	045A-1	Inconclusive: NAD	< 1% Chrysotile	No*	NA
			045B-1	Inconclusive: NAD	< 1% Chrysotile		

Notes:

NA - Non Applicable
ACM - Asbestos Containing Material (a material containing >1% asbestos)
NAD - No Asbestos Detected
TEM - Transmission Electron Microscopy
PLM - Polarized Light Microscopy
Positive Stop - Sample was not analyzed due to the fact that a previous sample of the same Homogenous Material contained >1% asbestos.
Friable ACM - any material containing more than 1 percent asbestos as determined using PLM, that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.
Nonfriable ACM - any material containing more than 1 percent asbestos as determined using PLM, that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.
* = sample result indicated "< 1% asbestos"

Table 4
Asbestos Analytical Results
NPS
Functional Space 004 - Hangar 4 Administration Area
Brooklyn, NY
October 2023

Homogenous Material #	Material Description	Sample Location	Sample ID	PLM Analytical Results	TEM Analytical Results	ACM? (Yes/No)	Friable? (Yes/No)
004	Top roof material, black	Roof of Hangar 4 admin area	004A	Inconclusive: NAD	No asbestos detected	No	NA
			004B	Inconclusive: NAD	No asbestos detected		
005	Underlying roof felt, brown	Roof of Hangar 4 admin area	005A	Inconclusive: NAD	No asbestos detected	No	NA
			005B	Inconclusive: NAD	No asbestos detected		
-	Composite of HMs 004, 005	Roof of Hangar 4 admin area	007A	Inconclusive: NAD	No asbestos detected	No	NA
			007B	Inconclusive: NAD	No asbestos detected		
006	Gray roof felt material	Edge of Hangar 4 admin area roof	006A	8.5% Chrysotile	Not analyzed	Yes	No
			006B	24% Chrysotile	Not analyzed		
007	Gray roof sealant	Edge of Hangar 4 admin area roof	008A	4.9% Chrysotile	Not analyzed	Yes	No
			008B	1.8% Chrysotile	Not analyzed		
008	Light gray caulk	Exterior of Hangar 4 admin area, west wall, in brick	009A	Inconclusive: NAD	No asbestos detected	No	NA
			009B	Inconclusive: NAD	No asbestos detected		
043	Outer plaster layer on ceiling	Hangar 4 admin area ceiling	047A	No asbestos detected	Not analyzed	No	NA
			047B	No asbestos detected	Not analyzed		
-	Blind Duplicate of HM 043	Hangar 4 admin area ceiling	048A	No asbestos detected	Not analyzed	No	NA
			048B	No asbestos detected	Not analyzed		
044	Dry wall material	Hangar 4 admin area, north end	049A	No asbestos detected	Not analyzed	No	NA
			049B	No asbestos detected	Not analyzed		
-	Blind Duplicate of HM 044	Hangar 4 admin area, north end	050A	No asbestos detected	Not analyzed	No	NA
			050B	No asbestos detected	Not analyzed		
045	Outer plaster layer, crème colored	Hangar 4 admin area, south end, on wood frame wall	051A	No asbestos detected	Not analyzed	No	NA
			051B	No asbestos detected	Not analyzed		
046	Inner plaster layer, gray colored	Hangar 4 admin area, south end, on wood frame wall	052A	No asbestos detected	Not analyzed	No	NA
			052B	No asbestos detected	Not analyzed		

Table 4
Asbestos Analytical Results
NPS
Functional Space 004 - Hangar 4 Administration Area
Brooklyn, NY
October 2023

-	Blind Duplicate of HM 046	Hangar 4 admin area, south end, on wood frame wall	053A	No asbestos detected	Not analyzed	No	NA
			053B	No asbestos detected	Not analyzed		
047	Plaster layer, gray	Hangar 4 admin area, south end, on brick wall	054A	No asbestos detected	Not analyzed	No	NA
			054B	No asbestos detected	Not analyzed		
048	12" x 12" floor tile, light gray	Hangar 4 admin area, south end	055A	2.6% Chrysotile	Not analyzed	Yes	No
			055B	Positive Stop	Not analyzed		
048-1	Mastic under 12" x 12" floor tile	Hangar 4 admin area, south end	055A-1	Inconclusive: NAD	No asbestos detected	No*	NA
			055B-1	Inconclusive: NAD	< 1% Chrysotile		
-	Blind Duplicate of HM 048	Hangar 4 admin area, south end	056A	2.3% Chrysotile	Not analyzed	Yes	No
			056B	Positive Stop	Not analyzed		
-	Blind Duplicate of HM 048-1	Hangar 4 admin area, south end	056A-1	Inconclusive: NAD	No asbestos detected	No*	NA
			056B-1	Inconclusive: NAD	< 1% Chrysotile		
049	Light gray caulk	Hangar 4 admin area, interior windows on west side	057A	Inconclusive: NAD	No asbestos detected	No	NA
			057B	Inconclusive: NAD	No asbestos detected		
050	Dry wall panelling	Hangar 4 admin area, center	058A	No asbestos detected	Not analyzed	No	NA
			058B	No asbestos detected	Not analyzed		
051	Outer plaster layer on ceiling, gray	Hangar 4 admin area ceiling	059A	No asbestos detected	Not analyzed	No	NA
			059B	No asbestos detected	Not analyzed		

Notes:

NA - Non Applicable
ACM - Asbestos Containing Material (a material containing >1% asbestos)
NAD - No Asbestos Detected
TEM - Transmission Electron Microscopy
PLM - Polarized Light Microscopy
Positive Stop - Sample was not analyzed due to the fact that a previous sample of the same Homogenous Material contained >1% asbestos.
Friable ACM - any material containing more than 1 percent asbestos as determined using PLM, that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.
Nonfriable ACM - any material containing more than 1 percent asbestos as determined using PLM, that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.
* = sample result indicated "< 1% asbestos"

Table 5
Asbestos Analytical Results
NPS
Functional Space 005 - Boiler Room
Brooklyn, NY
October 2023

Homogenous Material #	Material Description	Sample Location	Sample ID	PLM Analytical Results	TEM Analytical Results	ACM? (Yes/No)	Friable? (Yes/No)
001	TSI boiler insulation, white	Boiler room, west boiler	001A	No asbestos detected	Not analyzed	No	NA
			001B	No asbestos detected	Not analyzed		
			001C	No asbestos detected	Not analyzed		
002	Insulation around piping	Boiler room, multiple boilers	002A	Inconclusive: NAD	No asbestos detected	No	NA
			002B	Inconclusive: NAD	No asbestos detected		
			002C	Inconclusive: NAD	No asbestos detected		
003	Elbow mud wrap, gray	Boiler room, on multiple pipe elbows	003A	No asbestos detected	Not analyzed	No	NA
			003B	No asbestos detected	Not analyzed		
			003C	No asbestos detected	Not analyzed		
015	Top roof layer, black	Boiler room roof	017A	Inconclusive: NAD	No asbestos detected	No	NA
			017B	Inconclusive: NAD	No asbestos detected		
016	Underlying roof layer, black	Boiler room roof	018A	Inconclusive: NAD	No asbestos detected	No	NA
			018B	Inconclusive: NAD	No asbestos detected		

Table 5
Asbestos Analytical Results
NPS
Functional Space 005 - Boiler Room
Brooklyn, NY
October 2023

Homogenous Material #	Material Description	Sample Location	Sample ID	PLM Analytical Results	TEM Analytical Results	ACM? (Yes/No)	Friable? (Yes/No)
017	Underlying roof felt, dark brown	Boiler room roof	019A	Inconclusive: NAD	No asbestos detected	No	NA
			019B	Inconclusive: NAD	No asbestos detected		
-	Composite of HMs 015, 016, 017	Boiler room roof	020A	Inconclusive: NAD	No asbestos detected	No	NA
			020B	Inconclusive: NAD	No asbestos detected		
018	Dark gray roof sealant	Boiler roomm roof, around penetrations	021A	Inconclusive: NAD	No asbestos detected	No	NA
			021B	Inconclusive: NAD	No asbestos detected		
034	Light gray caulk	Boiler room, north exterior wall	038A	Inconclusive: NAD	No asbestos detected	No	NA
			038B	Inconclusive: NAD	No asbestos detected		

Notes:

NA - Non Applicable
ACM - Asbestos Containing Material (a material containing >1% asbestos)
NAD - No Asbestos Detected
TEM - Transmission Electron Microscopy
PLM - Polarized Light Microscopy
Positive Stop - Sample was not analyzed due to the fact that a previous sample of the same Homogenous Material contained >1% asbestos.
Friable ACM - any material containing more than 1 percent asbestos as determined using PLM, that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.
Nonfriable ACM - any material containing more than 1 percent asbestos as determined using PLM, that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.
* = sample result indicated "< 1% asbestos"

Table 6
Asbestos Analytical Results
NPS
Functional Space 006 - Shooting Range
Brooklyn, NY
October 2023

Homogenous Material #	Material Description	Sample Location	Sample ID	PLM Analytical Results	TEM Analytical Results	ACM? (Yes/No)	Friable? (Yes/No)
009	White caulk	Shooting rang, around exterior of north door	010A	Inconclusive: NAD	No asbestos detected	No	NA
			010B	Inconclusive: NAD	No asbestos detected		
010	Top roof layer, black	Shooting range roof	011A	Inconclusive: NAD	No asbestos detected	No	NA
			011B	Inconclusive: NAD	No asbestos detected		
011	Underlying roof layer, black	Shooting range roof	012A	Inconclusive: NAD	No asbestos detected	No	NA
			012B	Inconclusive: NAD	No asbestos detected		
012	Underlying roof felt, brown	Shooting range roof	013A	Inconclusive: NAD	No asbestos detected	No	NA
			013B	Inconclusive: NAD	No asbestos detected		
-	Composite of HMs 010, 012, 013	Shooting range roof	014A	Inconclusive: NAD	No asbestos detected	No	NA
			014B	Inconclusive: NAD	No asbestos detected		
013	Light gray caulk	Shooting range roof, around seams of roof exterior	015A	Inconclusive: NAD	No asbestos detected	No	NA
			015B	Inconclusive: NAD	No asbestos detected		
014	Dark gray caulk	Shooting range roof, around exterior windows	016A	10% Chrysotile	Not analyzed	Yes	No
			016B	13% Chrysotile	Not analyzed		
019	Dark gray roof sealant	Shooting range roof, northwest corner	022A	16% Chrysotile	Not analyzed	Yes	No
			022B	5.5% Chrysotile	Not analyzed		
023	9" x 9" floor tile, dark gray	Shooting range, 2nd floor bathroom	027A	16% Chrysotile	Not analyzed	Yes	No
			027B	5.5% Chrysotile	Not analyzed		
023-1	Mastic under 9" x 9" floor tile	Shooting range, 2nd floor bathroom	027A-1	8.6% Chrysotile	No asbestos detected	Yes	No
			027B-1	11% Chrysotile	No asbestos detected		

Table 6
Asbestos Analytical Results
NPS
Functional Space 006 - Shooting Range
Brooklyn, NY
October 2023

Homogenous Material #	Material Description	Sample Location	Sample ID	PLM Analytical Results	TEM Analytical Results	ACM? (Yes/No)	Friable? (Yes/No)
024	White drywall material with brown felt	Shooting range room, wall	028A	No asbestos detected	Not analyzed	No	NA
			028B	No asbestos detected	Not analyzed		
025	White drywall material with brown felt	Shooting range room, ceiling	029A	No asbestos detected	Not analyzed	No	NA
			029B	No asbestos detected	Not analyzed		
026	Dark gray adhesive for dark gray soundproofing material	Shooting range room, wall	030A	Inconclusive: NAD	No asbestos detected	No	NA
			030B	Inconclusive: NAD	No asbestos detected		
027	White/gray soundproofing material	Shooting range room, wall	031A	No asbestos detected	Not analyzed	No	NA
			031B	No asbestos detected	Not analyzed		
028	Dry wall material, crème colored	Shooting range, center	032A	No asbestos detected	Not analyzed	No	NA
			032B	No asbestos detected	Not analyzed		
029	White caulk	Shooting range, interior windows on north wall	033A	Inconclusive: NAD	No asbestos detected	No	NA
			033B	Inconclusive: NAD	No asbestos detected		

Notes:

NA - Non Applicable
ACM - Asbestos Containing Material (a material containing >1% asbestos)
NAD - No Asbestos Detected
TEM - Transmission Electron Microscopy
PLM - Polarized Light Microscopy
Positive Stop - Sample was not analyzed due to the fact that a previous sample of the same Homogenous Material contained >1% asbestos.
Friable ACM - any material containing more than 1 percent asbestos as determined using PLM, that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.
Nonfriable ACM - any material containing more than 1 percent asbestos as determined using PLM, that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.
* = sample result indicated "< 1% asbestos"

Table 7
Paint Chip - Lead Analytical Results
NPS
Hangars 3 and 4
Brooklyn, NY
October 2023

Sample ID	Sample Description	Lead Concentration (% wt)
PC-01	Light blue paint - Hangar 4 admin - west	**0.53**
PC-02	Green paint - Hangar 4 admin - center	0.32
PC-03	Dark blue paint - Hangar 4 admin - center door frame	**5.2**
PC-04	Light green paint - Hangar 4 admin - center	**0.85**
PC-05	Crème paint - Hangar 4 admin - center	0.29
PC-06	Light blue paint - Hangar 4 admin - north	**7.1**
PC-07	Dark gray paint - Hangar 4 admin - center cabinet	0.2
PC-08	Light blue/light green paint - Hangar 4 admin - center hallway	0.12
PC-09	Green paint - Hangar 4 admin - plaster	**12**
PC-10	Light blue paint - Hangar 4 - west wall	**1.7**
PC-11	Dark blue paint - Hangar 4 - west door	**1.9**
PC-12	Pink paint - Hangar 4 - west wall	**4**
PC-13	Crème paint - Hangar 4 - west wall	**31**
PC-14	Dark blue paint - Hangar 4 - east wall	0.22
PC-15	Yellow paint - Shooting range - north wall	0.32
PC-16	Gray paint - Shooting range - north wall	0.3
PC-17	Crème paint - Shooting range - west wall	**0.84**
PC-18	Dark green paint - Shooting range, west wall	**5.2**
PC-19	Yellow paint - Shooting range - south wall	**0.83**
PC-20	Crème paint - Shooting range - south wall	**1.3**
PC-21	Dark brown paint - Shooting range - south wall	**0.74**
PC-22	Dark gray paint - Shooting range - 2nd floor bathroom door	**4**
PC-23	Black paint - Shooting range - 2nd floor structural beams	**11**
PC-24	Light green paint - Shooting range - 2nd floor bathroom stalls	**6.7**

Table 7
Paint Chip - Lead Analytical Results
NPS
Hangars 3 and 4
Brooklyn, NY
October 2023

Sample ID	Sample Description	Lead Concentration (% wt)
PC-25	Light blue paint - Hangar 3 - east wall	**2.5**
PC-26	Gray paint - Hangar 3 - west wall	**23**
PC-27	White paint - Hangar 3 - west wall	**37**
PC-28	Crème paint - Hangar 3 admin - north wall	0.054
PC-29	Light blue paint - Hangar 3 admin - center hallway	**5.8**
PC-30	Dark green paint - Hangar 3 admin - center	**4.7**
PC-31	Crème paint - Hangar 3 admin - center	0.26
PC-32	Dark blue paint - Hangar 3 admin - south	**0.82**
PC-33	Light blue paint - Hangar 3 admin - south	0.032
PC-34	Dark gray paint - Boiler room - south	**2**
PC-35	Black paint - Boiler room - south	**0.62**
PC-36	Light gray paint - Boiler room - east	**21**
PC-01 - 3.13.24	Orange and black paint - Above Hangar 4 Doors	**4.8**
PC-02 - 3.13.24	Cream paint - NYC Sign Above Hangar 4 Doors	**9.7**
PC-03 - 3.13.24	Orange and black paint - Above Hangar 3 Doors	**6.4**
PC-04 - 3.13.24	Blue and green paint - Hangar 3 Catwalk	**1.8**
PC-05 - 3.13.24	Blue and green paint - Hangar 3 Trusses	**12**
PC-06 - 3.13.24	Blue and green paint - Hangar 3 Catwalk	0.44
PC-07 - 3.13.24	Black paint - Boiler Door	0.26
PC-08 - 3.13.24	Grey/Silver paint - Boiler Door	**0.93**
PC-09 - 3.13.24	Green paint - Boiler Pumps	**5.7**
PC-10 - 3.13.24	Blue/Grey paint - Double doors from Hangar 3 to Shooting range	**0.73**
PC-11 - 3.13.24	Blue/Grey paint - Double doors from Hangar 4 to Shooting range	0.24

Notes:
- Concentrations presented in bold and red were detected above TCLP and LBP screening criteria (0.5% by weight).

Table 8
PCB Caulk Analytical Results
NPS
Hangars 3 and 4
Brooklyn, NY
October 2023

Sample ID	Sample Description	Total PCB Result (ug/kg)
S-12617668-101023-SM-001	Light gray caulk - Hangar 4 admin exterior	ND
S-12617668-101023-SM-002	White caulk - Shooting range exterior	ND
S-12617668-101023-SM-003	Light gray caulk - Shooting range exterior	ND
S-12617668-101023-SM-004	Dark gray caulk - Shooting range exterior - roof	120 J
S-12617668-101123-SM-005	White caulk - Shooting range interior	ND
S-12617668-101123-SM-006	White caulk - Hangar 3 exterior windows - north	ND
S-12617668-101123-SM-007	Light gray caulk - Hangar 4 exterior windows - north	ND
S-12617668-101123-SM-008	White caulk - Hangar 3 exterior windows - south	ND
S-12617668-101123-SM-009	Light gray caulk - Hangar 4 exterior windows - south	ND
S-12617668-101123-SM-010	Light gray caulk - Boiler room exterior	ND
S-12617668-101123-SM-011	White caulk - Hangar 3 interior windows - south	ND
S-12617668-101123-SM-012	White caulk - Hangar 3 admin interior windows - south	97 J
S-12617668-101123-SM-013	Light gray caulk - Hangar 4 interior windows - north	169 J
S-12617668-101123-SM-014	Light gray caulk - Hangar 4 admin interior	300

Notes:
PCB samples were analyzed by Eurofins Environemental Testing via SW846 method 8082A.
ug/Kg - micrograms per kilogram
J - Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
ND - Nondetect

Table 9
TCLP Analytical Results
NPS
Hangars 3 and 4
Brooklyn, NY
March 2024

Analyte	EPA Hazardous Waste Level (mg/L)	01 Result (mg/L)	02 Result (mg/L)	03 Result (mg/L)
Volatile Organic Compounds:				
1,1-Dichloroethene	0.7	<0.020	<0.020	<0.020
1,2-Dichloroethane	0.5	<0.020	<0.020	<0.020
2-Butanone	200.0	<0.200	<0.200	<0.200
Benzene	0.5	<0.020	<0.020	<0.020
Carbon Tetrachloride	0.5	<0.020	<0.020	<0.020
Chlorobenzene	100.0	<0.020	<0.020	<0.020
Tetrachloroethene	0.7	<0.020	<0.020	<0.020
Trichloroethene	0.5	<0.020	<0.020	<0.020
Vinyl Chloride	0.2	<0.020	<0.020	<0.020
Semi-Volatile Organic Compounds:				
1,4-Dichlorobenzene	7.5	<0.015	<0.015	<0.015
2,4,5-Trichlorophenol	400.0	<0.015	<0.015	<0.015
2,4,6-Trichlorophenol	2.0	<0.015	<0.015	<0.015
2,4-Dinitrotoluene	0.13	<0.015	<0.015	<0.015
Hexachlorobenzene	0.13	<0.015	<0.015	<0.015
Hexachlorobutadiene	0.5	<0.015	<0.015	<0.015
Hexachloroethane	3.0	<0.015	<0.015	<0.015
mp-Cresol	200.0	<0.015	<0.015	<0.015
Nitrobenzene	2.0	<0.015	<0.015	<0.015
o-Cresol	200.0	<0.015	<0.015	<0.015
Pentachlorphenol	100.0	<0.030	<0.030	**0.0629**
Pyridine	5.0	<0.015	<0.015	<0.015
Metals:				
Arsenic	5.0	<0.13	<0.13	<0.13
Barium	100.0	<2.5	<2.5	<2.5
Cadmium	1.0	**0.012**	<0.0099	**0.34**
Chromium	5.0	<0.025	<0.025	<0.025
Lead	5.0	**0.27**	0.038	**7.5**
Mercury	0.2	<0.00020	<0.00020	<0.00020
Selenium	1.0000	<0.099	<0.099	<0.099
Silver	5.0000	<0.020	<0.020	<0.020

Table 10
Lead Wipe Sample Analytical Results
NPS
Hangars 3 and 4
Brooklyn, NY
October 2024

Sample No.	Sample ID	Map H1.6 IDs	Location	Area	Lead – Total Micrograms (µg)	Lead Concentration (µg/cm^2)
1	NPS-093024-01	LD01	NPS Gate Shooting Range	10 x 10 cm floor below shooter location	2600	26
2	NPS-093024-02	LD02	NPS Gate Shooting Range	10 x 10 cm floor in middle of shooting range	6600	66
3	NPS-093024-03	LD03	NPS Gate Shooting Range	10 x 10 cm north wall middle of shooting range	92	0.92
4	NPS-093024-04	LD04	NPS Gate Shooting Range	10 x 10 cm south wall middle of shooting range	120	1.2
5	NPS-093024-05	LD05	NPS Gate Shooting Range	10 x 10 cm floor in hallway between offices	1900	1.9
6	NPS-093024-06	LD06	NPS Gate Shooting Range	10 x 10 cm floor below range target location	14000	140
7	NPS-093024-07	LD07	NPS Gate Shooting Range	10 x 10 cm floor of bullet landing location	14000	140
8	NPS-093024-08	LD08	NPS Gate Shooting Range	10 x 10 cm floor of hallway adjacent to range	390	3.9
9	NPS-093024-09	LD09	NPS Gate Field Hangar 3	10 x 10 cm floor outside door in Hangar 3	470	4.7
10	NPS-093024-10	LD10	NPS Gate Field Hangar 4	10 x 10 cm floor outside door in Hangar 4	550	5.5

Notes:
NPS = National Park Service
cm = centimeter
µg = micrograms
LD = Lead Dust

Appendix I

Sampling Notes

Dustin Zedaker

From: Shaun McEvoy
Sent: Wednesday, November 1, 2023 10:45 PM
To: Dustin Zedaker
Subject: NPS Haz Mat sampling summary
Attachments: 12617668 NPS Sampling Tables.xlsx; 142304959_002.pdf; 142304959_003.pdf; 142304959_001.pdf; 062319961_001.pdf; J241772-1 UDS Level 2 Report Final Report.pdf

CompleteRepository: 010000101
Description: Test
JobNo: 00001
OperatingCentre: 01
RepoEmail: 010000101@ghd.com
RepoType: Overhead
SubJob: 01

Hello Dustin

Attached is a file (12617668 NPS Sampling Tables) with 8 tables that include all of the ACM, PCB caulk, and lead paint samples I collected at the NPS site on October 9-11. I'm sure the tables will require formatting, but they include all the samples and results from the sampling I conducted at the site. I also attached all of the laboratory analytical results, which I believe you already have.

The sampling was performed from October 9-11, 2023, at the NPS site in Brooklyn, NY. My New York State Asbestos Inspector certificate number is #03-18547.

For the purposes of the asbestos sampling, the entire building encompassing Hangars 3 and 4 was divided into 6 "functional spaces". The functional spaces are described as follows:

Functional Space 001 (FS001): Hangar 3. 135' x 150'
FS002: Hangar 4. 135' x 150'
FS003: Hangar 3 administration office area (referred to as "Hangar 3 admin"). 150' x 30'. East of Hangar 3. This functional space included several individual offices that were in severe states of disrepair, and could not be fully accessed.
FS004: Hangar 4 administration office area (referred to as "Hangar 4 admin"). 150' x 30'. West of Hangar 4. This functional space included several individual offices that were in severe states of disrepair, and could not be fully accessed.
FS005: Boiler Room. 50' x 40'.
FS006: Shooting Range: 50' x 105'.

It should be noted that I was able to access the roofs of Hangar 4, Boiler room, Shooting Range, and Hangar 4 admin area. I was not able to access the roofs of Hangar 3 and the Hangar 3 admin area.

In these functional spaces, a total of 55 homogeneous materials were evaluated as possible ACM. A total of 121 samples of possible ACM were collected and analyzed via polarized light microscopy (PLM) analysis via NY State ELAP 198.1 Method and NY State ELAP 198.6 Method. For samples analyzed via Method 198.6 that had a result of "Inconclusive: No Asbestos Detected", those samples were automatically analyzed via Transmission Electron Microscopy via NY State ELAP Method 198.4. At least two samples of each homogenous material was sampled during the sampling event (three samples were collected from a few homogenous samples in the Boiler room). Samples were sent to EMSL Analytical in Depew, NY for analysis. The homogenous materials, along with their corresponding samples and sample results, are presented in Tables 1-6, for functional spaces 001 – 006.

Based on sample results, a total of 8 homogenous materials were found to be ACM (> 1% asbestos). Those homogeneous materials are as follows:
HM 006: Gray roof felt material. Located at the edge of the Hangar 4 admin area roof (FS004).
HM 007: Gray roof sealant: Located at the edge of the Hangar 4 admin area roof (FS004).

HM 014: Dark gray caulk. Located on the shooting range roof, around exterior windows (FS006)
HM 019: Dark gray roof sealant. Located on shooting range roof, in the northeast corner (FS006)
HM 023: 9" x 9" floor tile, dark gray. Located in the shooting range, 2nd floor bathroom (FS006)
HM 023-1: Mastic under 9" x 9" floor tile. Located in the shooting range, 2nd floor bathroom (FS006)
HM 041: 9" x 9" floor tile, dark brown. Located in the Hangar 3 admin area, under 12”x 12” floor tile (FS003).
HM 048: 12" x 12" floor tile, light gray. Located in the Hangar 4 admin area, south end (FS004)

In addition to the 8 homogenous materials that had sample results > 1% asbestos, there were two homogenous materials that had sample results that were below 1% asbestos. These would not be considered ACM, but should still be noted in the report. These homogenous materials are as follows:
HM 041-1: Mastic under 9" x 9" floor tile, dark brown. Located in the Hangar 3 admin area (FS003), under 12”x 12” floor tile.
HM 048-1: Mastic under 12" x 12" floor tile, light gray. Located in the Hangar 4 admin area (FS004), south end

PCB caulk sampling: A total of 14 individual samples were collected of various caulks around the interior and exterior of Hangars 3 and 4. Samples were sent to Eurofins Lancaster Laboratories in Lancaster, PA to be analyzed for PCBs via method SW846 8082A. The PCB caulk sample and results are presented in Table 7. A total of 4 samples had PCB detections:
S-12617668-101123-SM-004: Dark gray caulk - Shooting range exterior - roof
S-12617668-101123-SM-012: White caulk - Hangar 3 admin interior windows – south
S-12617668-101123-SM-013: Light gray caulk - Hangar 4 interior windows – north
S-12617668-101123-SM-014: Light gray caulk - Hangar 4 admin interior windows

Paint chip sampling: A total of 36 paint chip samples were collected from the interiors of Hangar 3, Hangar 4, and associated areas. A list of those samples is provided in Table 8. Samples were sent to EMSL Analytical in Carle Place, NY to be analyzed to Lead in Paint chips via Flame AAS (SW 846 3051A/7000B). All 36 paint chip samples had some detection of lead, with the smallest detection being 0.032%

I have photos of every homogenous material (and PCB caulk sample), as well as every paint ship sample, if we want to add them to the report\

Let me know if you have any questions.

Shaun McEvoy
Environmental Engineer

GHD
T: +1 716 205 1975 | M: +1 716 583 9623 | E: shaun.mcevoy@ghd.com
2055 Niagara Falls Boulevard | Niagara Falls New York 14304 USA | www.ghd.com

WATER | ENERGY & RESOURCES | ENVIRONMENT | PROPERTY & BUILDINGS | TRANSPORTATION

Please consider our environment before printing this email

Notes as transcribed from field notebook:

Sample Date: October 3, 2024
GHD Staff: Scott Walczyk
Arrive on Site: 10:30 AM
Departed Site: 12:45 PM
Weather Conditions: Overcast, Temperature in 60s (F)
PPE: Long sleeves, jeans, safety glasses, hard hat, steel-toed boots, N95 mask, silicone gloves (changed each sample)

***Field Conditions**:*

- Debris and dust in all areas
- Debris concentrated near central area
- Very low visibility in shooting range area, flashlight required
- Hanging target hazards in shooting range area
- Large piles of dust in range area pushed towards back of range
- High volume of tripping hazards
- High volume of debris in Hangar 3

Sampling Information

<u>Sample 2: Middle of range floor</u>

- Sample collected 11:15 AM
- Dusty floor, some brushed away before sampling
- Sample surface: concrete

<u>Sample 1: Floor below shooter booth/shooting location</u>

- Sample collected 11:05 AM
- Dusty floor, some brushed away before sampling
- Sample surface: concrete

<u>Sample 3: Left/north wall, approx. 6 feet high, middle of range</u>

- Sample collected 11:25 AM
- Sample surface: rusted metal

<u>Sample 4: Right/south wall, approx. 5 feet high, middle of range</u>

- Sample collected 11:29 AM
- Sample surface: smooth metal

<u>Sample 5: Floor of adjacent room south of range</u>

- Sample collected: 11:36 AM
- Hallway between 3 rooms
- Dusty floor, some brushed away before sampling
- Sample surface: concrete

<u>Sample 6: Floor below target location, most of the way downrange</u>

- Sample collected: Sample Collected 11:41 AM

- Highly dusty area, some brushed away before sampling
- Sample surface: concrete
- Approx 2 feet away from debris piles

<u>Sample 7: Bullet landing location floor</u>

- Sample collected: 11:49 AM
- No bullet trap seen
- Sample surface: metal floor
- Area with most dust, a few inches had to be cleared to create a sample location

<u>Sample 8: Floor of hallway adjacent to shooting range</u>

- Sample collected: 12:03 PM
- Dusty floor, some brushed away before sampling
- Sample surface: concrete

<u>Sample 9: Hangar 3, left/north of range</u>

- Sample collected: 12:21 PM
- Sampling location near shared wall with shooting range
- Sample surface: concrete

<u>Sample 10: Hangar 4, right/south of range</u>

- Sample collected: 12:26 PM
- Sampling location near shared wall with shooting range
- Sample surface: concrete

Ventilation Observation Notes:

<u>Shooting range:</u>

- Little ventilation overall
- HVAC system seen above shooting area and back of range
- Fan above lobby just past entryway
- Unidentifiable port at back of range
    - Potentially open, potentially windowed

<u>Hangars:</u>

- Various fans and blowers hanging from ceiling

Appendix II

Sample Collection Location Figures

GENERAL NOTES

1. A HAZARDOUS MATERIALS INSPECTION WAS PERFORMED. THE SURVEY/INSPECTION REPORT IS ATTACHED TO THE SPECIFICATION AS APPENDIX A FOR INFORMATION. THE WORK WILL REQUIRE THE REMOVAL OF ASBESTOS CONTAINING MATERIALS AS INDICATED. DESTRUCTIVE ACTIVITIES SUCH AS BREAKING INTO WALLS, CEILINGS, AND FLOORS WERE NOT PERFORMED IN ORDER TO LOCATE MATERIALS. THEREFORE, IF DURING THE WORK SUSPECT MATERIALS ARE UNCOVERED, STOP WORK AND NOTIFY THE CO. DRAWINGS, SPECIFICATIONS, AND REPORT ARE PROVIDED FOR INFORMATION ONLY. ASSESS HAZARDOUS CONDITIONS PRIOR TO START OF CONSTRUCTION AND COLLECT WASTE CHARACTERIZATION SAMPLES PRIOR TO DISPOSAL.

2. CONTACT THE NATIONAL PARK SERVICE (NPS) OFFICE PRIOR TO BEGINNING THE PAINT ABATEMENT ACTIVITIES IN ARCHITECTURAL DRAWINGS. COORDINATE WITH NPS TO SET UP AN ACCUMULATION AREA FOR THE REMOVED PAINT WHICH TESTED HAZARDOUS. LABEL THE CONTAINER CONTENTS AND START DATE OF ACCUMULATION. NPS MUST PRE-APPROVE THE DISPOSAL FACILITY AND SIGN THE MANIFEST PRIOR TO OFF-SITE DISPOSAL. PROVIDE NPS A COPY OF THE SIGNED MANIFEST FROM THE DISPOSAL FACILITY. CONTACT THE NPS OFFICE PRIOR TO BEGINNING THE ACM REMOVAL ACTIVITIES. SET UP AN ACCUMULATION AREA FOR THE REMOVED ACM. NPS MUST PRE-APPROVE THE DISPOSAL FACILITY AND SIGN THE MANIFEST PRIOR TO THE OFF-SITE DISPOSAL. PROVIDE NPS A COPY OF THE SIGNED MANIFEST FROM THE DISPOSAL FACILITY.

3. EXISTING PAINT HAS BEEN DETERMINED TO CONTAIN LEAD, AT CONCENTRATIONS ABOVE THE LABORATORY'S DETECTION LIMIT. REVIEW ENVIRONMENTAL HAZARDOUS MATERIALS REPORT FOR LEAD BASED PAINT INFORMATION. PERFORM RENOVATION/DEMOLITION WORK IN ACCORDANCE WITH SPECIFICATION SECTION 02 83 00 "LEAD REMEDIATION". CONSTRUCTION STANDARDS DEVELOPED BY OSHA FOR AND LEAD ARE; LEAD, 29 CFR 1926.62. REFER TO SPECIFICATION SECTION 02 83 33 FOR ADDITIONAL INFORMATION ON CLEANING AND PAINT REMOVAL ON EQUIPMENT, PIPING AND CONDUIT. ALL LEAD PAINT THAT IS ON EXISTING ITEMS TO REMAIN ARE TO BE ABATED. ALL ITEMS CONTAINING LEAD-BASED PAINT THAT ARE NOTED TO BE REMOVED SHALL BE DISPOSED OF PROPERLY ACCORDING TO THE SPECIFICATIONS. REFER TO HAZMAT REPORT AND DRAWINGS FOR ITEMS AND LOCATIONS. CERTAIN ITEMS SUCH AS THE WOOD CEILING PLANKS AND THE CORRUGATED METAL EXTERIOR FRIEZES ABOVE THE HANGAR DOORS TESTED FOR LEAD PAINT ARE NOT TO BE DEMOLISHED OR ABATED DURING THIS PHASE.

4. PROVIDE AIR EXPOSURE MONITORING TO MONITOR FOR CHROMIUM, CADMIUM, AND LEAD IN ACCORDANCE WITH GUIDANCE PROVIDED IN SPECIFICATION SECTION 02 83 33 – LEAD REMEDIATION.

5. REMOVE IDENTIFIED ASBESTOS IN ACCORDANCE WITH GUIDANCE PROVIDED IN SPECIFICATION SECTION 02 82 13 – ASBESTOS REMEDIATION.

6. IF PAINTED METAL COMPONENTS THAT TESTED POSITIVE FOR LEAD ARE TO BE REMOVED FROM THE SITE, THE CONTRACTOR MAY SEND THE METAL COMPONENTS FOR OFF-SITE RECYCLING. ~~PAINT MUST REMAIN INTACT DURING REMOVAL AND TRANSPORTATION.~~ REVIEW ENVIRONMENTAL HAZARDOUS MATERIALS REPORT FOR LEAD BASED PAINT INFORMATION.

7. DOORS MARKED TO REMAIN IN PLACE OR SALVAGE ON AD-101 TO BE ABATED FOR LEAD PAINT. ASSUME FIRE RATED DOORS CONTAIN ASBESTOS. REMOVE AND INSPECT FIRE RATED DOORS FOR ASBESTOS CONTAINING MATERIAL. FOLLOWING INSPECTION, NON-ASBESTOS FIRE DOORS CAN BE DISPOSED OF AS REGULAR CONSTRUCTION WASTE IF NOT MARKED TO REMAIN IN PLACE OR SALVAGE ON AD-101.

8. LIGHT BALLAST HAVE BEEN INSPECTED. NO INDICATION IS PROVIDED IF PCB FLUIDS ARE PRESENT IN BALLAST. BASED ON AGE OF HANGAR BALLAST SHOULD BE TREATED AS PCB CONTAINING UNLESS TESTING DETERMINES OTHERWISE.

9. INCORPORATE POTENTIAL EXPOSURE TO BIRD DROPPINGS AND MOLD INTO HEALTH AND SAFETY PLAN.

10. ALL WORK SHALL BE COMPLETED IN ACCORDANCE WITH STATE OF NEW YORK STANDARDS.

11. PRESUMED ASBESTOS-CONTAINING PIPE INSULATION WAS OBSERVED IN THE NORTH/SOUTH TRENCH UNDER THE BUILDING. THE MATERIAL WAS OBSERVED TO BE ON THE PIPING AND ALSO ON THE TRENCH FLOOR AND SHOULD BE ASSUMED TO BE FRIABLE. NO TESTING WAS PERFORMED ON THIS MATERIAL. THE EXACT QUANTITY IS UNKNOWN BUT IT IS ASSUMED TO BE THE LENGTH OF THE TRENCH.

ABBREVIATIONS

ABBREVIATION	DESCRIPTION
CMU	CONCRETE MASONRY UNIT
CONC	CONCRETE
EV	ENVIRONMENTAL
EQUIP	EQUIPMENT
FT	FEET
LF	LINEAR FEET
NTS	NOT TO SCALE
RM	ROOM
STR	STAIR
TYP	TYPICAL
UNO	UNLESS NOTED OTHERWISE

SYMBOLS LIST

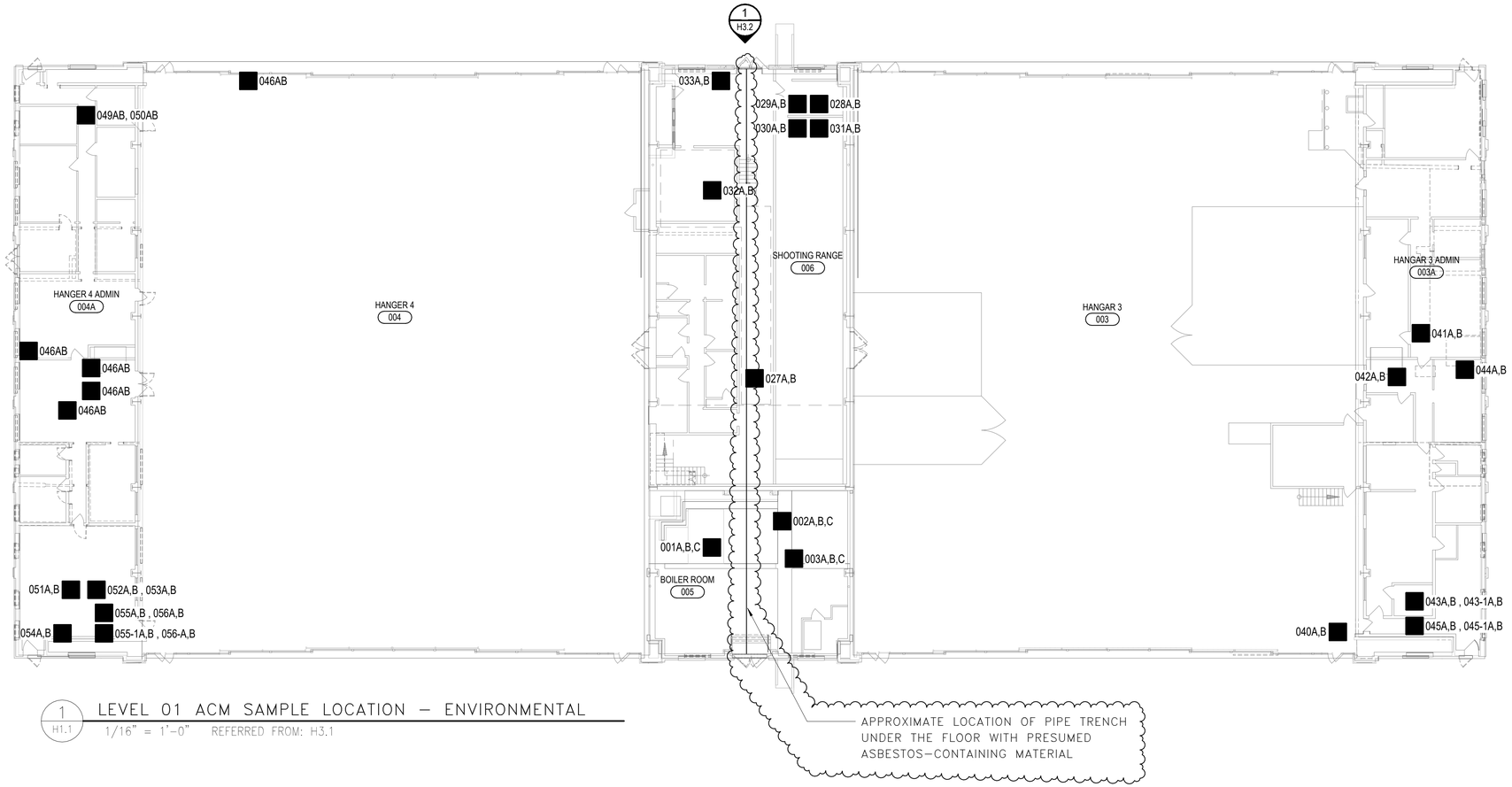
-·-·-·-·-	MATCHLINE
■	ENVIRONMENTAL SAMPLE
◇ #	REMOVAL NOTE INDICATOR

SAMPLE DESCRIPTION

ABBREVIATION	DESCRIPTION
ACM	ASBESTOS
PC	PAINT CHIP
PCB	POLYCHLORINATED BIPHENYL

Autodesk Docs://GATE Floyd Bennett Field/NPS Gate_Floyd Bennett Field-GHD.rvt
6/4/2025 10:27:59 AM

DESIGNED: DAZ CADD LDB TECH. REVIEW: CCW DATE: 10/04/2024	SUB SHEET NO. H0.1	TITLE OF SHEET GENERAL NOTES, SYMBOLS AND ABBREVIATIONS HANGARS 3 & 4 HAZARDOUS MATERIALS REMEDIATION AND EARLY DEMOLITION	DRAWING NO. 646 / 190066 PMIS/PKG NO. GATE 308504 SHEET 3 OF 86



1 / H1.1 LEVEL 01 ACM SAMPLE LOCATION – ENVIRONMENTAL

1/16" = 1'-0" REFERRED FROM: H3.1

SHEET NOTES

1. THE FOLLOWING ACM SAMPLES CONTAINED GREATER THAN 1% ASBESTOS:
   - ACM-45A & B- 9"X9" DARK BROWN FLOOR TILE
   - ACM 027A&B AND 027A-1 & 027B-1"X9" DARK GARY FLOOR TILE AND ASSOCIATED MASTIC
   - ACM 055A&B 12"x12" LIGHT GRAY FLOOR TILE
2. PRESUMED ASBESTOS-CONTAINING MATERIAL IS LOCATED IN THE TRENCH UNDER THE FLOOR. THIS MATERIAL HAS NOT BEEN TESTED AND APPEARS TO BE FRIABLE.

DESIGNED: DAZ	SUB SHEET NO.	TITLE OF SHEET	DRAWING NO.
CADD LDB	H1.1	LEVEL 01 ACM SAMPLE LOCATION - ENVIRONMENTAL	646 / 190066
TECH. REVIEW: CCW			PMIS/PKG NO. GATE 308504
DATE: 10/04/2024		HANGARS 3 & 4 HAZARDOUS MATERIALS REMEDIATION AND EARLY DEMOLITION	SHEET 4 OF 86

Autodesk Docs://GATE Floyd Bennett Field/NPS Gate_Floyd Bennett Field-GHD.rvt
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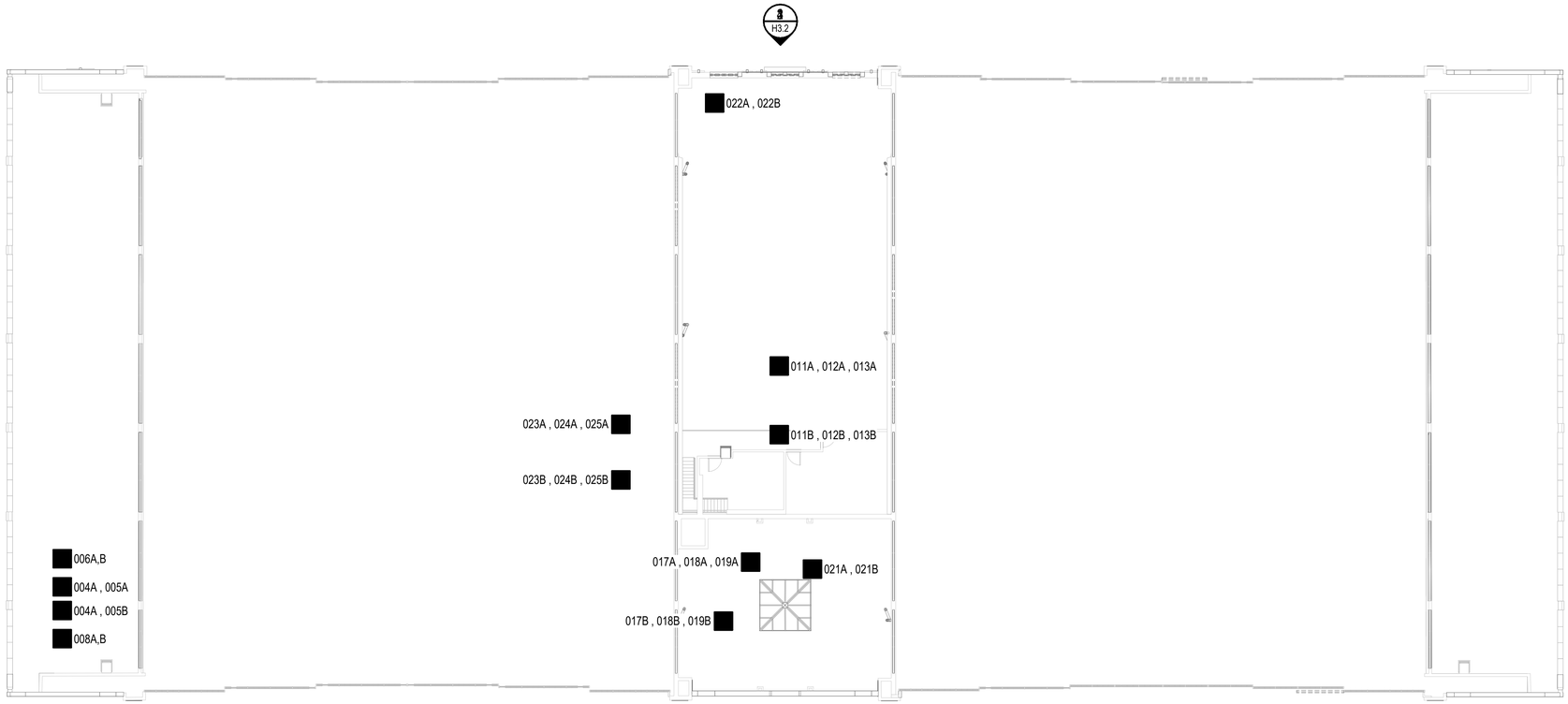

1 / H1.2 ROOF ACM SAMPLE LOCATION – ENVIRONMENTAL

1/16" = 1'-0" REFERRED FROM: H3.1

SHEET NOTES

1. THE FOLLOWING ACM SAMPLES CONTAINED GREATER THAN 1% ASBESTOS:
   - ACM-006A & B – Gray Roof FELT
   - ACM-008A & B – Gray Roof SEALANT
   - ACM 022A&B – DARK GRAY ROOF SEALANT

DESIGNED:	SUB SHEET NO.	TITLE OF SHEET	DRAWING NO.
DAZ ADD LDB TECH. REVIEW: CCW DATE: 10/04/2024	H1.2	ROOF ACM SAMPLE LOCATION - ENVIRONMENTAL HANGARS 3 & 4 HAZARDOUS MATERIALS REMEDIATION AND EARLY DEMOLITION	646 190066 PMIS/PKG NO. GATE 308504 SHEET 5 OF 86

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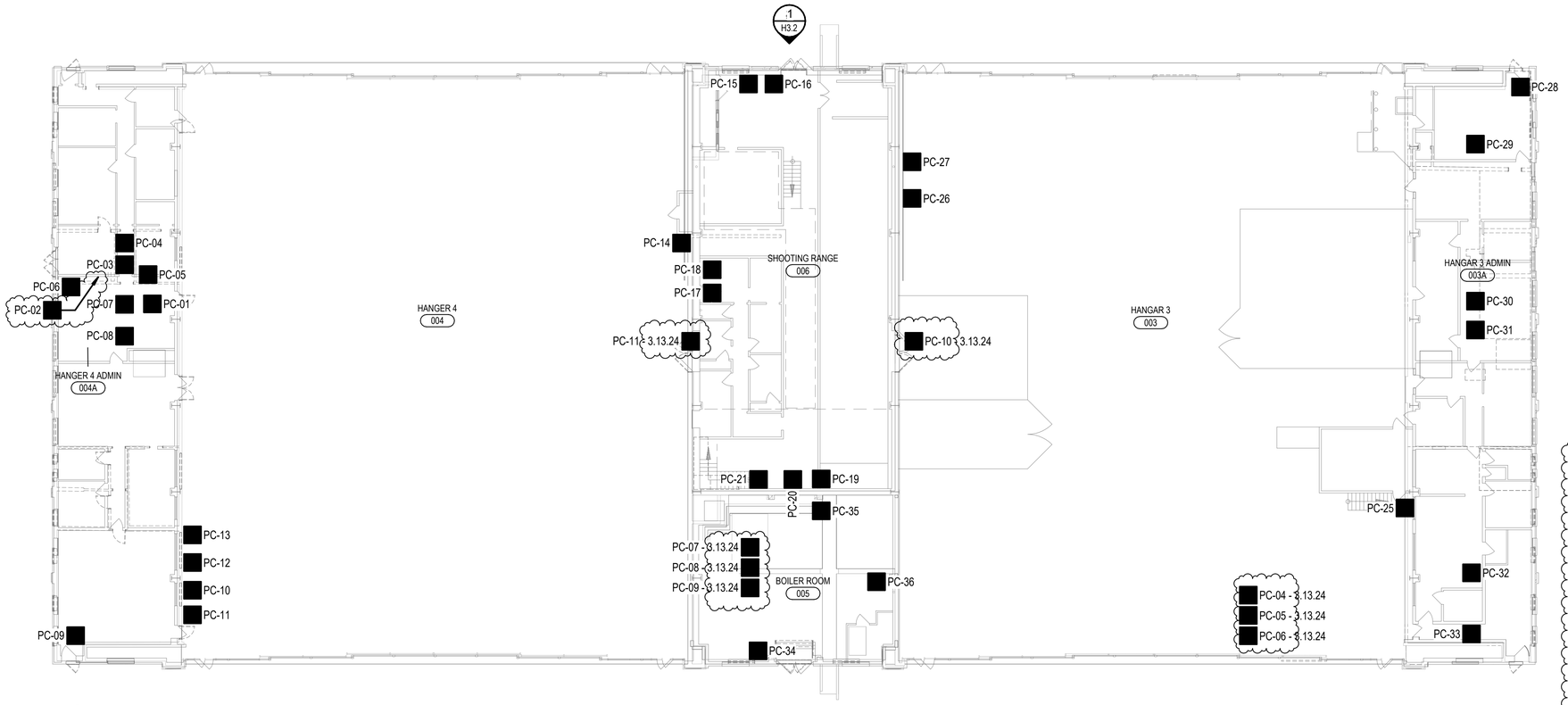
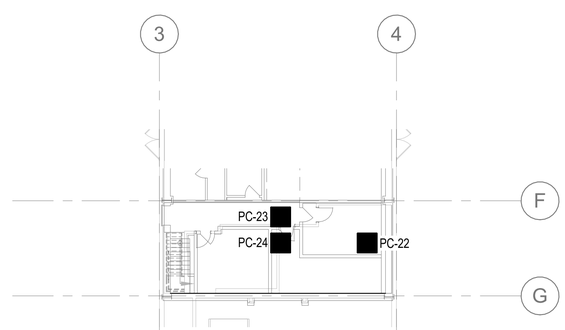


1 H1.3 LEVEL 01 PC SAMPLE LOCATION – ENVIRONMENTAL

1/16" = 1'-0" REFERRED FROM: H3.1



2 H1.3 LEVEL 01M PC SAMPLE LOCATION – ENVIRONMENTAL

1/16" = 1'-0" REFERRED FROM: H3.1

SHEET NOTES

1. LEAD BASED PAINT WAS DETECTED AT THE FOLLOWING PAINT SAMPLE LOCATIONS:
   - PC 01, 03, 04, 06, 09, 10, 11, 12, 13, 17 THROUGH 27, 29, 30, 32, 34, 35, AND 36, PC-04 – 3.13.24, PC-05 – 3.13.24, PC-08 3.13.24, PC-09 3.13.24, PC-10 3.13.24

   LEAD CONTAINING PAINT WAS DETECTED IN ALL SAMPLE LOCATIONS

Sample ID	Sample Description	Lead Concentration (% wt)
PC-01	Light blue paint - Hangar 4 admin - west	**0.53**
PC-02	Green paint - Hangar 4 admin - center	0.32
PC-03	Dark blue paint - Hangar 4 admin - center door frame	**5.2**
PC-04	Light green paint - Hangar 4 admin - center	**0.85**
PC-05	Crème paint - Hangar 4 admin - center	0.29
PC-06	Light blue paint - Hangar 4 admin - north	**7.1**
PC-07	Dark gray paint - Hangar 4 admin - center cabinet	0.2
PC-08	Light blue/light green paint - Hangar 4 admin - center hallway	0.12
PC-09	Green paint - Hangar 4 admin - plaster	**12**
PC-10	Light blue paint - Hangar 4 - west wall	**1.7**
PC-11	Dark blue paint - Hangar 4 - west door	**1.9**
PC-12	Pink paint - Hangar 4 - west wall	**4**
PC-13	Crème paint - Hangar 4 - west wall	**31**
PC-14	Dark blue paint - Hangar 4 - east wall	0.22
PC-15	Yellow paint - Shooting range - north wall	0.32
PC-16	Gray paint - Shooting range - north wall	0.3
PC-17	Crème paint - Shooting range - west wall	**0.84**
PC-18	Dark green paint - Shooting range, west wall	**5.2**
PC-19	Yellow paint - Shooting range - south wall	**0.83**
PC-20	Crème paint - Shooting range - south wall	**1.3**
PC-21	Dark brown paint - Shooting range - south wall	**0.74**
PC-22	Dark gray paint - Shooting range - 2nd floor bathroom door	**4**
PC-23	Black paint - Shooting range - 2nd floor structural beams	**11**
PC-24	Light green paint - Shooting range - 2nd floor bathroom stalls	**6.7**
PC-25	Light blue paint - Hangar 3 - east wall	**2.5**
PC-26	Gray paint - Hangar 3 - west wall	**23**
PC-27	White paint - Hangar 3 - west wall	**37**
PC-28	Crème paint - Hangar 3 admin - north wall	0.054
PC-29	Light blue paint - Hangar 3 admin - center hallway	**5.8**
PC-30	Dark green paint - Hangar 3 admin - center	**4.7**
PC-31	Crème paint - Hangar 3 admin - center	0.26
PC-32	Dark blue paint - Hangar 3 admin - south	**0.82**
PC-33	Light blue paint - Hangar 3 admin - south	0.032
PC-34	Dark gray paint - Boiler room - south	**2**
PC-35	Black paint - Boiler room - south	**0.62**
PC-36	Light gray paint - Boiler room - east	**21**
PC-01 - 3.13.24	Orange and black paint - Above Hangar 4 Doors	**4.8**
PC-02 - 3.13.24	Cream paint - NYC Sign Above Hangar 4 Doors	**9.7**
PC-03 - 3.13.24	Orange and black paint - Above Hangar 3 Doors	**6.4**
PC-04 - 3.13.24	Blue and green paint - Hangar 3 Catwalk	**1.8**
PC-05 - 3.13.24	Blue and green paint - Hangar 3 Trusses	**12**
PC-06 - 3.13.24	Blue and green paint - Hangar 3 Catwalk	0.44
PC-07 - 3.13.24	Black paint - Boiler Door	0.26
PC-08 - 3.13.24	Grey/Silver paint - Boiler Door	**0.93**
PC-09 - 3.13.24	Green paint - Boiler Pumps	**5.7**
PC-10 - 3.13.24	Blue/Grey paint - Double doors from Hangar 3 to Shooting range	**0.73**
PC-11 - 3.13.24	Blue/Grey paint - Double doors from Hangar 4 to Shooting range	0.24

Notes:

- Concentrations presented in bold and red were detected above TCLP and LBP screening criteria (0.5% by weight).

DESIGNED: DAZ	SUB SHEET NO.	TITLE OF SHEET	DRAWING NO.
CADD LDB	H1.3	LEVEL 01 PC SAMPLE LOCATION - ENVIRONMENTAL	646 190066
TECH. REVIEW: CCW			PMIS/PKG NO. GATE 308504
DATE: 10/04/2024		HANGARS 3 & 4 HAZARDOUS MATERIALS REMEDIATION AND EARLY DEMOLITION	SHEET 6 OF 86

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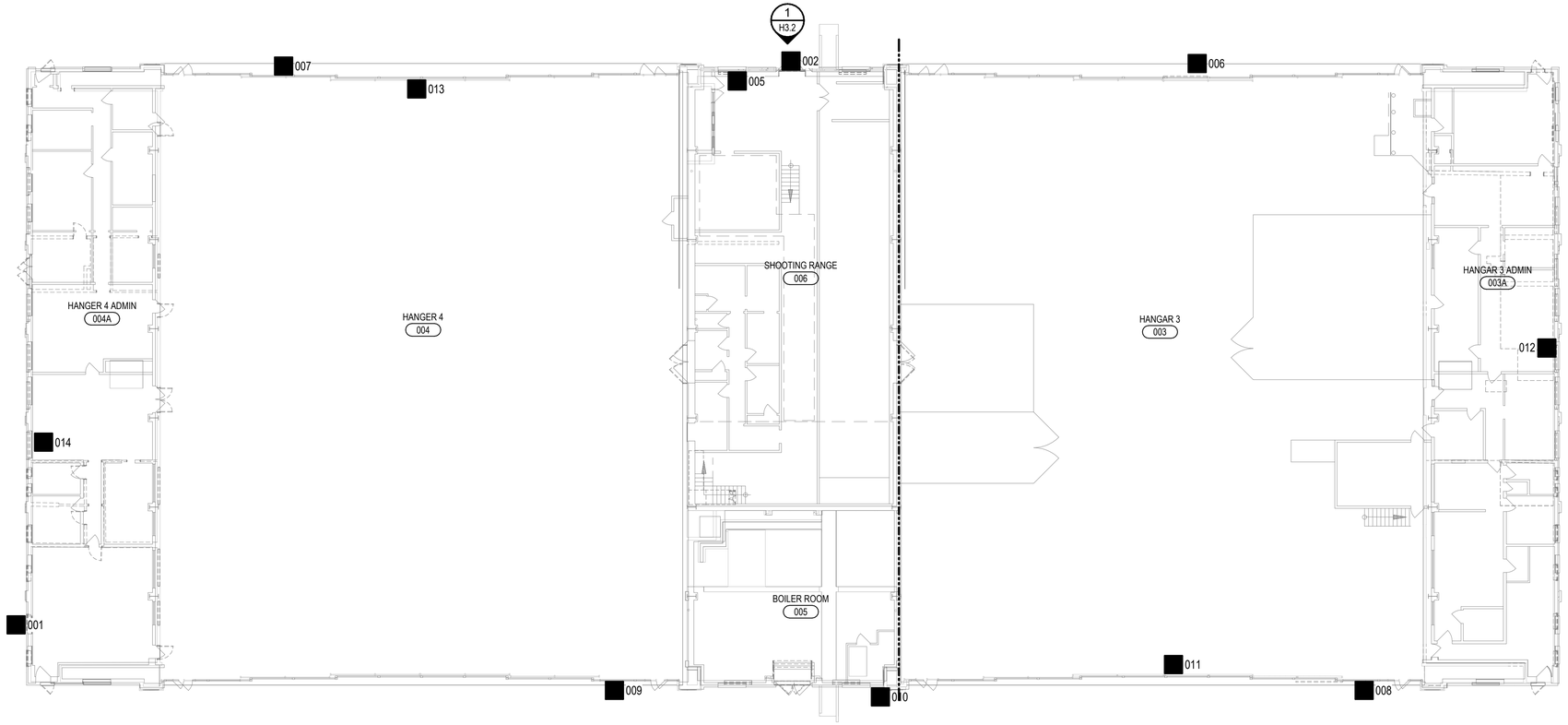

1 H1.4 LEVEL 01 CAULK PCB SAMPLE LOCATION – ENVIRONMENTAL

1/16" = 1'-0" REFERRED FROM: H3.1

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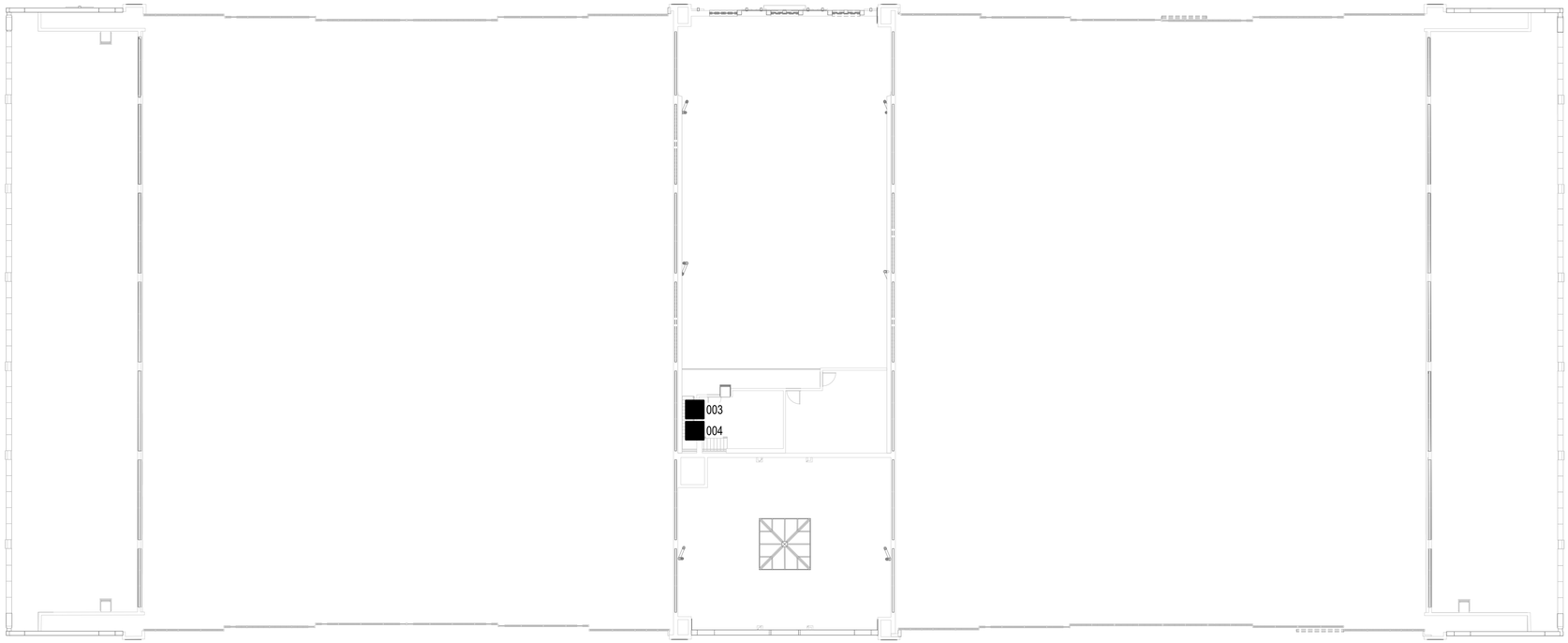
DESIGNED: DAZ CADD LDB TECH. REVIEW: CCW DATE: 10/04/2024	SUB SHEET NO. H1.4	TITLE OF SHEET LEVEL 01 CAULKING SAMPLE LOCATION - ENVIRONMENTAL HANGARS 3 & 4 HAZARDOUS MATERIALS REMEDIATION AND EARLY DEMOLITION	DRAWING NO. 646 / 190066 PMIS/PKG NO. GATE 308504 SHEET 7 OF 86



1 / H1.5 ROOF CAULK PCB SAMPLE LOCATION – ENVIRONMENTAL

1/16" = 1'-0" REFERRED FROM: H3.1

DESIGNED: DAZ CADD LDB TECH. REVIEW: CCW DATE: 10/04/2024	SUB SHEET NO. H1.5	TITLE OF SHEET ROOF CAULKING SAMPLE LOCATION - ENVIRONMENTAL HANGARS 3 & 4 HAZARDOUS MATERIALS REMEDIATION AND EARLY DEMOLITION	DRAWING NO. 646 / 190066 PMIS/PKG NO. GATE 308504 SHEET 8 OF 86

Autodesk Docs://GATE Floyd Bennett Field/NPS Gate_Floyd Bennett Field-GHD.rvt
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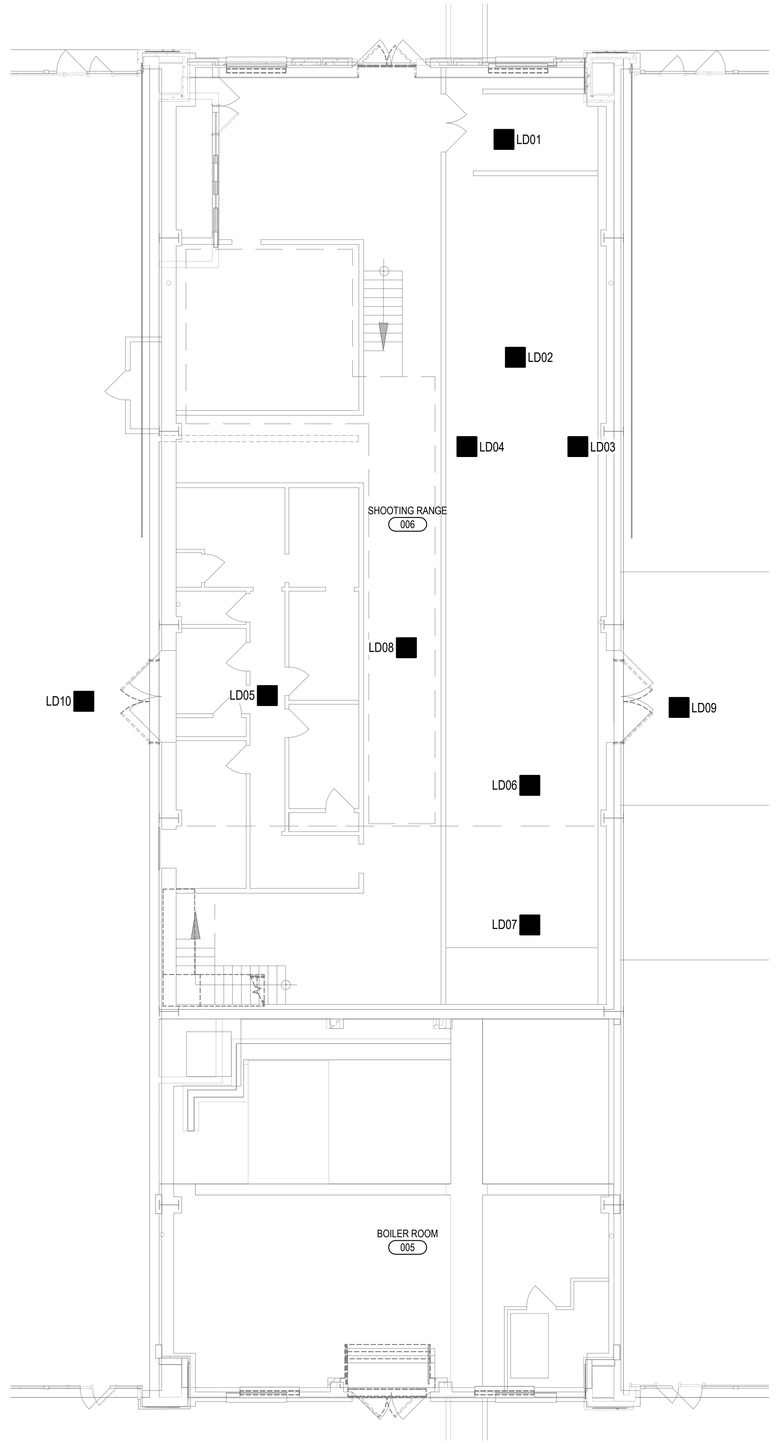

1 H1.6 SHOOTING RANGE LD SAMPLE LOCATION – ENVIRONMENTAL

1/8" = 1'-0" REFERRED FROM: H3.1

DESIGNED: DAZ AECOM LDB TECH. REVIEW: CCW DATE: 10/04/2024	SUB SHEET NO. H1.6	TITLE OF SHEET SHOOTING RANGE LD SAMPLE LOCATION - ENVIRONMENTAL HANGARS 3 & 4 HAZARDOUS MATERIALS REMEDIATION AND EARLY DEMOLITION	DRAWING NO. 646 190066 PMIS/PKG NO. GATE 308504 SHEET 8 OF 86

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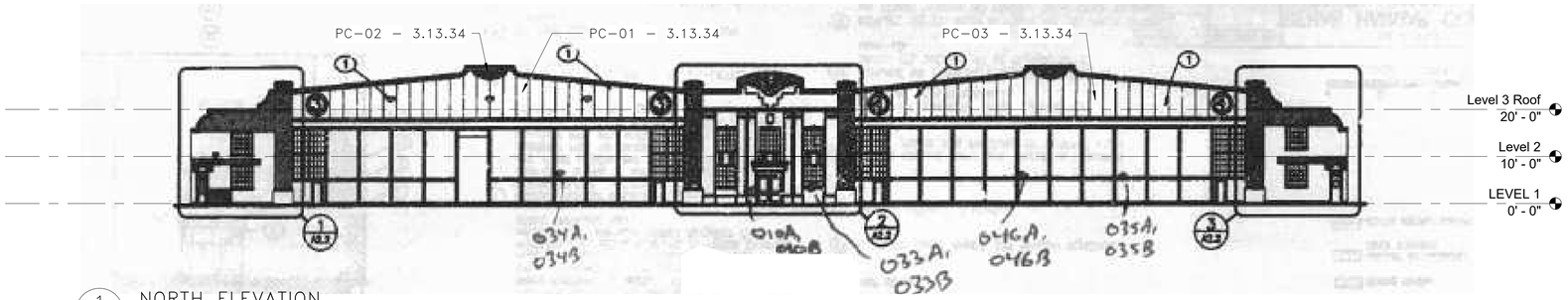
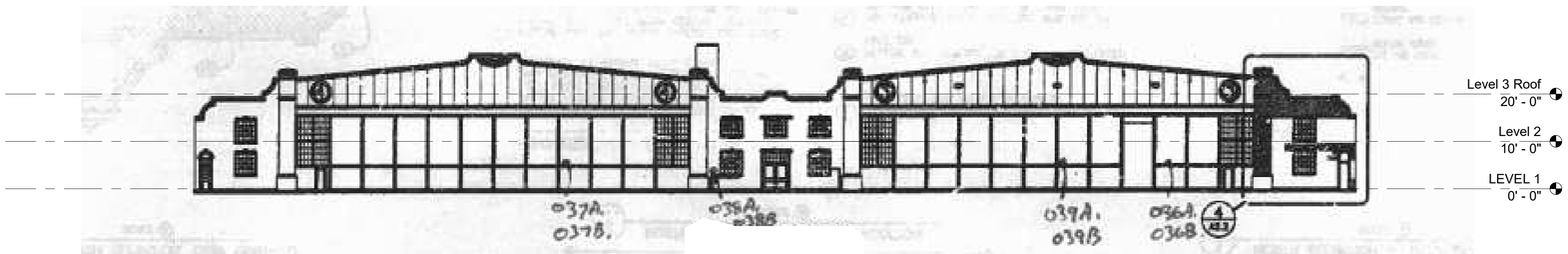


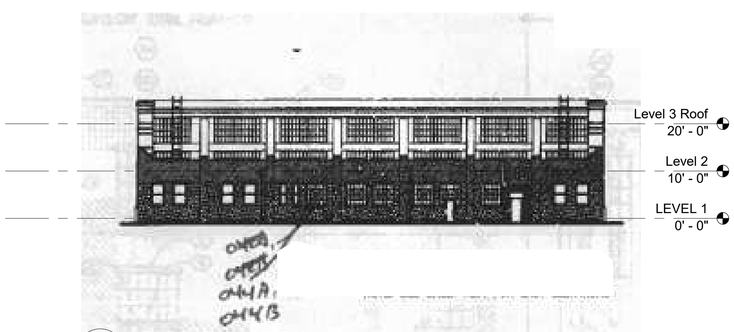
1 H3.1 NORTH ELEVATION

1/16" = 1'-0" REFERRED FROM: H1.1



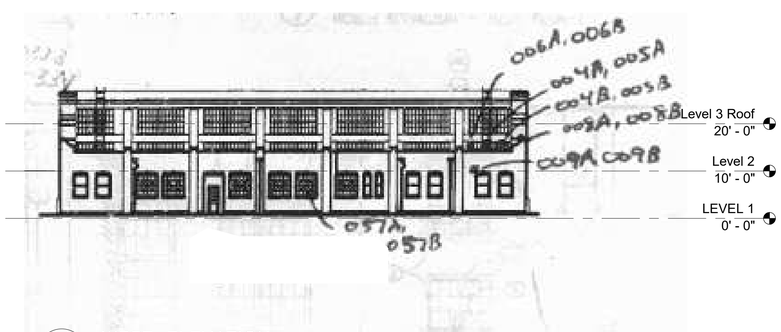
2 H3.1 SOUTH ELEVATION

1/16" = 1'-0" REFERRED FROM: H1.1



3 H3.1 EAST ELEVATION

1/16" = 1'-0" REFERRED FROM: H1.1



4 H3.1 WEST ELEVATION

1/16" = 1'-0" REFERRED FROM: H1.1

SHEET NOTES

1. THE FOLLOWING ACM SAMPLES CONTAINED GREATER THAN 1% ASBESTOS:
   - ACM-006A & B - Gray Roof FELT
   - ACM-006A & B - Gray Roof SEALANT

2. LEAD BASED PAINT WAS DETECTED AT THE FOLLOWING PAINT SAMPLE LOCATIONS:
   - PC -01 - 3.13.24, PC - 02 3.13.24, and PC - 03 3.13.24

   LEAD CONTAINING PAINT WAS DETECTED IN ALL SAMPLE LOCATIONS

DESIGNED: DAZ	SUB SHEET NO.	TITLE OF SHEET	DRAWING NO.
ADD LDB	H3.1	ELEVATION	646 190066
TECH. REVIEW: CCW			PMIS/PKG NO. GATE 308504
DATE: 10/04/2024		HANGARS 3 & 4 HAZARDOUS MATERIALS REMEDIATION AND EARLY DEMOLITION	SHEET 9 OF 86

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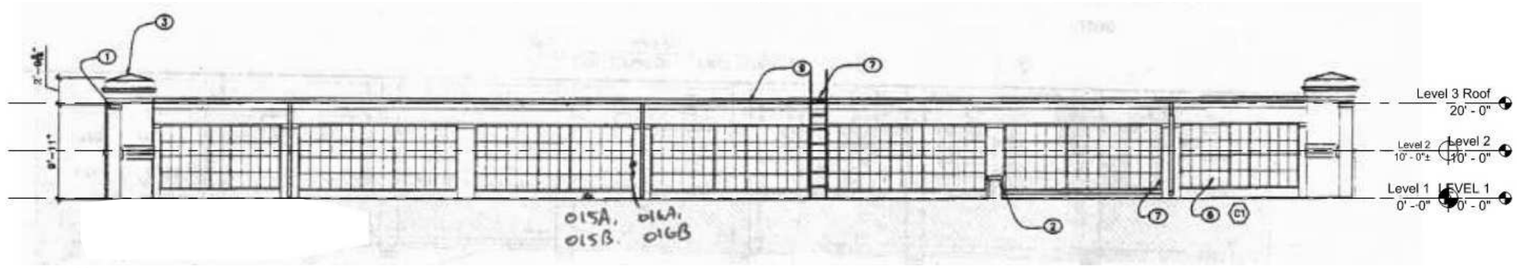

1 / H3.2 EAST ELEVATION WEST HANGAR

1/16" = 1'-0" REFERRED FROM: H1.1

SHEET NOTES

1. THE FOLLOWING ACM SAMPLES CONTAINED GREATER THAN 1% ASBESTOS:
   - ACM-016A & B - Dark Gray Caulk around Shooting Range Roof Exterior Windows

DESIGNED: DAZ ADD LDB TECH. REVIEW: CCW DATE: 10/04/2024	SUB SHEET NO. H3.2	TITLE OF SHEET ELEVATION HANGARS 3 & 4 HAZARDOUS MATERIALS REMEDIATION AND EARLY DEMOLITION	DRAWING NO. 646 / 190066 PMIS/PKG NO. GATE 308504 SHEET 10 OF 86

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GENERAL NOTES

1. A HAZARDOUS MATERIALS INSPECTION WAS PERFORMED. THE SURVEY/INSPECTION REPORT IS ATTACHED TO THE SPECIFICATION AS APPENDIX A FOR INFORMATION. THE WORK WILL REQUIRE THE REMOVAL OF ASBESTOS CONTAINING MATERIALS AS INDICATED. DESTRUCTIVE ACTIVITIES SUCH AS BREAKING INTO WALLS, CEILINGS, AND FLOORS WERE NOT PERFORMED IN ORDER TO LOCATE MATERIALS. THEREFORE, IF DURING THE WORK SUSPECT MATERIALS ARE UNCOVERED, STOP WORK AND NOTIFY THE CO. DRAWINGS, SPECIFICATIONS, AND REPORT ARE PROVIDED FOR INFORMATION ONLY. ASSESS HAZARDOUS CONDITIONS PRIOR TO START OF CONSTRUCTION AND COLLECT WASTE CHARACTERIZATION SAMPLES PRIOR TO DISPOSAL.

2. CONTACT THE NATIONAL PARK SERVICE (NPS) OFFICE PRIOR TO BEGINNING THE PAINT ABATEMENT ACTIVITIES IN ARCHITECTURAL DRAWINGS. COORDINATE WITH NPS TO SET UP AN ACCUMULATION AREA FOR THE REMOVED PAINT WHICH TESTED HAZARDOUS. LABEL THE CONTAINER CONTENTS AND START DATE OF ACCUMULATION. NPS MUST PRE-APPROVE THE DISPOSAL FACILITY AND SIGN THE MANIFEST PRIOR TO OFF-SITE DISPOSAL. PROVIDE NPS A COPY OF THE SIGNED MANIFEST FROM THE DISPOSAL FACILITY. CONTACT THE NPS OFFICE PRIOR TO BEGINNING THE ACM REMOVAL ACTIVITIES. SET UP AN ACCUMULATION AREA FOR THE REMOVED ACM. NPS MUST PRE-APPROVE THE DISPOSAL FACILITY AND SIGN THE MANIFEST PRIOR TO THE OFF-SITE DISPOSAL. PROVIDE NPS A COPY OF THE SIGNED MANIFEST FROM THE DISPOSAL FACILITY.

3. EXISTING PAINT HAS BEEN DETERMINED TO CONTAIN LEAD, AT CONCENTRATIONS ABOVE THE LABORATORY'S DETECTION LIMIT. REVIEW ENVIRONMENTAL HAZARDOUS MATERIALS REPORT FOR LEAD BASED PAINT INFORMATION. PERFORM RENOVATION/DEMOLITION WORK IN ACCORDANCE WITH SPECIFICATION SECTION 02 83 00 "LEAD REMEDIATION". CONSTRUCTION STANDARDS DEVELOPED BY OSHA FOR AND LEAD ARE; LEAD, 29 CFR 1926.62. REFER TO SPECIFICATION SECTION 02 83 33 FOR ADDITIONAL INFORMATION ON CLEANING AND PAINT REMOVAL ON EQUIPMENT, PIPING AND CONDUIT. ALL LEAD PAINT THAT IS ON EXISTING ITEMS TO REMAIN ARE TO BE ABATED. ALL ITEMS CONTAINING LEAD-BASED PAINT THAT ARE NOTED TO BE REMOVED SHALL BE DISPOSED OF PROPERLY ACCORDING TO THE SPECIFICATIONS. REFER TO HAZMAT REPORT AND DRAWINGS FOR ITEMS AND LOCATIONS. CERTAIN ITEMS SUCH AS THE WOOD CEILING PLANKS AND THE CORRUGATED METAL EXTERIOR FRIEZES ABOVE THE HANGAR DOORS TESTED FOR LEAD PAINT ARE NOT TO BE DEMOLISHED OR ABATED DURING THIS PHASE.

4. PROVIDE AIR EXPOSURE MONITORING TO MONITOR FOR CHROMIUM, CADMIUM, AND LEAD IN ACCORDANCE WITH GUIDANCE PROVIDED IN SPECIFICATION SECTION 02 83 33 – LEAD REMEDIATION.

5. REMOVE IDENTIFIED ASBESTOS IN ACCORDANCE WITH GUIDANCE PROVIDED IN SPECIFICATION SECTION 02 82 13 – ASBESTOS REMEDIATION.

6. IF PAINTED METAL COMPONENTS THAT TESTED POSITIVE FOR LEAD ARE TO BE REMOVED FROM THE SITE, THE CONTRACTOR MAY SEND THE METAL COMPONENTS FOR OFF-SITE RECYCLING. ~~PAINT MUST REMAIN INTACT DURING REMOVAL AND TRANSPORTATION.~~ REVIEW ENVIRONMENTAL HAZARDOUS MATERIALS REPORT FOR LEAD BASED PAINT INFORMATION.

7. DOORS MARKED TO REMAIN IN PLACE OR SALVAGE ON AD-101 TO BE ABATED FOR LEAD PAINT. ASSUME FIRE RATED DOORS CONTAIN ASBESTOS. REMOVE AND INSPECT FIRE RATED DOORS FOR ASBESTOS CONTAINING MATERIAL. FOLLOWING INSPECTION, NON-ASBESTOS FIRE DOORS CAN BE DISPOSED OF AS REGULAR CONSTRUCTION WASTE IF NOT MARKED TO REMAIN IN PLACE OR SALVAGE ON AD-101.

8. LIGHT BALLAST HAVE BEEN INSPECTED. NO INDICATION IS PROVIDED IF PCB FLUIDS ARE PRESENT IN BALLAST. BASED ON AGE OF HANGAR BALLAST SHOULD BE TREATED AS PCB CONTAINING UNLESS TESTING DETERMINES OTHERWISE.

9. INCORPORATE POTENTIAL EXPOSURE TO BIRD DROPPINGS AND MOLD INTO HEALTH AND SAFETY PLAN.

10. ALL WORK SHALL BE COMPLETED IN ACCORDANCE WITH STATE OF NEW YORK STANDARDS.

ABBREVIATIONS

ABBREVIATION	DESCRIPTION
CMU	CONCRETE MASONRY UNIT
CONC	CONCRETE
EV	ENVIRONMENTAL
EQUIP	EQUIPMENT
FT	FEET
LF	LINEAR FEET
NTS	NOT TO SCALE
RM	ROOM
STR	STAIR
TYP	TYPICAL
UNO	UNLESS NOTED OTHERWISE

SYMBOLS LIST

MATCHLINE

ENVIRONMENTAL SAMPLE

REMOVAL NOTE INDICATOR

SAMPLE DESCRIPTION

ABBREVIATION	DESCRIPTION
ACM	ASBESTOS
PC	PAINT CHIP
PCB	POLYCHLORINATED BIPHENYL

DESIGNED: DAZ	SUB SHEET NO.	TITLE OF SHEET	DRAWING NO. 646
CADD LDB	H0.1	GENERAL NOTES, SYMBOLS AND ABBREVIATIONS	190066
TECH. REVIEW: CCW			PMIS/PKG NO. GATE 308504
DATE: 10/04/2024		HANGARS 3 & 4 HAZARDOUS MATERIALS REMEDIATION AND EARLY DEMOLITION	SHEET 3 OF 86

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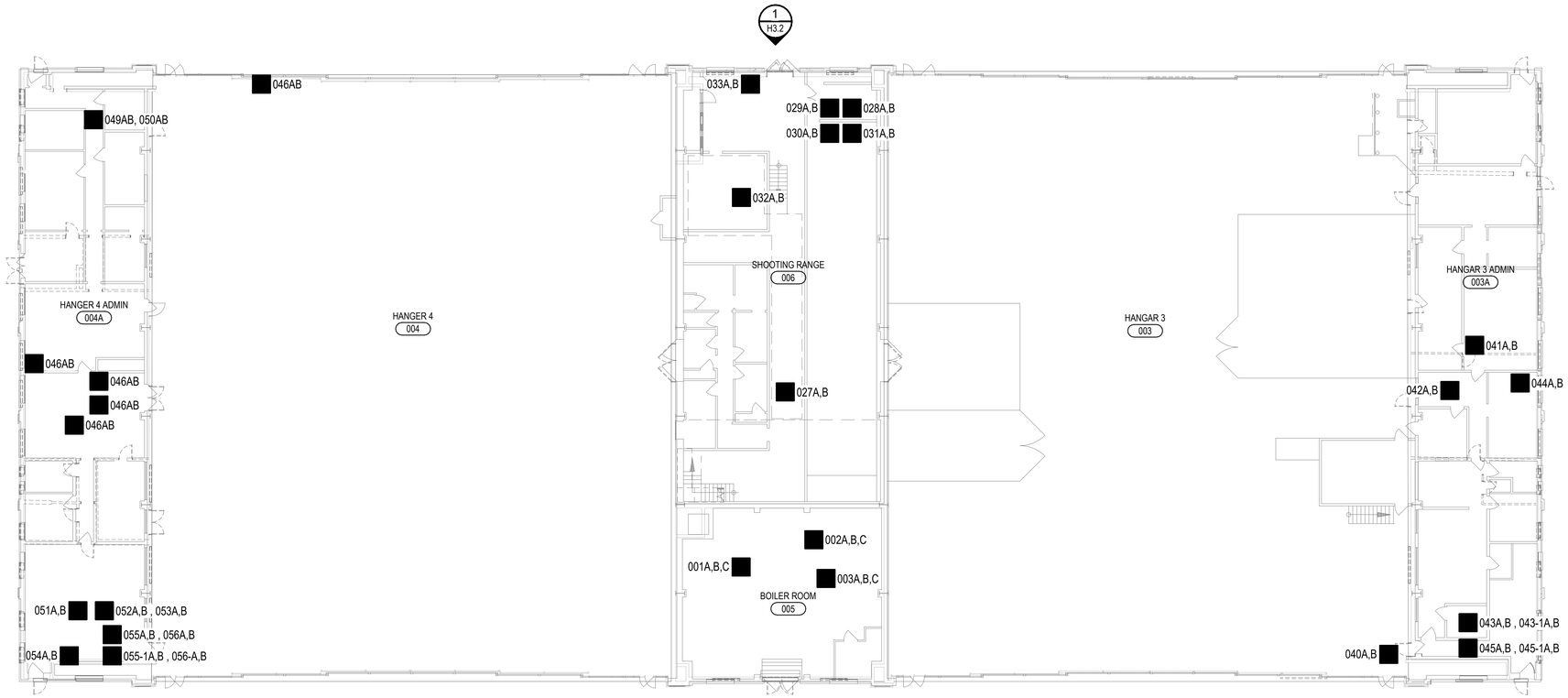

1 H1.1 LEVEL 01 ACM SAMPLE LOCATION – ENVIRONMENTAL

1/16" = 1'-0" REFERRED FROM: H3.1

SHEET NOTES

1. THE FOLLOWING ACM SAMPLES CONTAINED GREATER THAN 1% ASBESTOS:
   - ACM–45A & B– 9"X9" DARK BROWN FLOOR TILE
   - ACM 027A&B AND 027A–1 & 027B–1"X9" DARK GARY FLOOR TILE AND ASSOCIATED MASTIC
   - ACM 055A&B 12"x12" LIGHT GRAY FLOOR TILE

DESIGNED: DAZ	SUB SHEET NO.	TITLE OF SHEET	DRAWING NO.
CADD LDB	H1.1	LEVEL 01 ACM SAMPLE LOCATION - ENVIRONMENTAL	646 / 190066
TECH. REVIEW: CCW			PMIS/PKG NO. GATE 308504
DATE: 10/04/2024		HANGARS 3 & 4 HAZARDOUS MATERIALS REMEDIATION AND EARLY DEMOLITION	SHEET 4 OF 86

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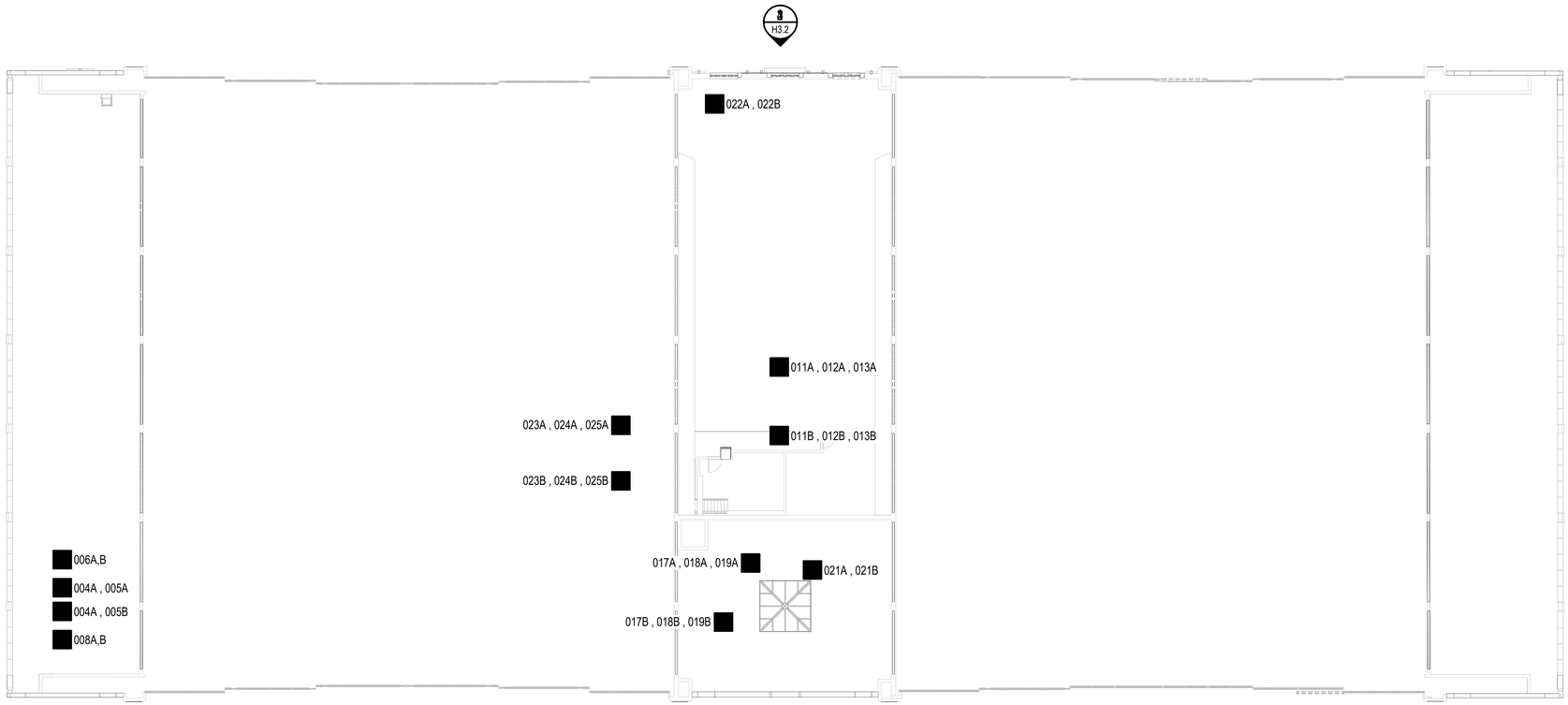

1 H1.2 ROOF ACM SAMPLE LOCATION – ENVIRONMENTAL

1/16" = 1'-0" REFERRED FROM: H3.1

SHEET NOTES

1. THE FOLLOWING ACM SAMPLES CONTAINED GREATER THAN 1% ASBESTOS:
   - ACM-006A & B – Gray Roof FELT
   - ACM-008A & B – Gray Roof SEALANT
   - ACM 022A&B – DARK GRAY ROOF SEALANT

DESIGNED:	SUB SHEET NO.	TITLE OF SHEET	DRAWING NO.
DAZ AECOM LDB TECH. REVIEW: CCW DATE: 10/04/2024	H1.2	ROOF ACM SAMPLE LOCATION - ENVIRONMENTAL HANGARS 3 & 4 HAZARDOUS MATERIALS REMEDIATION AND EARLY DEMOLITION	646 190066 PMIS/PKG NO. GATE 308504 SHEET 5 OF 86

Autodesk Docs://GATE Floyd Bennett Field/NPS Gate_Floyd Bennett Field-GHD.rvt
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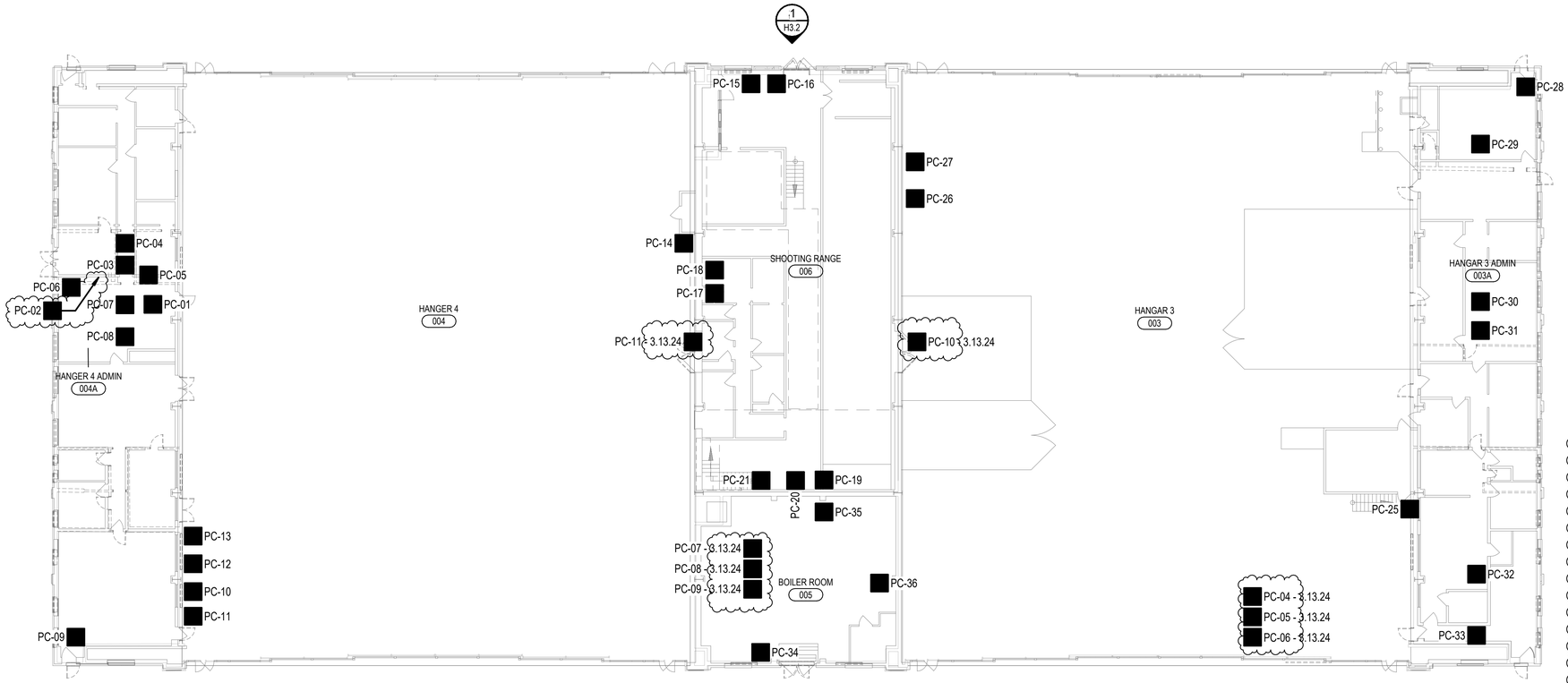
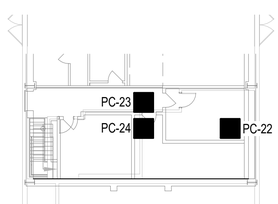


1 H1.3 LEVEL 01 PC SAMPLE LOCATION – ENVIRONMENTAL

1/16" = 1'-0" REFERRED FROM: H3.1



2 H1.3 LEVEL 01M PC SAMPLE LOCATION – ENVIRONMENTAL

1/16" = 1'-0" REFERRED FROM: H3.1

SHEET NOTES

1. LEAD BASED PAINT WAS DETECTED AT THE FOLLOWING PAINT SAMPLE LOCATIONS:
   - PC 01, 03, 04, 06, 09, 10, 11, 12, 13, 17 THROUGH 27, 29, 30, 32, 34, 35, AND 36, PC–04 – 3.13.24, PC–05 – 3.13.24, PC–08 3.13.24, PC–09 3.13.24, PC–10 3.13.24

   LEAD CONTAINING PAINT WAS DETECTED IN ALL SAMPLE LOCATIONS

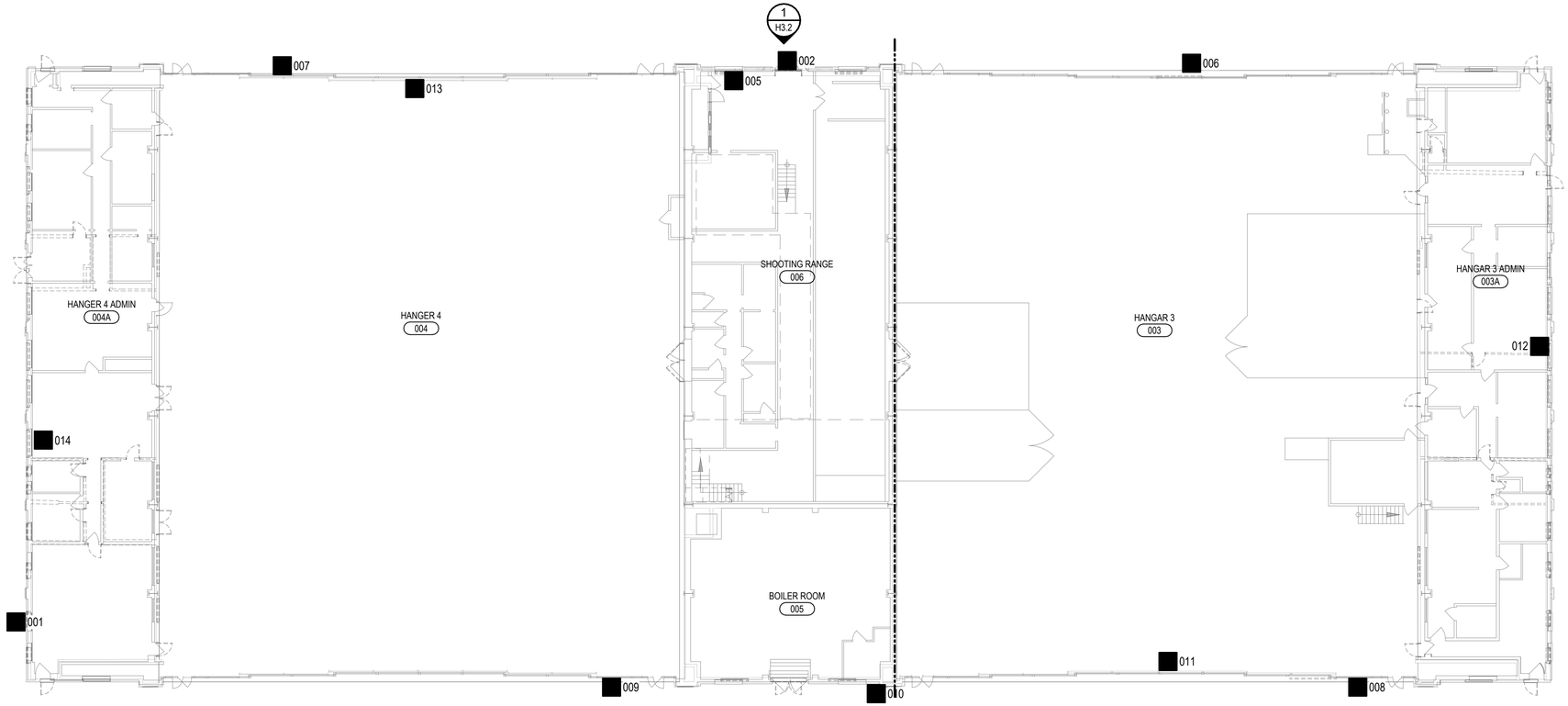
Sample ID	Sample Description	Lead Concentration (% wt)
PC-01	Light blue paint - Hangar 4 admin - west	**0.53**
PC-02	Green paint - Hangar 4 admin - center	0.32
PC-03	Dark blue paint - Hangar 4 admin - center door frame	**5.2**
PC-04	Light green paint - Hangar 4 admin - center	**0.85**
PC-05	Crème paint - Hangar 4 admin - center	0.29
PC-06	Light blue paint - Hangar 4 admin - north	**7.1**
PC-07	Dark gray paint - Hangar 4 admin - center cabinet	0.2
PC-08	Light blue/light green paint - Hangar 4 admin - center hallway	0.12
PC-09	Green paint - Hangar 4 admin - plaster	**12**
PC-10	Light blue paint - Hangar 4 - west wall	**1.7**
PC-11	Dark blue paint - Hangar 4 - west door	**1.9**
PC-12	Pink paint - Hangar 4 - west wall	**4**
PC-13	Crème paint - Hangar 4 - west wall	**31**
PC-14	Dark blue paint - Hangar 4 - east wall	0.22
PC-15	Yellow paint - Shooting range - north wall	0.32
PC-16	Gray paint - Shooting range - north wall	0.3
PC-17	Crème paint - Shooting range - west wall	**0.84**
PC-18	Dark green paint - Shooting range, west wall	**5.2**
PC-19	Yellow paint - Shooting range - south wall	**0.83**
PC-20	Crème paint - Shooting range - south wall	**1.3**
PC-21	Dark brown paint - Shooting range - south wall	**0.74**
PC-22	Dark gray paint - Shooting range - 2nd floor bathroom door	**4**
PC-23	Black paint - Shooting range - 2nd floor structural beams	**11**
PC-24	Light green paint - Shooting range - 2nd floor bathroom stalls	**6.7**
PC-25	Light blue paint - Hangar 3 - east wall	**2.5**
PC-26	Gray paint - Hangar 3 - west wall	**23**
PC-27	White paint - Hangar 3 - west wall	**37**
PC-28	Crème paint - Hangar 3 admin - north wall	0.054
PC-29	Light blue paint - Hangar 3 admin - center hallway	**5.8**
PC-30	Dark green paint - Hangar 3 admin - center	**4.7**
PC-31	Crème paint - Hangar 3 admin - center	0.26
PC-32	Dark blue paint - Hangar 3 admin - south	**0.82**
PC-33	Light blue paint - Hangar 3 admin - south	0.032
PC-34	Dark gray paint - Boiler room - south	**2**
PC-35	Black paint - Boiler room - south	**0.62**
PC-36	Light gray paint - Boiler room - east	**21**
PC-01 - 3.13.24	Orange and black paint - Above Hangar 4 Doors	**4.8**
PC-02 - 3.13.24	Cream paint - NYC Sign Above Hangar 4 Doors	**9.7**
PC-03 - 3.13.24	Orange and black paint - Above Hangar 3 Doors	**6.4**
PC-04 - 3.13.24	Blue and green paint - Hangar 3 Catwalk	**1.8**
PC-05 - 3.13.24	Blue and green paint - Hangar 3 Trusses	**12**
PC-06 - 3.13.24	Blue and green paint - Hangar 3 Catwalk	0.44
PC-07 - 3.13.24	Black paint - Boiler Door	0.26
PC-08 - 3.13.24	Grey/Silver paint - Boiler Door	**0.93**
PC-09 - 3.13.24	Green paint - Boiler Pumps	**5.7**
PC-10 - 3.13.24	Blue/Grey paint - Double doors from Hangar 3 to Shooting range	**0.73**
PC-11 - 3.13.24	Blue/Grey paint - Double doors from Hangar 4 to Shooting range	0.24

Notes:

- Concentrations presented in bold and red were detected above TCLP and LBP screening criteria (0.5% by weight).

DESIGNED: DAZ	SUB SHEET NO.	TITLE OF SHEET	DRAWING NO.
CADD LDB	H1.3	LEVEL 01 PC SAMPLE LOCATION - ENVIRONMENTAL	646 190066
TECH. REVIEW: CCW			PMIS/PKG NO. GATE 308504
DATE: 10/04/2024		HANGARS 3 & 4 HAZARDOUS MATERIALS REMEDIATION AND EARLY DEMOLITION	SHEET 6 OF 86

Autodesk Docs://GATE Floyd Bennett Field/NPS Gate_Floyd Bennett Field-GHD.rvt
12/3/2024 8:22:48 AM

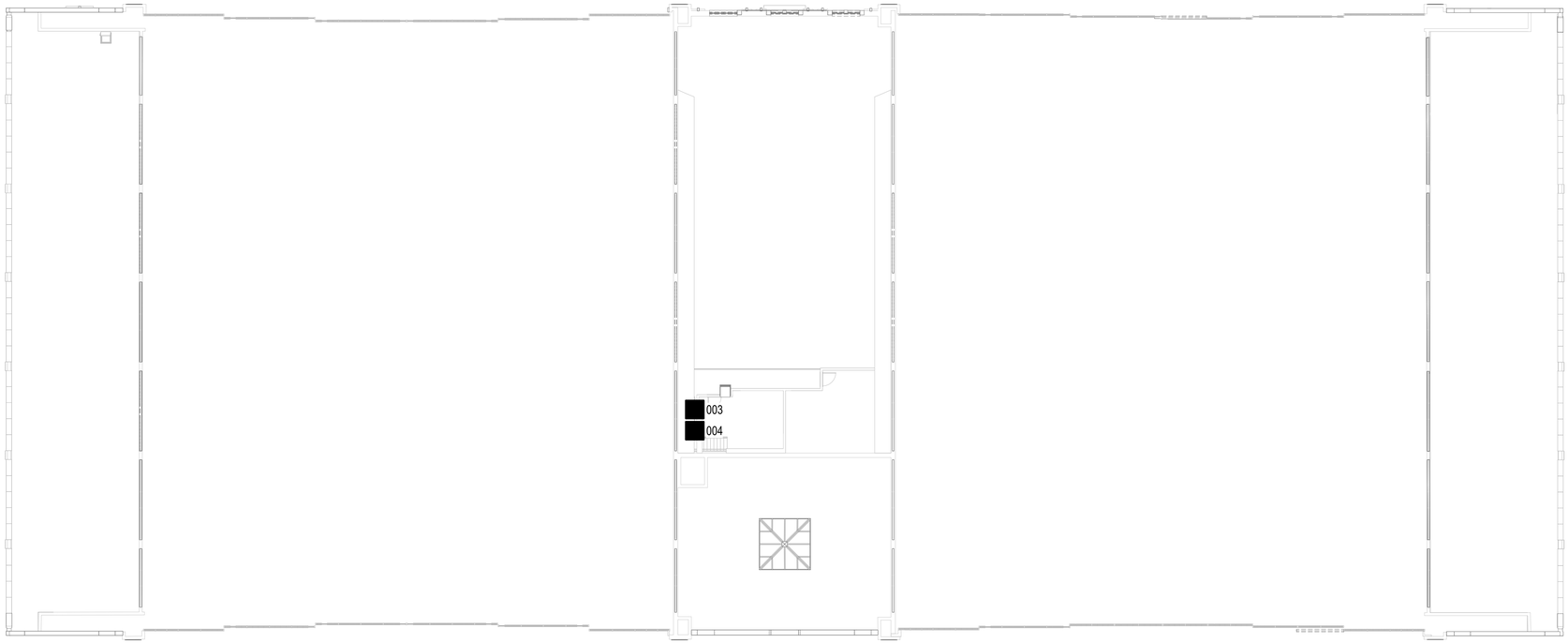


1 H1.4 LEVEL 01 CAULK PCB SAMPLE LOCATION – ENVIRONMENTAL

1/16" = 1'-0" REFERRED FROM: H3.1

DESIGNED: DAZ CADD LDB TECH. REVIEW: CCW DATE: 10/04/2024	SUB SHEET NO. H1.4	TITLE OF SHEET LEVEL 01 CAULKING SAMPLE LOCATION - ENVIRONMENTAL HANGARS 3 & 4 HAZARDOUS MATERIALS REMEDIATION AND EARLY DEMOLITION	DRAWING NO. 646 190066 PMIS/PKG NO. GATE 308504 SHEET 7 OF 86

Autodesk Docs://GATE Floyd Bennett Field/NPS Gate_Floyd Bennett Field-GHD.rvt
12/3/2024 8:22:48 AM



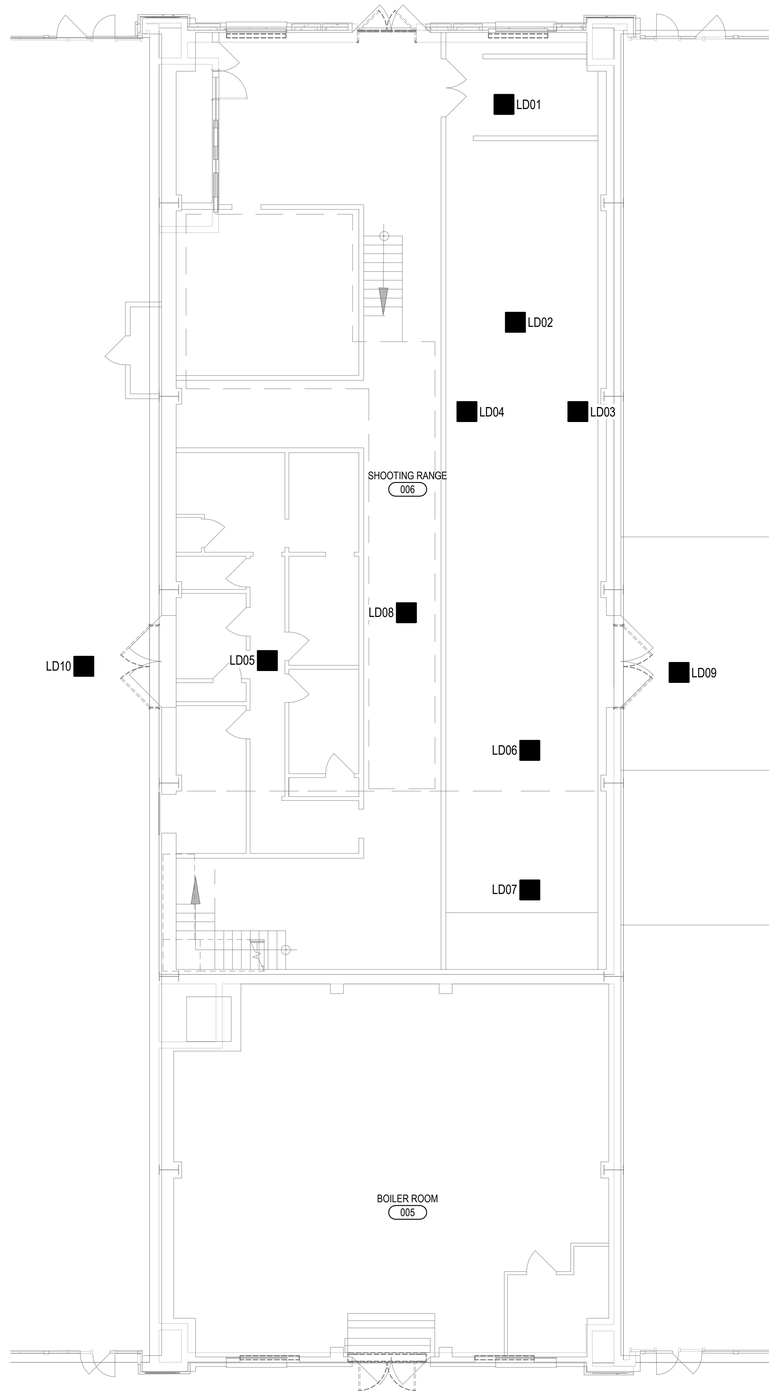
1 H1.5 ROOF CAULK PCB SAMPLE LOCATION – ENVIRONMENTAL

1/16" = 1'-0" REFERRED FROM: H3.1

Autodesk Docs://GATE Floyd Bennett Field/NPS Gate_Floyd Bennett Field-GHD.rvt

12/3/2024 8:22:48 AM

DESIGNED: DAZ CADD LDB TECH. REVIEW: CCW DATE: 10/04/2024	SUB SHEET NO. H1.5	TITLE OF SHEET ROOF CAULKING SAMPLE LOCATION - ENVIRONMENTAL HANGARS 3 & 4 HAZARDOUS MATERIALS REMEDIATION AND EARLY DEMOLITION	DRAWING NO. 646 / 190066 PMIS/PKG NO. GATE 308504 SHEET 8 OF 86

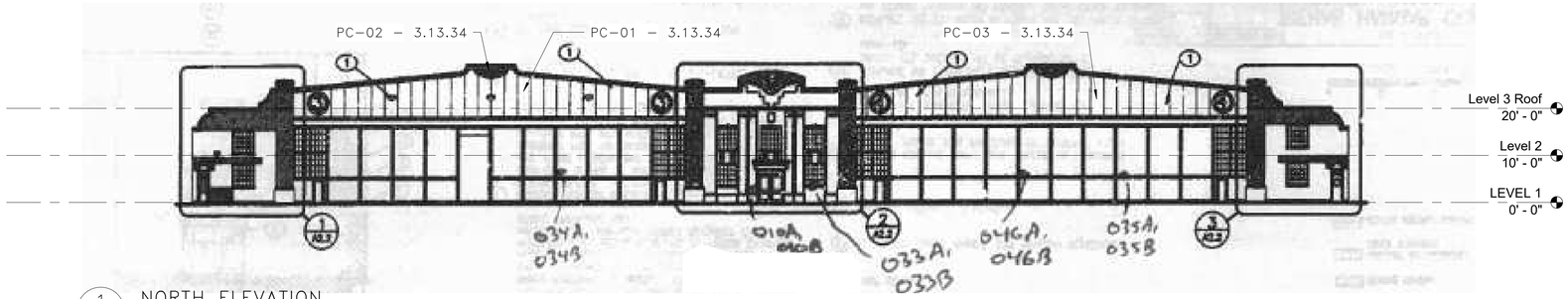


1 H1.6 SHOOTING RANGE LD SAMPLE LOCATION – ENVIRONMENTAL

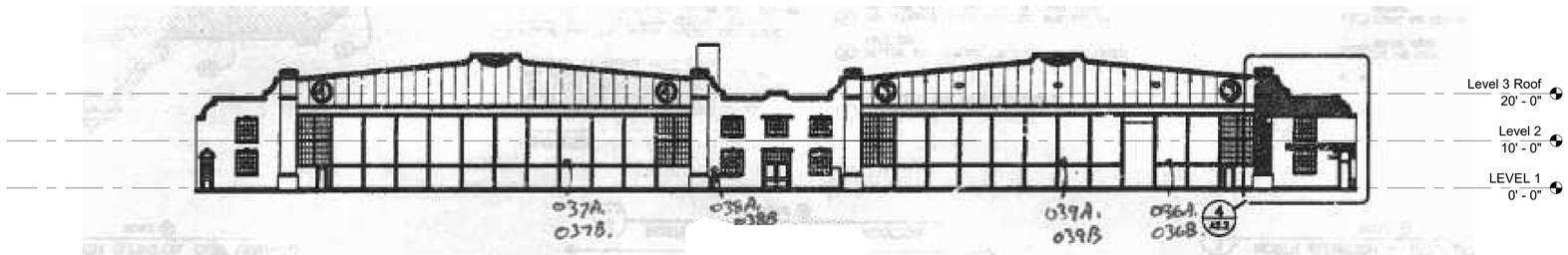
1/8" = 1'-0" REFERRED FROM: H3.1

DESIGNED: DAZ ADD LDB TECH. REVIEW: CCW DATE: 10/04/2024	SUB SHEET NO. H1.6	TITLE OF SHEET SHOOTING RANGE LD SAMPLE LOCATION - ENVIRONMENTAL HANGARS 3 & 4 HAZARDOUS MATERIALS REMEDIATION AND EARLY DEMOLITION	DRAWING NO. 646 190066 PMIS/PKG NO. GATE 308504 SHEET 8 OF 86

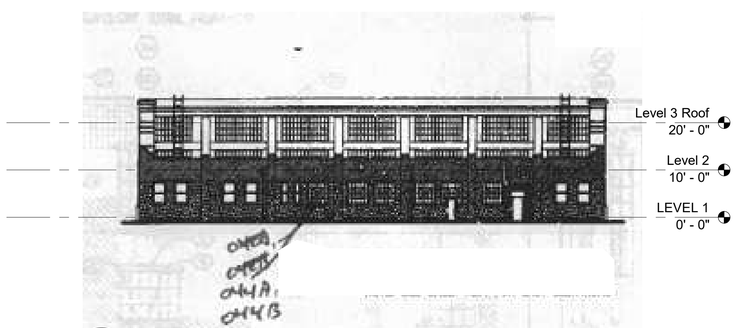
Autodesk Docs://GATE Floyd Bennett Field/NPS Gate_Floyd Bennett Field-GHD.rvt
12/3/2024 8:22:48 AM



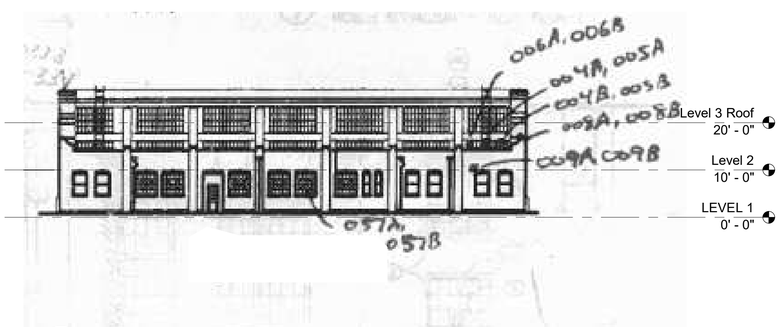
1 H3.1 NORTH ELEVATION
1/16" = 1'-0" REFERRED FROM: H1.1



2 H3.1 SOUTH ELEVATION
1/16" = 1'-0" REFERRED FROM: H1.1



3 H3.1 EAST ELEVATION
1/16" = 1'-0" REFERRED FROM: H1.1



4 H3.1 WEST ELEVATION
1/16" = 1'-0" REFERRED FROM: H1.1

SHEET NOTES

1. THE FOLLOWING ACM SAMPLES CONTAINED GREATER THAN 1% ASBESTOS:
   - ACM-006A & B – Gray Roof FELT
   - ACM-006A & B – Gray Roof SEALANT

2. LEAD BASED PAINT WAS DETECTED AT THE FOLLOWING PAINT SAMPLE LOCATIONS:
   - PC -01 – 3.13.24, PC – 02 3.13.24, and PC – 03 3.13.24

   LEAD CONTAINING PAINT WAS DETECTED IN ALL SAMPLE LOCATIONS

DESIGNED: DAZ	SUB SHEET NO.	TITLE OF SHEET	DRAWING NO.
CADD LDB	H3.1	ELEVATION	646 190066
TECH. REVIEW: CCW			PMIS/PKG NO. GATE 308504
DATE: 04/19/2024		HANGARS 3 & 4 HAZARDOUS MATERIALS REMEDIATION AND EARLY DEMOLITION	SHEET 9 OF 32

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12/3/2024 8:22:48 AM

Appendix III

EMSL Asbestos Laboratory Analytical Results, COCs, and Certifications

EMSL Analytical, Inc.
490 Rowley Road Depew, NY 14043
Tel/Fax: (716) 651-0030 / (716) 651-0394
http://www.EMSL.com / buffalolab@emsl.com

EMSL Order: 142304959
Customer ID: CONE53Z
Customer PO: Need
Project ID:

Attention: Dustin Zedaker
GHD
121 North 20th Street
Richmond, VA 23223

Project: None

Phone: (804) 514-6365
Fax:
Received Date: 10/13/2023 5:11 PM
Analysis Date: 10/18/2023 - 10/19/2023
Collected Date: 10/13/2023

Test Report: Asbestos Analysis of Non-Friable Organically Bound Materials by PLM via the NY State ELAP 198.6 Method

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types
002A *142304959-0004* HA: 002	Boiler Room, Water Tank - TSI around Piping	Tan/Silver/Yellow Fibrous Homogeneous	41% Other	59 Glass	**Inconclusive: No Asbestos Detected**
002B *142304959-0005* HA: 002	Boiler Room, Water Tank - TSI around Piping	Tan/Silver/Yellow Fibrous Homogeneous	52% Other	48 Glass	**Inconclusive: No Asbestos Detected**
002C *142304959-0006* HA: 002	Boiler Room, Water Tank - TSI around Piping	Tan/Silver/Yellow Fibrous Homogeneous	59% Other	41 Glass	**Inconclusive: No Asbestos Detected**
004A *142304959-0010* HA: 004	Roof of Hanger 4 Admin Area - Top Roof Layer, Black	Brown/Black Fibrous Homogeneous	90.7% Other	9.3 Glass	**Inconclusive: No Asbestos Detected**
004B *142304959-0011* HA: 004	Roof of Hanger 4 Admin Area - Top Roof Layer, Black	Black Fibrous Homogeneous	95.1% Other	4.9 Glass	**Inconclusive: No Asbestos Detected**
005A *142304959-0012* HA: 005	Roof of Hanger 4 Admin Area - Underlying Roof Felt, Brown	Brown/Black Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
005B *142304959-0013* HA: 005	Roof of Hanger 4 Admin Area - Underlying Roof Felt, Brown	Brown/Black Fibrous Homogeneous	98.5% Other	1.5 Cellulose	**Inconclusive: No Asbestos Detected**
006A *142304959-0014* HA: 006	Roof of Hanger 4 Admin Area - Gray Roof Felt at Roof Edge	Brown/Black Fibrous Homogeneous	91.5% Other	None	**8.5% Chrysotile** **8.5% Total**

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Test Report: Asbestos Analysis of Non-Friable Organically Bound Materials by PLM via the NY State ELAP 198.6 Method

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types
006B *142304959-0015* HA: 006	Roof of Hanger 4 Admin Area - Gray Roof Felt at Roof Edge	Brown/Black Fibrous Homogeneous	76% Other	None	**24% Chrysotile** **24% Total**
007A *142304959-0016* HA: 006, 005	Roof of Hanger 4 Admin Area - Composite of Top Roof Layer and Underlying Felt	Brown/Black Fibrous Homogeneous	95.7% Other	4.3 Glass	**Inconclusive: No Asbestos Detected**
007B *142304959-0017* HA: 006, 005	Roof of Hanger 4 Admin Area - Composite of Top Roof Layer and Underlying Felt	Brown/Black Fibrous Homogeneous	90.6% Other	9.4 Glass	**Inconclusive: No Asbestos Detected**
008A *142304959-0018* HA: 007	Roof of Hanger 4 Admin Area - Gay Roof Sealant at Roof Edge	Black Non-Fibrous Homogeneous	95.1% Other	None	**4.9% Chrysotile** **4.9% Total**
008B *142304959-0019* HA: 007	Roof of Hanger 4 Admin Area - Gay Roof Sealant at Roof Edge	Tan/Black Non-Fibrous Homogeneous	98.2% Other	None	**1.8% Chrysotile** **1.8% Total**
009A *142304959-0020* HA: 008	Exterior Wall of Hanger 4 Admin - Lt. Gray Caulk in Brick around Windows	Brown/Black/Pink Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
009B *142304959-0021* HA: 008	Exterior Wall of Hanger 4 Admin - Lt. Gray Caulk in Brick around Windows	Brown/Gray/Pink Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
010A *142304959-0022* HA: 009	Exterior Wall of Shooting Range - White Caulk around Door and Concrete Seams	Gray/Tan/Green Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**

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Samples analyzed by EMSL Analytical, Inc. Depew, NY NYS ELAP 11606, NVLAP Lab Code 200056-0

EMSL Analytical, Inc.
490 Rowley Road Depew, NY 14043
Tel/Fax: (716) 651-0030 / (716) 651-0394
http://www.EMSL.com / buffalolab@emsl.com

EMSL Order: 142304959
Customer ID: CONE53Z
Customer PO: Need
Project ID:

Attention: Dustin Zedaker
GHD
121 North 20th Street
Richmond, VA 23223

Project: None

Phone: (804) 514-6365
Fax:
Received Date: 10/13/2023 5:11 PM
Analysis Date: 10/18/2023 - 10/19/2023
Collected Date: 10/13/2023

Test Report: Asbestos Analysis of Non-Friable Organically Bound Materials by PLM via the NY State ELAP 198.6 Method

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types
010B *142304959-0023* HA: 009	Exterior Wall of Shooting Range - White Caulk around Door and Concrete Seams	Gray/Tan/Green Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
011A *142304959-0024* HA: 010	Roof of Shooting Range - Top Roof Layer, Black	Black Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
011B *142304959-0025* HA: 010	Roof of Shooting Range - Top Roof Layer, Black	Black Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
012A *142304959-0026* HA: 011	Roof of Shooting Range - Underlying Roof Layer, Black	Black Fibrous Homogeneous	98% Other	2.0 Glass	**Inconclusive: No Asbestos Detected**
012B *142304959-0027* HA: 011	Roof of Shooting Range - Underlying Roof Layer, Black	Black Fibrous Homogeneous	96.5% Other	3.5 Glass	**Inconclusive: No Asbestos Detected**
013A *142304959-0028* HA: 012	Roof of Shooting Range - Underlying Roof Felt, Brown	Brown/Yellow Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
013B *142304959-0029* HA: 012	Roof of Shooting Range - Underlying Roof Felt, Brown	Brown/Yellow Fibrous Homogeneous	100% Other	<1 Glass	**Inconclusive: No Asbestos Detected**
014A *142304959-0030* HA: 010, 011, 012	Roof of Shooting Range - Composite of 3 Roof Layer above Shooting Range	Brown/Black/Yellow Fibrous Homogeneous	98.9% Other	1.1 Glass	**Inconclusive: No Asbestos Detected**

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Analysis Date: 10/18/2023 - 10/19/2023
Collected Date: 10/13/2023

Test Report: Asbestos Analysis of Non-Friable Organically Bound Materials by PLM via the NY State ELAP 198.6 Method

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types
014B *142304959-0031* HA: 010, 011, 012	Roof of Shooting Range - Composite of 3 Roof Layer above Shooting Range	Brown/Black Fibrous Homogeneous	98.4% Other	1.6 Glass	**Inconclusive: No Asbestos Detected**
015A *142304959-0032* HA: 013	Roof of Shooting Range - Lt. Gray Caulk on Exterior Concrete Seams	Brown/Gray/Rust Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
015B *142304959-0033* HA: 013	Roof of Shooting Range - Lt. Gray Caulk on Exterior Concrete Seams	Brown/Gray/Rust Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
016A *142304959-0034* HA: 014	Roof of Shooting Range - Dark Gray Caulk on Exterior Windows	Black/Orange Non-Fibrous Homogeneous	90% Other	None	**10% Chrysotile** **10% Total**
016B *142304959-0035* HA: 014	Roof of Shooting Range - Dark Gray Caulk on Exterior Windows	Black/Orange Non-Fibrous Homogeneous	87% Other	None	**13% Chrysotile** **13% Total**
017A *142304959-0036* HA: 015	Roof of Boiler Room - Top Roof Layer, Black	White/Black Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
017B *142304959-0037* HA: 015	Roof of Boiler Room - Top Roof Layer, Black	Black Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
018A *142304959-0038* HA: 016	Roof of Boiler Room - Underlying Roof Layer, Black	Black Fibrous Homogeneous	96.7% Other	3.3 Glass	**Inconclusive: No Asbestos Detected**

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EMSL Order: 142304959
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Customer PO: Need
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Attention: Dustin Zedaker
GHD
121 North 20th Street
Richmond, VA 23223

Project: None

Phone: (804) 514-6365
Fax:
Received Date: 10/13/2023 5:11 PM
Analysis Date: 10/18/2023 - 10/19/2023
Collected Date: 10/13/2023

Test Report: Asbestos Analysis of Non-Friable Organically Bound Materials by PLM via the NY State ELAP 198.6 Method

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types
018B *142304959-0039* HA: 016	Roof of Boiler Room - Underlying Roof Layer, Black	Black Fibrous Homogeneous	98.2% Other	1.8 Glass	**Inconclusive: No Asbestos Detected**
019A *142304959-0040* HA: 017	Roof of Boiler Room - Underlying Roof Felt, Dark Brown	Black Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
019B *142304959-0041* HA: 017	Roof of Boiler Room - Underlying Roof Felt, Dark Brown	Black Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
020A *142304959-0042* HA: 015, 016, 017	Roof of Boiler Room - Composite of 3 Layers above Boiler Room	Brown/Black Fibrous Homogeneous	98.7% Other	1.3 Glass	**Inconclusive: No Asbestos Detected**
020B *142304959-0043* HA: 015, 016, 017	Roof of Boiler Room - Composite of 3 Layers above Boiler Room	Brown/Black Fibrous Homogeneous	98.1% Other	1.9 Glass	**Inconclusive: No Asbestos Detected**
021A *142304959-0044* HA: 018	Roof of Boiler Room	Black Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
021B *142304959-0045* HA: 018	Roof of Boiler Room	Black Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
022A *142304959-0046* HA: 019	Roof of Shooting Range - Dk. Gray Roof Sealant in NW Corner	Gray/Black Non-Fibrous Homogeneous	84% Other	None	**16% Chrysotile** **16% Total**

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EMSL Analytical, Inc.
490 Rowley Road Depew, NY 14043
Tel/Fax: (716) 651-0030 / (716) 651-0394
http://www.EMSL.com / buffalolab@emsl.com

EMSL Order: 142304959
Customer ID: CONE53Z
Customer PO: Need
Project ID:

Attention: Dustin Zedaker
GHD
121 North 20th Street
Richmond, VA 23223

Project: None

Phone: (804) 514-6365
Fax:
Received Date: 10/13/2023 5:11 PM
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Test Report: Asbestos Analysis of Non-Friable Organically Bound Materials by PLM via the NY State ELAP 198.6 Method

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types
022B *142304959-0047* HA: 019	Roof of Shooting Range - Dk. Gray Roof Sealant in NW Corner	Gray/Black Non-Fibrous Homogeneous	94.5% Other	None	**5.5% Chrysotile** **5.5% Total**
023A *142304959-0048* HA: 020	Roof of Hanger 4 - Top Roof Layer, Black	Black Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
023B *142304959-0049* HA: 020	Roof of Hanger 4 - Top Roof Layer, Black	Black Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
024A *142304959-0050* HA: 021	Roof of Hanger 4 - Underlying Roof Layer, Black	Black Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
024B *142304959-0051* HA: 021	Roof of Hanger 4 - Underlying Roof Layer, Black	Black Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
025A *142304959-0052* HA: 022	Roof of Hanger 4 - Underlying Roof Felt, Brown	Brown Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
025B *142304959-0053* HA: 022	Roof of Hanger 4 - Underlying Roof Felt, Brown	Brown Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
026A *142304959-0054* HA: 020, 021, 022	Roof of Hanger 4	Brown/Black Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**

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GHD
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Test Report: Asbestos Analysis of Non-Friable Organically Bound Materials by PLM via the NY State ELAP 198.6 Method

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types
026B *142304959-0055* HA: 020, 021, 022	Roof of Hanger 4	Brown/Black Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
027A *142304959-0056* HA: 023	2nd Floor of Shooting Range - 9x9 Floor Tile Dark Gray	Brown/Gray Non-Fibrous Homogeneous	91.4% Other	None	**8.6% Chrysotile** **8.6% Total**
027A-1 *142304959-0057* HA: 023	2nd Floor of Shooting Range - Mastic	Black Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
027B *142304959-0058* HA: 023	West Wall of Shooting Range - 9x9 Floor Tile Dark Gray	Brown/Gray Non-Fibrous Homogeneous	89% Other	None	**11% Chrysotile** **11% Total**
027B-1 *142304959-0059* HA: 023	West Wall of Shooting Range - Mastic	Black Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
030A *142304959-0064* HA: 026	East Section of Shooting Range - Dark Gray Adhesive for Soundproofing Material	Gray/Black Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
030B *142304959-0065* HA: 026	East Section of Shooting Range - Dark Gray Adhesive for Soundproofing Material	Gray Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
033A *142304959-0070* HA: 029	North Wall of Shooting Range - White Caulk on Interior Windows	White/Rust Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**

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Test Report: Asbestos Analysis of Non-Friable Organically Bound Materials by PLM via the NY State ELAP 198.6 Method

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types
033B *142304959-0071* HA: 029	North Wall of Shooting Range - White Caulk on Interior Windows	White/Rust Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
034A *142304959-0072* HA: 030	North Side of Hanger 3 - White Caulk on Exterior of North Windows	Brown/Gray/White Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
034B *142304959-0073* HA: 030	North Side of Hanger 3 - White Caulk on Exterior of North Windows	Brown/Gray/White Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
035A *142304959-0074* HA: 031	North Side of Hanger 4 - Lt. Gray Caulk on Exterior of Windows	Gray Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
035B *142304959-0075* HA: 031	North Side of Hanger 4 - Lt. Gray Caulk on Exterior of Windows	Gray Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
036A *142304959-0076* HA: 032	South Side of Hanger 3 - White Caulk on Exterior of Windows	Brown/Tan/White Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
036B *142304959-0077* HA: 032	South Side of Hanger 3 - White Caulk on Exterior of Windows	Brown/Gray/White Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
037A *142304959-0078* HA: 033	South Side of Hanger 4 - Lt. Gray Caulk on Exterior of Windows	Gray Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**

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490 Rowley Road Depew, NY 14043
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http://www.EMSL.com / buffalolab@emsl.com

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GHD
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Test Report: Asbestos Analysis of Non-Friable Organically Bound Materials by PLM via the NY State ELAP 198.6 Method

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types
037B *142304959-0079* HA: 033	South Side of Hanger 4 - Lt. Gray Caulk on Exterior of Windows	Gray Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
038A *142304959-0080* HA: 034	Boiler Room Exterior - Lt. Gray Caulk in Brick Seams	Brown/Pink Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
038B *142304959-0081* HA: 034	Boiler Room Exterior - Lt. Gray Caulk in Brick Seams	Brown/Gray/Pink Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
039A *142304959-0082* HA: 035	South Side of Hanger 3 - White Caulk on Interior of Windows	Brown/Gray/White Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
039B *142304959-0083* HA: 035	South Side of Hanger 3 - White Caulk on Interior of Windows	Gray/Tan/White Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
043A *142304959-0090* HA: 039	Hanger 3 Admin Area - 12x12 Floor Tile Crème Colored	Tan Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
043A-1 *142304959-0091* HA: 039	Hanger 3 Admin Area - Mastic	Yellow Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
043B *142304959-0092* HA: 039	Hanger 3 Admin Area - 12x12 Floor Tile Crème Colored	Tan Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**

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490 Rowley Road Depew, NY 14043
Tel/Fax: (716) 651-0030 / (716) 651-0394
http://www.EMSL.com / buffalolab@emsl.com

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Customer ID: CONE53Z
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Attention: Dustin Zedaker
GHD
121 North 20th Street
Richmond, VA 23223

Project: None

Phone: (804) 514-6365
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Test Report: Asbestos Analysis of Non-Friable Organically Bound Materials by PLM via the NY State ELAP 198.6 Method

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types
043B-1 *142304959-0093* HA: 039	Hanger 3 Admin Area - Mastic	Yellow Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
044A *142304959-0094* HA: 040	Hanger 3 Admin Area - White Caulk on Interior Windows, East Wall	Brown/Gray/White Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
044B *142304959-0095* HA: 040	Hanger 3 Admin Area - White Caulk on Interior Windows, East Wall	Brown/Gray Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
045A *142304959-0096* HA: 041	Hanger 3 Admin Area - 9x9 Floor Tile Dark Brown	Brown/Red Non-Fibrous Homogeneous	83% Other	None	**17% Chrysotile** **17% Total**
045A-1 *142304959-0097* HA: 041	Hanger 3 Admin Area - Mastic	Black Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
045B *142304959-0098* HA: 041	Hanger 3 Admin Area - 9x9 Floor Tile Dark Brown	Brown/Red Non-Fibrous Homogeneous	89% Other	None	**11% Chrysotile** **11% Total**
045B-1 *142304959-0099* HA: 041	Hanger 3 Admin Area - Mastic	Black Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
046A *142304959-0100* HA: 042	Hanger 4, North Side - Lt. Gray Caulk on Interior Windows	Brown/Gray Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**

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Test Report: Asbestos Analysis of Non-Friable Organically Bound Materials by PLM via the NY State ELAP 198.6 Method

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types
046B *142304959-0101* HA: 042	Hanger 4, North Side - Lt. Gray Caulk on Interior Windows	Brown/Gray Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
055A *142304959-0118* HA: 048	Hanger 4 Admin Area - 12x12 Floor Tile Lt. Gray	Gray/White Non-Fibrous Homogeneous	97.4% Other	None	**2.6% Chrysotile** **2.6% Total**
055A-1 *142304959-0119* HA: 048	Hanger 4 Admin Area - Mastic	Black Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
055B *142304959-0120* HA: 048	Hanger 4 Admin Area - 12x12 Floor Tile Lt. Gray				**Positive Stop (Not Analyzed)**
055B-1 *142304959-0121* HA: 048	Hanger 4 Admin Area - Mastic	Black Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
056A *142304959-0122* HA: 048	Hanger 4 Admin Area - 12x12 Floor Tile Lt. Gray	Gray/White Non-Fibrous Homogeneous	97.7% Other	None	**2.3% Chrysotile** **2.3% Total**
056A-1 *142304959-0123* HA: 048	Hanger 4 Admin Area - Mastic	Black Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
056B *142304959-0124* HA: 048	Hanger 4 Admin Area - 12x12 Floor Tile Lt. Gray				**Positive Stop (Not Analyzed)**

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Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types
056B-1 *142304959-0125* HA: 048	Hanger 4 Admin Area - Mastic	Black Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
057A *142304959-0126* HA: 049	Hanger 4 Admin Area - Lt. Gray Window Caulk from West Interior Windows	Gray/Rust Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**
057B *142304959-0127* HA: 049	Hanger 4 Admin Area - Lt. Gray Window Caulk from West Interior Windows	Brown/Gray/White Non-Fibrous Homogeneous	100% Other	None	**Inconclusive: No Asbestos Detected**

Analyst(s)
Hannah Parkes (89)

Rhonda McGee, Laboratory Manager
or other approved signatory

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Test Report: Asbestos Analysis of Bulk Materials by PLM via the NY State ELAP 198.1 Method

Sample	Description	Appearance	Non-Asbestos % Fibrous	Non-Asbestos % Non-Fibrous	Asbestos % Type
001A *142304959-0001*	Boiler Room, West Tank - TSI around Tank	Gray/Rust Non-Fibrous Homogeneous HA: 001	40% Glass	60% Non-fibrous (Other)	**None Detected**
001B *142304959-0002*	Boiler Room, West Tank - TSI around Tank	Gray Non-Fibrous Homogeneous HA: 001	60% Glass	40% Non-fibrous (Other)	**None Detected**
001C *142304959-0003*	Boiler Room, West Tank - TSI around Tank	Gray Non-Fibrous Homogeneous HA: 001	30% Glass	70% Non-fibrous (Other)	**None Detected**
003A *142304959-0007*	Boiler Room, Water Tank - Elbow Mud Wrap	Gray Fibrous Homogeneous HA: 003	20% Glass	80% Non-fibrous (Other)	**None Detected**
003B *142304959-0008*	Boiler Room, Water Tank - Elbow Mud Wrap	Gray Fibrous Homogeneous HA: 003	20% Glass	80% Non-fibrous (Other)	**None Detected**
003C *142304959-0009*	Boiler Room, Water Tank - Elbow Mud Wrap	Gray Fibrous Homogeneous HA: 003	30% Glass	70% Non-fibrous (Other)	**None Detected**
028A *142304959-0060*	West Wall of Shooting Range - White Drywall	Gray Fibrous Homogeneous HA: 024	10% Cellulose	90% Non-fibrous (Other)	**None Detected**

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Samples analyzed by EMSL Analytical, Inc. Depew, NY NYS ELAP 11606, NVLAP Lab Code 200056-0

Initial report from: 10/19/2023 09:14:14

EMSL Analytical, Inc.
490 Rowley Road Depew, NY 14043
Phone/Fax: (716) 651-0030 / (716) 651-0394
http://www.EMSL.com / buffalolab@emsl.com

EMSL Order: 142304959
Customer ID: CONE53Z
Customer PO: Need
Project ID:

Attention: Dustin Zedaker
GHD
121 North 20th Street
Richmond, VA 23223

Project: None

Phone: (804) 514-6365
Fax:
Received: 10/13/2023 5:11 PM
Analysis Date: 10/16/2023 - 10/18/2023
Collected: 10/13/2023

Test Report: Asbestos Analysis of Bulk Materials by PLM via the NY State ELAP 198.1 Method

Sample	Description	Appearance	Non-Asbestos % Fibrous	Non-Asbestos % Non-Fibrous	Asbestos % Type
028B *142304959-0061*	West Wall of Shooting Range - White Drywall	Gray Fibrous Homogeneous HA: 024	10% Cellulose	90% Non-fibrous (Other)	**None Detected**
029A *142304959-0062*	Ceiling of Shooting Range - White Drywall	Gray Fibrous Homogeneous HA: 025	20% Cellulose	80% Non-fibrous (Other)	**None Detected**
029B *142304959-0063*	Ceiling of Shooting Range - White Drywall Material	Gray Fibrous Homogeneous HA: 025	20% Cellulose	80% Non-fibrous (Other)	**None Detected**
031A *142304959-0066*	East Section of Shooting Range - White/Gray Soundproofing Material	Gray/White Non-Fibrous Homogeneous HA: 027		100% Non-fibrous (Other)	**None Detected**
031B *142304959-0067*	East Section of Shooting Range - White/Gray Soundproofing Material	Gray/White Non-Fibrous Homogeneous HA: 027		100% Non-fibrous (Other)	**None Detected**
032A *142304959-0068*	Center of Shooting Range - Crème-Colored Drywall in Center of Shooting Range	Gray Fibrous Homogeneous HA: 028	20% Cellulose	80% Non-fibrous (Other)	**None Detected**
032B *142304959-0069*	Center of Shooting Range - Crème-Colored Drywall in Center of Shooting Range	Gray Fibrous Homogeneous HA: 028	10% Cellulose	90% Non-fibrous (Other)	**None Detected**

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Test Report: Asbestos Analysis of Bulk Materials by PLM via the NY State ELAP 198.1 Method

Sample	Description	Appearance	Non-Asbestos % Fibrous	Non-Asbestos % Non-Fibrous	Asbestos % Type
040A *142304959-0084*	SE Corner of Hanger 3 - Gray Pipe Wrap around Piping	Brown/Gray Fibrous Homogeneous HA: 036	80% Cellulose	20% Non-fibrous (Other)	**None Detected**
040B *142304959-0085*	SE Corner of Hanger 3 - Gray Pipe Wrap around Piping	Brown/Gray Fibrous Homogeneous HA: 036	80% Cellulose	20% Non-fibrous (Other)	**None Detected**
041A *142304959-0086*	Hanger 3 Admin Area - White Drywall Material	Gray Fibrous Homogeneous HA: 037	5% Cellulose	95% Non-fibrous (Other)	**None Detected**
041B *142304959-0087*	Hanger 3 Admin Area - White Drywall Material	Gray Fibrous Homogeneous HA: 037	5% Cellulose	95% Non-fibrous (Other)	**None Detected**
042A *142304959-0088*	Hanger 3 Admin Area - Plaster under Ceiling Material	Brown/Gray Fibrous Homogeneous HA: 038	10% Cellulose	90% Non-fibrous (Other)	**None Detected**
042B *142304959-0089*	Hanger 3 Admin Area - Plaster under Ceiling Material	Brown/Gray Fibrous Homogeneous HA: 038	20% Cellulose	80% Non-fibrous (Other)	**None Detected**
047A *142304959-0102*	Hanger 4 Admin Area - White Plaster, Lower Layer	White Non-Fibrous Homogeneous HA: 043		100% Non-fibrous (Other)	**None Detected**

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Test Report: Asbestos Analysis of Bulk Materials by PLM via the NY State ELAP 198.1 Method

Sample	Description	Appearance	Non-Asbestos % Fibrous	Non-Asbestos % Non-Fibrous	Asbestos % Type
047B *142304959-0103*	Hanger 4 Admin Area - White Plaster, Lower Layer	White Non-Fibrous Homogeneous HA: 043		100% Non-fibrous (Other)	**None Detected**
048A *142304959-0104*	Hanger 4 Admin Area - White Plaster, Lower Layer	White Non-Fibrous Homogeneous HA: 043		100% Non-fibrous (Other)	**None Detected**
048B *142304959-0105*	Hanger 4 Admin Area - White Plaster, Lower Layer	White Non-Fibrous Homogeneous HA: 043		100% Non-fibrous (Other)	**None Detected**
049A *142304959-0106*	Hanger 4 Admin Area - Drywall in North Section of Admin Area	Tan Fibrous Homogeneous HA: 044	10% Cellulose	90% Non-fibrous (Other)	**None Detected**
049B *142304959-0107*	Hanger 4 Admin Area - Drywall in North Section of Admin Area	Tan Fibrous Homogeneous HA: 044	20% Cellulose	80% Non-fibrous (Other)	**None Detected**
050A *142304959-0108*	Hanger 4 Admin Area - Drywall in North Section of Admin Area	Tan Fibrous Homogeneous HA: 044	20% Cellulose	80% Non-fibrous (Other)	**None Detected**
050B *142304959-0109*	Hanger 4 Admin Area - Drywall in North Section of Admin Area	Tan Fibrous Homogeneous HA: 044	10% Cellulose	90% Non-fibrous (Other)	**None Detected**

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Test Report: Asbestos Analysis of Bulk Materials by PLM via the NY State ELAP 198.1 Method

Sample	Description	Appearance	Non-Asbestos % Fibrous	Non-Asbestos % Non-Fibrous	Asbestos % Type
051A *142304959-0110*	Hanger 4 Admin Area - Outer Plaster Layer over Wood Frame Wall, White	White Non-Fibrous Homogeneous HA: 045		100% Non-fibrous (Other)	**None Detected**
051B *142304959-0111*	Hanger 4 Admin Area - Outer Plaster Layer over Wood Frame Wall, White	White Non-Fibrous Homogeneous HA: 045		100% Non-fibrous (Other)	**None Detected**
052A *142304959-0112*	Hanger 4 Admin Area - Inner Plaster Layer over Wood Frame Wall, Gray	Brown/Rust Non-Fibrous Homogeneous HA: 046		100% Non-fibrous (Other)	**None Detected**
052B *142304959-0113*	Hanger 4 Admin Area - Inner Plaster Layer over Wood Frame Wall, Gray	Gray/Rust Non-Fibrous Homogeneous HA: 046		100% Non-fibrous (Other)	**None Detected**
053A *142304959-0114*	Hanger 4 Admin Area - Inner Plaster Layer over Wood Frame Wall, Gray	Gray/Rust Non-Fibrous Homogeneous HA: 046		100% Non-fibrous (Other)	**None Detected**
053B *142304959-0115*	Hanger 4 Admin Area - Inner Plaster Layer over Wood Frame Wall, Gray	Gray/Rust Non-Fibrous Homogeneous HA: 046		100% Non-fibrous (Other)	**None Detected**
054A *142304959-0116*	Hanger 4 Admin Area - White Plaster Layer over Brick Wall	White Non-Fibrous Homogeneous HA: 047		100% Non-fibrous (Other)	**None Detected**

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Test Report: Asbestos Analysis of Bulk Materials by PLM via the NY State ELAP 198.1 Method

Sample	Description	Appearance	Non-Asbestos % Fibrous	Non-Asbestos % Non-Fibrous	Asbestos % Type
054B *142304959-0117*	Hanger 4 Admin Area - White Plaster Layer over Brick Wall	White Non-Fibrous Homogeneous HA: 047		100% Non-fibrous (Other)	**None Detected**
058A *142304959-0128*	Hanger 4 Admin Area - Drywall Paneling, Green	Brown/Green Fibrous Homogeneous HA: 050	60% Cellulose	40% Non-fibrous (Other)	**None Detected**
058B *142304959-0129*	Hanger 4 Admin Area - Drywall Paneling, Green	Brown/Green Fibrous Homogeneous HA: 050	50% Cellulose	50% Non-fibrous (Other)	**None Detected**
059A *142304959-0130*	Hanger 4 Admin Area - Upper Layer of Ceiling Plaster, Gray	Gray/Rust Non-Fibrous Homogeneous HA: 051		100% Non-fibrous (Other)	**None Detected**
059B *142304959-0131*	Hanger 4 Admin Area - Upper Layer of Ceiling Plaster, Gray	Brown/Gray/Rust Non-Fibrous Homogeneous HA: 051		100% Non-fibrous (Other)	**None Detected**

Analyst(s)
Hannah Parkes (40)

Rhonda McGee, Laboratory Manager
or other approved signatory

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Test Report:Asbestos Analysis of Non-Friable Organically Bound Materials by Transmission Electron Microscopy via NYS ELAP Method 198.4

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types	% Total Asbestos
002A *142304959-0004* HA: 002	Boiler Room, Water Tank - TSI around Piping	Tan/Silver/Yellow Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
002B *142304959-0005* HA: 002	Boiler Room, Water Tank - TSI around Piping	Tan/Silver/Yellow Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
002C *142304959-0006* HA: 002	Boiler Room, Water Tank - TSI around Piping	Tan/Silver/Yellow Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
004A *142304959-0010* HA: 004	Roof of Hanger 4 Admin Area - Top Roof Layer, Black	Brown/Black Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
004B *142304959-0011* HA: 004	Roof of Hanger 4 Admin Area - Top Roof Layer, Black	Black Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
005A *142304959-0012* HA: 005	Roof of Hanger 4 Admin Area - Underlying Roof Felt, Brown	Brown/Black Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
005B *142304959-0013* HA: 005	Roof of Hanger 4 Admin Area - Underlying Roof Felt, Brown	Brown/Black Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
006A *142304959-0014* HA: 006 Not Analyzed	Roof of Hanger 4 Admin Area - Gray Roof Felt at Roof Edge					

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Samples analyzed by EMSL Analytical, Inc. Depew, NY NYS ELAP 11606

Initial report from: 10/20/2023 02:10 PM

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Test Report:Asbestos Analysis of Non-Friable Organically Bound Materials by Transmission Electron Microscopy via NYS ELAP Method 198.4

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types	% Total Asbestos
006B *142304959-0015* HA: 006 Not Analyzed	Roof of Hanger 4 Admin Area - Gray Roof Felt at Roof Edge					
007A *142304959-0016* HA: 006, 005	Roof of Hanger 4 Admin Area - Composite of Top Roof Layer and Underlying Felt	Brown/Black Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
007B *142304959-0017* HA: 006, 005	Roof of Hanger 4 Admin Area - Composite of Top Roof Layer and Underlying Felt	Brown/Black Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
008A *142304959-0018* HA: 007 Not Analyzed	Roof of Hanger 4 Admin Area - Gay Roof Sealant at Roof Edge					
008B *142304959-0019* HA: 007 Not Analyzed	Roof of Hanger 4 Admin Area - Gay Roof Sealant at Roof Edge					
009A *142304959-0020* HA: 008	Exterior Wall of Hanger 4 Admin - Lt. Gray Caulk in Brick around Windows	Brown/Black/Pink Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
009B *142304959-0021* HA: 008	Exterior Wall of Hanger 4 Admin - Lt. Gray Caulk in Brick around Windows	Brown/Gray/Pink Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected

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Test Report:Asbestos Analysis of Non-Friable Organically Bound Materials by Transmission Electron Microscopy via NYS ELAP Method 198.4

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types	% Total Asbestos
010A *142304959-0022* HA: 009	Exterior Wall of Shooting Range - White Caulk around Door and Concrete Seams	Gray/Tan/Green Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
010B *142304959-0023* HA: 009	Exterior Wall of Shooting Range - White Caulk around Door and Concrete Seams	Gray/Tan/Green Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
011A *142304959-0024* HA: 010	Roof of Shooting Range - Top Roof Layer, Black	Black Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
011B *142304959-0025* HA: 010	Roof of Shooting Range - Top Roof Layer, Black	Black Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
012A *142304959-0026* HA: 011	Roof of Shooting Range - Underlying Roof Layer, Black	Black Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
012B *142304959-0027* HA: 011	Roof of Shooting Range - Underlying Roof Layer, Black	Black Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
013A *142304959-0028* HA: 012	Roof of Shooting Range - Underlying Roof Felt, Brown	Brown/Yellow Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
013B *142304959-0029* HA: 012	Roof of Shooting Range - Underlying Roof Felt, Brown	Brown/Yellow Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected

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Test Report:Asbestos Analysis of Non-Friable Organically Bound Materials by Transmission Electron Microscopy via NYS ELAP Method 198.4

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types	% Total Asbestos
014A *142304959-0030* HA: 010, 011, 012	Roof of Shooting Range - Composite of 3 Roof Layer above Shooting Range	Brown/Black/Yellow Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
014B *142304959-0031* HA: 010, 011, 012	Roof of Shooting Range - Composite of 3 Roof Layer above Shooting Range	Brown/Black Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
015A *142304959-0032* HA: 013	Roof of Shooting Range - Lt. Gray Caulk on Exterior Concrete Seams	Brown/Gray/Rust Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
015B *142304959-0033* HA: 013	Roof of Shooting Range - Lt. Gray Caulk on Exterior Concrete Seams	Brown/Gray/Rust Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
016A *142304959-0034* HA: 014 Not Analyzed	Roof of Shooting Range - Dark Gray Caulk on Exterior Windows					
016B *142304959-0035* HA: 014 Not Analyzed	Roof of Shooting Range - Dark Gray Caulk on Exterior Windows					
017A *142304959-0036* HA: 015	Roof of Boiler Room - Top Roof Layer, Black	White/Black Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
017B *142304959-0037* HA: 015	Roof of Boiler Room - Top Roof Layer, Black	Black Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected

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Samples analyzed by EMSL Analytical, Inc. Depew, NY NYS ELAP 11606

Initial report from: 10/20/2023 02:10 PM

EMSL Analytical, Inc.

490 Rowley Road Depew, NY 14043
Tel/Fax: (716) 651-0030 / (716) 651-0394
http://www.EMSL.com / buffalolab@emsl.com

EMSL Order: 142304959
Customer ID: CONE53Z
Customer PO: Need
Project ID:

Attention: Dustin Zedaker
GHD
121 North 20th Street
Richmond, VA 23223

Project: None

Phone: (804) 514-6365
Fax:
Received Date: 10/13/2023 05:11 PM
Analysis Date: 10/19/2023 - 10/20/2023
Collected Date: 10/13/2023

Test Report:Asbestos Analysis of Non-Friable Organically Bound Materials by Transmission Electron Microscopy via NYS ELAP Method 198.4

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types	% Total Asbestos
018A *142304959-0038* HA: 016	Roof of Boiler Room - Underlying Roof Layer, Black	Black Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
018B *142304959-0039* HA: 016	Roof of Boiler Room - Underlying Roof Layer, Black	Black Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
019A *142304959-0040* HA: 017	Roof of Boiler Room - Underlying Roof Felt, Dark Brown	Black Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
019B *142304959-0041* HA: 017	Roof of Boiler Room - Underlying Roof Felt, Dark Brown	Black Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
020A *142304959-0042* HA: 015, 016, 017	Roof of Boiler Room - Composite of 3 Layers above Boiler Room	Brown/Black Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
020B *142304959-0043* HA: 015, 016, 017	Roof of Boiler Room - Composite of 3 Layers above Boiler Room	Brown/Black Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
021A *142304959-0044* HA: 018	Roof of Boiler Room	Black Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
021B *142304959-0045* HA: 018	Roof of Boiler Room	Black Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected

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Collected Date: 10/13/2023

Test Report:Asbestos Analysis of Non-Friable Organically Bound Materials by Transmission Electron Microscopy via NYS ELAP Method 198.4

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types	% Total Asbestos
022A *142304959-0046* HA: 019 Not Analyzed	Roof of Shooting Range - Dk. Gray Roof Sealant in NW Corner					
022B *142304959-0047* HA: 019 Not Analyzed	Roof of Shooting Range - Dk. Gray Roof Sealant in NW Corner					
023A *142304959-0048* HA: 020	Roof of Hanger 4 - Top Roof Layer, Black	Black Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
023B *142304959-0049* HA: 020	Roof of Hanger 4 - Top Roof Layer, Black	Black Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
024A *142304959-0050* HA: 021	Roof of Hanger 4 - Underlying Roof Layer, Black	Black Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
024B *142304959-0051* HA: 021	Roof of Hanger 4 - Underlying Roof Layer, Black	Black Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
025A *142304959-0052* HA: 022	Roof of Hanger 4 - Underlying Roof Felt, Brown	Brown Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
025B *142304959-0053* HA: 022	Roof of Hanger 4 - Underlying Roof Felt, Brown	Brown Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected

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Test Report:Asbestos Analysis of Non-Friable Organically Bound Materials by Transmission Electron Microscopy via NYS ELAP Method 198.4

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types	% Total Asbestos
026A *142304959-0054* HA: 020, 021, 022	Roof of Hanger 4	Brown/Black Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
026B *142304959-0055* HA: 020, 021, 022	Roof of Hanger 4	Brown/Black Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
027A *142304959-0056* HA: 023 Not Analyzed	2nd Floor of Shooting Range - 9x9 Floor Tile Dark Gray					
027A-1 *142304959-0057* HA: 023	2nd Floor of Shooting Range - Mastic	Black Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
027B *142304959-0058* HA: 023 Not Analyzed	West Wall of Shooting Range - 9x9 Floor Tile Dark Gray					
027B-1 *142304959-0059* HA: 023	West Wall of Shooting Range - Mastic	Black Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
030A *142304959-0064* HA: 026	East Section of Shooting Range - Dark Gray Adhesive for Soundproofing Material	Gray/Black Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
030B *142304959-0065* HA: 026	East Section of Shooting Range - Dark Gray Adhesive for Soundproofing Material	Gray Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected

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Test Report:Asbestos Analysis of Non-Friable Organically Bound Materials by Transmission Electron Microscopy via NYS ELAP Method 198.4

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types	% Total Asbestos
033A *142304959-0070* HA: 029	North Wall of Shooting Range - White Caulk on Interior Windows	White/Rust Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
033B *142304959-0071* HA: 029	North Wall of Shooting Range - White Caulk on Interior Windows	White/Rust Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
034B *142304959-0073* HA: 030	North Side of Hanger 3 - White Caulk on Exterior of North Windows	Brown/Gray/White Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
035A *142304959-0074* HA: 031	North Side of Hanger 4 - Lt. Gray Caulk on Exterior of Windows	Gray Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
035B *142304959-0075* HA: 031	North Side of Hanger 4 - Lt. Gray Caulk on Exterior of Windows	Gray Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
036A *142304959-0076* HA: 032	South Side of Hanger 3 - White Caulk on Exterior of Windows	Brown/Tan/White Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
036B *142304959-0077* HA: 032	South Side of Hanger 3 - White Caulk on Exterior of Windows	Brown/Gray/White Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
037A *142304959-0078* HA: 033	South Side of Hanger 4 - Lt. Gray Caulk on Exterior of Windows	Gray Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
037B *142304959-0079* HA: 033	South Side of Hanger 4 - Lt. Gray Caulk on Exterior of Windows	Gray Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected

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Samples analyzed by EMSL Analytical, Inc. Depew, NY NYS ELAP 11606

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490 Rowley Road Depew, NY 14043
Tel/Fax: (716) 651-0030 / (716) 651-0394
http://www.EMSL.com / buffalolab@emsl.com

EMSL Order: 142304959
Customer ID: CONE53Z
Customer PO: Need
Project ID:

Attention: Dustin Zedaker
GHD
121 North 20th Street
Richmond, VA 23223

Project: None

Phone: (804) 514-6365
Fax:
Received Date: 10/13/2023 05:11 PM
Analysis Date: 10/19/2023 - 10/20/2023
Collected Date: 10/13/2023

Test Report:Asbestos Analysis of Non-Friable Organically Bound Materials by Transmission Electron Microscopy via NYS ELAP Method 198.4

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types	% Total Asbestos
038A *142304959-0080* HA: 034	Boiler Room Exterior - Lt. Gray Caulk in Brick Seams	Brown/Pink Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
038B *142304959-0081* HA: 034	Boiler Room Exterior - Lt. Gray Caulk in Brick Seams	Brown/Gray/Pink Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
039A *142304959-0082* HA: 035	South Side of Hanger 3 - White Caulk on Interior of Windows	Brown/Gray/White Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
039B *142304959-0083* HA: 035	South Side of Hanger 3 - White Caulk on Interior of Windows	Gray/Tan/White Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
043A *142304959-0090* HA: 039	Hanger 3 Admin Area - 12x12 Floor Tile Crème Colored	Tan Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
043A-1 *142304959-0091* HA: 039	Hanger 3 Admin Area - Mastic	Yellow Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
043B *142304959-0092* HA: 039	Hanger 3 Admin Area - 12x12 Floor Tile Crème Colored	Tan Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
043B-1 *142304959-0093* HA: 039	Hanger 3 Admin Area - Mastic	Yellow Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
044A *142304959-0094* HA: 040	Hanger 3 Admin Area - White Caulk on Interior Windows, East Wall	Brown/Gray/White Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected

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Samples analyzed by EMSL Analytical, Inc. Depew, NY NYS ELAP 11606

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Tel/Fax: (716) 651-0030 / (716) 651-0394
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Project ID:

Attention: Dustin Zedaker
GHD
121 North 20th Street
Richmond, VA 23223

Project: None

Phone: (804) 514-6365
Fax:
Received Date: 10/13/2023 05:11 PM
Analysis Date: 10/19/2023 - 10/20/2023
Collected Date: 10/13/2023

Test Report:Asbestos Analysis of Non-Friable Organically Bound Materials by Transmission Electron Microscopy via NYS ELAP Method 198.4

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types	% Total Asbestos
044B *142304959-0095* HA: 040	Hanger 3 Admin Area - White Caulk on Interior Windows, East Wall	Brown/Gray Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
045A *142304959-0096* HA: 041 Not Analyzed	Hanger 3 Admin Area - 9x9 Floor Tile Dark Brown					
045A-1 *142304959-0097* HA: 041	Hanger 3 Admin Area - Mastic	Black Non-Fibrous Homogeneous	100% Other	None	<1% Chrysotile	<1%
045B *142304959-0098* HA: 041 Not Analyzed	Hanger 3 Admin Area - 9x9 Floor Tile Dark Brown					
045B-1 *142304959-0099* HA: 041	Hanger 3 Admin Area - Mastic	Black Non-Fibrous Homogeneous	100% Other	None	<1% Chrysotile	<1%
046A *142304959-0100* HA: 042	Hanger 4, North Side - Lt. Gray Caulk on Interior Windows	Brown/Gray Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
046B *142304959-0101* HA: 042	Hanger 4, North Side - Lt. Gray Caulk on Interior Windows	Brown/Gray Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
055A *142304959-0118* HA: 048 Not Analyzed	Hanger 4 Admin Area - 12x12 Floor Tile Lt. Gray					

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Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types	% Total Asbestos
055A-1 *142304959-0119* HA: 048	Hanger 4 Admin Area - Mastic	Black Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
055B *142304959-0120* HA: 048 Not Analyzed	Hanger 4 Admin Area - 12x12 Floor Tile Lt. Gray					
055B-1 *142304959-0121* HA: 048	Hanger 4 Admin Area - Mastic	Black Non-Fibrous Homogeneous	100% Other	None	<1% Chrysotile	<1%
056A *142304959-0122* HA: 048 Not Analyzed	Hanger 4 Admin Area - 12x12 Floor Tile Lt. Gray					
056A-1 *142304959-0123* HA: 048	Hanger 4 Admin Area - Mastic	Black Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected
056B *142304959-0124* HA: 048 Not Analyzed	Hanger 4 Admin Area - 12x12 Floor Tile Lt. Gray					
056B-1 *142304959-0125* HA: 048	Hanger 4 Admin Area - Mastic	Black Non-Fibrous Homogeneous	100% Other	None	<1% Chrysotile	<1%
057A *142304959-0126* HA: 049	Hanger 4 Admin Area - Lt. Gray Window Caulk from West Interior Windows	Gray/Rust Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected

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Test Report:Asbestos Analysis of Non-Friable Organically Bound Materials by Transmission Electron Microscopy via NYS ELAP Method 198.4

Sample ID	Description	Appearance	Matrix Material	% Non-Asbestos Fibers	% Asbestos Types	% Total Asbestos
057B *142304959-0127* HA: 049	Hanger 4 Admin Area - Lt. Gray Window Caulk from West Interior Windows	Brown/Gray/White Non-Fibrous Homogeneous	100% Other	None	No Asbestos Detected	None Detected

Analyst(s)
Rhonda McGee (74)

Rhonda McGee, Laboratory Manager
or other Approved Signatory

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Samples analyzed by EMSL Analytical, Inc. Depew, NY NYS ELAP 11606

Initial report from: 10/20/2023 02:10 PM

Appendix IV

EMSL Paint Chip Laboratory Analytical Results, COCs, and Certifications

EMSL Analytical, Inc.
528 Mineola Avenue, Carle Place, NY 11514
Phone/Fax: (516) 997-7251 / (516) 997-7528
http://www.EMSL.com carleplacelab@emsl.com

EMSL Order:	062319961
CustomerID:	CONE53Z
CustomerPO:	12617668
ProjectID:	

Attn: **Dustin Zedaker**
GHD
121 North 20th Street
Richmond, VA 23223

Phone:	(804) 514-6365
Fax:	
Received:	10/18/2023 10:37 AM
Collected:	10/11/2023

Project: **12617668**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3051A/7000B)*

Client Sample Description	*Lab ID*	*Collected*	*Analyzed*	*Lead Concentration*
PC-01	*062319961-0001*	10/11/2023	10/24/2023	0.53 % wt
	Site: Hanger 4 Admin Area Desc: Lt. Blue Paint			
PC-02	*062319961-0002*	10/11/2023	10/24/2023	0.32 % wt
	Site: Hanger 4 Admin Area Desc: Green Paint			
PC-03	*062319961-0003*	10/11/2023	10/24/2023	5.2 % wt
	Site: Hanger 4 Admin Area Desc: Dk Blue Paint			
PC-04	*062319961-0004*	10/11/2023	10/24/2023	0.85 % wt
	Site: Hanger 4 Admin Area Desc: Lt. Green Paint			
PC-05	*062319961-0005*	10/11/2023	10/24/2023	0.29 % wt
	Site: Hanger 4 Admin Area Desc: Crème Paint			
PC-06	*062319961-0006*	10/11/2023	10/24/2023	7.1 % wt
	Site: Hanger 4 Admin Area Desc: Lt. Blue Paint			
PC-07	*062319961-0007*	10/11/2023	10/24/2023	0.20 % wt
	Site: Hanger 4 Admin Area Desc: Dark Grey Paint			
PC-08	*062319961-0008*	10/11/2023	10/24/2023	0.12 % wt
	Site: Hanger 4 Admin Area Desc: Lt. Blue/Lt. Green Paint			
PC-09	*062319961-0009*	10/11/2023	10/24/2023	12 % wt
	Site: Hanger 4 Admin Area Desc: Green Paint			
PC-10	*062319961-0010*	10/11/2023	10/24/2023	1.7 % wt
	Site: Hanger 4 Desc: Lt. Blue Paint			
PC-11	*062319961-0011*	10/11/2023	10/24/2023	1.9 % wt
	Site: Hanger 4 Desc: Dk. Blue Paint			

James Han, Chemistry Laboratory Manager
or other approved signatory

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Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.008% wt. based on the minimum sample weight per our SOP. "<" (less than) result signifies the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. Definitions of modifications are available upon request.

Samples analyzed by EMSL Analytical, Inc. Carle Place, NY AIHA LAP, LLC-ELLAP Accredited #102344, CT PH-0249, NYS ELAP 11469, CA 2339

Initial report from 10/25/2023 09:18:34

EMSL Analytical, Inc.
528 Mineola Avenue, Carle Place, NY 11514
Phone/Fax: (516) 997-7251 / (516) 997-7528
http://www.EMSL.com carleplacelab@emsl.com

EMSL Order:	062319961
CustomerID:	CONE53Z
CustomerPO:	12617668
ProjectID:	

Attn: **Dustin Zedaker**
GHD
121 North 20th Street
Richmond, VA 23223

Phone: (804) 514-6365
Fax:
Received: 10/18/2023 10:37 AM
Collected: 10/11/2023

Project: **12617668**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3051A/7000B)*

Client Sample Description	*Lab ID*	*Collected*	*Analyzed*	*Lead Concentration*
PC-12	*062319961-0012*	10/11/2023	10/24/2023	4.0 % wt
	Site: Hanger 4 Desc: Pink Paint			
PC-13	*062319961-0013*	10/11/2023	10/24/2023	31 % wt
	Site: Hanger 4 Desc: Crème Colored Paint			
PC-14	*062319961-0014*	10/11/2023	10/24/2023	0.22 % wt
	Site: Hanger 4 Desc: Dk. Blue Paint			
PC-15	*062319961-0015*	10/11/2023	10/24/2023	0.32 % wt
	Site: Shooting Range Desc: Yellow Paint			
PC-16	*062319961-0016*	10/11/2023	10/24/2023	0.30 % wt
	Site: Shooting Range Desc: Grey Paint			
PC-17	*062319961-0017*	10/11/2023	10/24/2023	0.84 % wt
	Site: Shooting Range Desc: Crème Paint			
PC-18	*062319961-0018*	10/11/2023	10/24/2023	5.2 % wt
	Site: Shooting Range Desc: Dk. Green Paint			
PC-19	*062319961-0019*	10/11/2023	10/24/2023	0.83 % wt
	Site: Shooting Range Desc: Yellow Paint			
PC-20	*062319961-0020*	10/11/2023	10/24/2023	1.3 % wt
	Site: Shooting Range Desc: Crème Paint			
PC-21	*062319961-0021*	10/11/2023	10/24/2023	0.74 % wt
	Site: Shooting Range Desc: Dk. Brown Paint			
PC-22	*062319961-0022*	10/11/2023	10/24/2023	4.0 % wt
	Site: Shooting Range Desc: Dk. Grey Paint			

James Han, Chemistry Laboratory Manager
or other approved signatory

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Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.008% wt. based on the minimum sample weight per our SOP. "<" (less than) result signifies the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. Definitions of modifications are available upon request.

Samples analyzed by EMSL Analytical, Inc. Carle Place, NY AIHA LAP, LLC-ELLAP Accredited #102344, CT PH-0249, NYS ELAP 11469, CA 2339

Initial report from 10/25/2023 09:18:34

EMSL Analytical, Inc.
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Phone/Fax: (516) 997-7251 / (516) 997-7528
http://www.EMSL.com carleplacelab@emsl.com

EMSL Order:	062319961
CustomerID:	CONE53Z
CustomerPO:	12617668
ProjectID:	

Attn: **Dustin Zedaker**
GHD
121 North 20th Street
Richmond, VA 23223

Phone: (804) 514-6365
Fax:
Received: 10/18/2023 10:37 AM
Collected: 10/11/2023

Project: **12617668**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3051A/7000B)*

Client Sample Description	*Lab ID*	*Collected*	*Analyzed*	*Lead Concentration*
PC-23	*062319961-0023*	10/11/2023	10/24/2023	11 % wt
	Site: Shooting Range Desc: Black Paint			
PC-24	*062319961-0024*	10/11/2023	10/24/2023	6.7 % wt
	Site: Shooting Range Desc: Lt. Blue Paint			
PC-25	*062319961-0025*	10/11/2023	10/24/2023	2.5 % wt
	Site: Hanger 3 Desc: Lt. Blue Paint			
PC-26	*062319961-0026*	10/11/2023	10/24/2023	23 % wt
	Site: Hanger 3 Desc: Med. Grey Paint			
PC-27	*062319961-0027*	10/11/2023	10/24/2023	37 % wt
	Site: Hanger 3 Desc: White Paint			
PC-28	*062319961-0028*	10/11/2023	10/24/2023	0.054 % wt
	Site: Hanger 3 Admin Area Desc: Crème Paint			
PC-29	*062319961-0029*	10/11/2023	10/24/2023	5.8 % wt
	Site: Hanger 3 Admin Area Desc: Lt. Blue Paint			
PC-30	*062319961-0030*	10/11/2023	10/24/2023	4.7 % wt
	Site: Hanger 3 Admin Area Desc: Dk. Green Paint			
PC-31	*062319961-0031*	10/11/2023	10/24/2023	0.26 % wt
	Site: Hanger 3 Admin Area Desc: Crene Paint			
PC-32	*062319961-0032*	10/11/2023	10/24/2023	0.82 % wt
	Site: Hanger 3 Admin Area Desc: Dk. Blue Paint			
PC-33	*062319961-0033*	10/11/2023	10/24/2023	0.032 % wt
	Site: Hanger 3 Admin Area Desc: Lt. Blue Paint			

James Han, Chemistry Laboratory Manager
or other approved signatory

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Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.008% wt. based on the minimum sample weight per our SOP. "<" (less than) result signifies the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. Definitions of modifications are available upon request.

Samples analyzed by EMSL Analytical, Inc. Carle Place, NY AIHA LAP, LLC-ELLAP Accredited #102344, CT PH-0249, NYS ELAP 11469, CA 2339

Initial report from 10/25/2023 09:18:34

EMSL Analytical, Inc.
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http://www.EMSL.com carleplacelab@emsl.com

EMSL Order:	062319961
CustomerID:	CONE53Z
CustomerPO:	12617668
ProjectID:	

Attn: **Dustin Zedaker**
GHD
121 North 20th Street
Richmond, VA 23223

Phone:	(804) 514-6365
Fax:	
Received:	10/18/2023 10:37 AM
Collected:	10/11/2023

Project: **12617668**

Test Report: Lead in Paint Chips by Flame AAS (SW 846 3051A/7000B)*

Client Sample Description	*Lab ID*	*Collected*	*Analyzed*	*Lead Concentration*
PC-34	*062319961-0034*	10/11/2023	10/24/2023	2.0 % wt
	Site: Boiler Room Desc: Dk. Grey Paint			
PC-35	*062319961-0035*	10/11/2023	10/24/2023	0.62 % wt
	Site: Boiler Room Desc: Black Paint			
PC-36	*062319961-0036*	10/11/2023	10/24/2023	21 % wt
	Site: Boiler Room Desc: Lt. Grey Paint			

James Han, Chemistry Laboratory Manager
or other approved signatory

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Analysis following Lead in Paint by EMSL SOP/Determination of Environmental Lead by FLAA. Reporting limit is 0.008% wt. based on the minimum sample weight per our SOP. "<" (less than) result signifies the analyte was not detected at or above the reporting limit. Measurement of uncertainty is available upon request. Definitions of modifications are available upon request.

Samples analyzed by EMSL Analytical, Inc. Carle Place, NY AIHA LAP, LLC-ELLAP Accredited #102344, CT PH-0249, NYS ELAP 11469, CA 2339

Initial report from 10/25/2023 09:18:34

EMSL Analytical, Inc.

200 Route 130, Cinnaminson, NJ, 08077
Telephone: 856-858-4800 Fax:856-786-5974
EMSL-CIN-01

EMSL Order ID: 012410700
LIMS Reference ID: AC10700
EMSL Customer ID: CONE53Z

Attention: Dustin Zedaker
GHD [CONE53Z]
121 North 20th Street
Richmond, VA 23223
(804) 514-6365
dustin.zedaker@ghd.com

Project Name: Floyd Bennett Field / 12617668

Customer PO:
EMSL Sales Rep: Jeromy Bish
Received: 03/14/2024 09:00
Reported: 03/18/2024 18:52

Analytical Results

Analyte	Results	RL	Weight(g)	Prep Date & Tech	Prep Method	Analysis Date & Analyst	Analytical Method	Q	DF
Client Sample ID: KW - 01/Hanger Four Above Bay Door								**Date Sampled: 03/13/24**	
Matrix: Chips								**LIMS Reference ID: AC10700-01**	
Lead	4.8 % wt	0.35 % wt	0.2869	03/15/24 NP2	SW-846 3050B	03/15/24 PMx	SW846-7000B	D	50
Sample Comments:									
Client Sample ID: KW - 02/Hanger Four NYC Sign								**Date Sampled: 03/13/24**	
Matrix: Chips								**LIMS Reference ID: AC10700-02**	
Lead	9.7 % wt	0.77 % wt	0.2597	03/15/24 NP2	SW-846 3050B	03/15/24 PMx	SW846-7000B	D	100
Sample Comments:									
Client Sample ID: KW - 03/Hanger Three above Bay Door								**Date Sampled: 03/13/24**	
Matrix: Chips								**LIMS Reference ID: AC10700-03**	
Lead	6.4 % wt	0.38 % wt	0.263	03/15/24 NP2	SW-846 3050B	03/15/24 PMx	SW846-7000B	D	50
Sample Comments:									
Client Sample ID: KW - 04/Hanger Three Cat Walk								**Date Sampled: 03/13/24**	
Matrix: Chips								**LIMS Reference ID: AC10700-04**	
Lead	1.8 % wt	0.077 % wt	0.2595	03/15/24 NP2	SW-846 3050B	03/15/24 PMx	SW846-7000B	D	10
Sample Comments:									
Client Sample ID: KW - 05/Hanger Three Cat Walk								**Date Sampled: 03/13/24**	
Matrix: Chips								**LIMS Reference ID: AC10700-05**	
Lead	12 % wt	0.69 % wt	0.29	03/15/24 NP2	SW-846 3050B	03/15/24 PMx	SW846-7000B	Pb2, D	100
Sample Comments:									
Client Sample ID: KW - 06/Hanger Three Cat Walk								**Date Sampled: 03/13/24**	
Matrix: Chips								**LIMS Reference ID: AC10700-06**	
Lead	0.44 % wt	0.039 % wt	0.2567	03/15/24 NP2	SW-846 3050B	03/18/24 PMx	SW846-7000B	Pb4, D	5
Sample Comments:									
Client Sample ID: KW - 07/Boiler Room								**Date Sampled: 03/13/24**	
Matrix: Chips								**LIMS Reference ID: AC10700-07**	
Lead	0.26 % wt	0.008 % wt	0.257	03/15/24 NP2	SW-846 3050B	03/15/24 PMx	SW846-7000B		1
Sample Comments:									
Client Sample ID: KW - 08/Boiler Room								**Date Sampled: 03/13/24**	
Matrix: Chips								**LIMS Reference ID: AC10700-08**	
Lead	0.93 % wt	0.038 % wt	0.261	03/15/24 NP2	SW-846 3050B	03/15/24 PMx	SW846-7000B	D	5
Sample Comments:									
Client Sample ID: KW - 09/Boiler Room Green Mechanical								**Date Sampled: 03/13/24**	
Matrix: Chips								**LIMS Reference ID: AC10700-09**	
Lead	5.7 % wt	0.38 % wt	0.2618	03/15/24 NP2	SW-846 3050B	03/15/24 PMx	SW846-7000B	D	50
Sample Comments:									
Client Sample ID: KW - 10/Hanger Three Door / Inside								**Date Sampled: 03/13/24**	

EMSL Analytical, Inc.

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Telephone: 856-858-4800 Fax:856-786-5974
EMSL-CIN-01

EMSL Order ID: 012410700
LIMS Reference ID: AC10700
EMSL Customer ID: CONE53Z

Attention: Dustin Zedaker
GHD [CONE53Z]
121 North 20th Street
Richmond, VA 23223
(804) 514-6365
dustin.zedaker@ghd.com

Project Name: Floyd Bennett Field / 12617668

Customer PO:
EMSL Sales Rep: Jeromy Bish
Received: 03/14/2024 09:00
Reported: 03/18/2024 18:52

Analytical Results
(Continued)

Analyte	Results	RL	Weight(g)	Prep Date & Tech	Prep Method	Analysis Date & Analyst	Analytical Method	Q	DF
Client Sample ID: KW - 10/Hanger Three Door / Inside									**Date Sampled: 03/13/24**
Matrix: Chips									**LIMS Reference ID: AC10700-10**
Lead	0.73 % wt	0.036 % wt	0.2749	03/15/24 NP2	SW-846 3050B	03/15/24 PMx	SW846-7000B	D	5
	Sample Comments:								
Client Sample ID: KW - 11/Hanger Four Door / Inside									**Date Sampled: 03/13/24**
Matrix: Chips									**LIMS Reference ID: AC10700-11**
Lead	0.24 % wt	0.008 % wt	0.2647	03/15/24 NP2	SW-846 3050B	03/15/24 PMx	SW846-7000B		1
	Sample Comments:								

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EMSL Order ID: 012410700
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dustin.zedaker@ghd.com

Project Name: Floyd Bennett Field / 12617668

Customer PO:
EMSL Sales Rep: Jeromy Bish
Received: 03/14/2024 09:00
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Certified Analyses included in this Report

Analyte	Certifications
SW846-7000B in Chips	
Lead	AIHA LAP

List of Certifications

Code	Description	Number	Expires
NJDEP	New Jersey Department of Environmental Protection	03036	06/30/2024
AIHA LAP	EMSL Analytical, Inc. Cinnaminson, NJ AIHA-LAP, LLC-ELLAP Accredited	100194	01/01/2025
NYSDOH	New York State Department of Health	10872	04/01/2024
California ELAP	California Water Boards	1877	06/30/2024
A2LA	A2LA Environmental Certificate	2845.01	07/31/2024
PADEP	Pennsylvania Department of Environmental Protection	68-00367	11/30/2024
MADEP	Massachusetts Department of Environmental Protection	M-NJ337	06/30/2024
CTDPH	Connecticut Department of Public Health	PH-0270	06/23/2024

Please see the specific Field of Testing (FOT) on www.emsl.com <http://www.emsl.com> for a complete listing of parameters for which EMSL is certified.

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Notes and Definitions

Item	Definition
D	Analyte was reported from a dilution run.
Pb2	The MS recovery for Lead was outside of the method control limits due to matrix bias.
Pb4	The QC sample duplicate RPD and MS recovery result for Lead was outside of the method control limits.
(Dig)	For metals analysis, sample was digested.
[2C]	Reported from the second channel in dual column analysis.
DF	Dilution Factor
MDL	Method Detection Limit.
ND	Analyte was NOT DETECTED at or above the detection limit.
Q	Qualifier
RL	Reporting Limit

For paint chips, the RL is 0.008% by wt. (equiv. to 80 mg/kg, or ppm) based upon a minimum sample weight of 0.25 grams.

For soils, the RL is 40 mg/kg (ppm) based upon a minimum sample weight of 0.5 grams.

For dust wipes, the RL is 10 µg/wipe; reporting units of µg/sq. ft. are not validated by the lab based upon data provided by non-lab personnel.

Measurement of uncertainty and any applicable definitions of method modifications are available upon request. Per EPA NLLAP policy, sample results are not blank corrected.

Owen McKenna Laboratory Manager or other approved signatory

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Analysis following EMSL SOP for the Determination of Environmental Lead by FLAA. The laboratory has a reporting limit of 0.008% by wt., based upon a minimum sample weight of 0.25g submitted to the lab, and is not responsible for any result or reporting limit provided in mg/cm2 since it is dependent upon an area value provided by non-lab personnel. A "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty and definitions of modifications are available upon request. Results in this report are not blank corrected unless specified.

EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

Lead Chain of Custody

EMSL Order Number / Lab Use Only: AC10700

EMSL Analytical, Inc.
200 Route 130 North
Cinnaminson, NJ 08077
PHONE: 1-800-220-3675
EMAIL: c@emsl.com

Customer Information

Customer ID:	
Company Name:	GHD
Contact Name:	Dustin Zedaker
Street Address:	121 North 20th Street
City, State, Zip:	Richmond VA 23223 Country: US
Phone:	804-53174461
Email(s) for Report:	dustin.zedaker@ghd.com

Billing Information

Billing ID:	
Company Name:	GHD Inc.
Billing Contact:	Dustin Zedaker
Street Address:	2055 Niagara Falls Blvd., Suite 3
City, State, Zip:	Niagara Falls NY 14304 Country: US
Phone:	716-297-2160
Email(s) for Invoice:	

Project Information

Project Name/No: Floyd Bennett Field / 12617668
Purchase Order:
EMSL LIMS Project ID: (If applicable, EMSL will provide)
US State where samples collected: NY
State of Connecticut (CT) must select project location: ☐ Commercial (Taxable) ☐ Residential (Non-Taxable)
Sampled By Name: Kyle Walters
Sampled By Signature: [signature]
No. of Samples in Shipment: 11

Turn-Around-Time (TAT)

☐ 3 Hour ☐ 6 Hour ☐ 24 Hour ☐ 32 Hour ☐ 48 Hour ☒ 72 Hour ☐ 96 Hour ☐ 1 Week ☐ 2 Week

Please call ahead for large projects and/or turnaround times 6 Hours or Less. *32 Hour TAT available for select tests only; samples must be submitted by 11:30am.

MATRIX	METHOD	INSTRUMENT	REPORTING LIMIT	SELECTION
CHIPS ☒ % by wt. ☐ ppm (mg/kg) ☐ mg/cm²	SW 846-7000B	Flame Atomic Absorption	0.008% (80ppm)	☒
*Reporting Limit based on a minimum 0.25g sample weight	SW 846-6010D*	ICP-OES	0.0004% (4ppm)	☐
AIR	NIOSH 7082	Flame Atomic Absorption	4µg/filter	☐
	NIOSH 7300M / NIOSH 7303M	ICP-OES	0.5µg/filter	☐
	NIOSH 7300M / NIOSH 7303M	ICP-MS	0.05µg/filter	☐
WIPE ☐ ASTM ☐ NON-ASTM	SW 846-7000B	Flame Atomic Absorption	10µg/wipe	☐
*If no box is checked, non-ASTM Wipe is assumed	SW 846-6010D*	ICP-OES	1.0µg/wipe	☐
TCLP	SW 846-1311 / 7000B / SM 3111B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	SW 846-1311 / SW 846-6010D*	ICP-OES	0.1 mg/L (ppm)	☐
SPLP	SW 846-1312 / 7000B / SM 3111B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	SW 846-1312 / SW 846-6010D*	ICP-OES	0.1 mg/L (ppm)	☐
TTLC	22 CCR App. II, 7000B	Flame Atomic Absorption	40mg/kg (ppm)	☐
	22 CCR App. II, SW 846-6010D*	ICP-OES	2mg/kg (ppm)	☐
STLC	22 CCR App. II, 7000B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	22 CCR App. II, SW 846-6010D*	ICP-OES	0.1 mg/L (ppm)	☐
Soil	SW 846-7000B	Flame Atomic Absorption	40mg/kg (ppm)	☐
	SW 846-6010D*	ICP-OES	2mg/kg (ppm)	☐
Wastewater Unpreserved ☐ Preserved with HNO3 ☐ PH<2	SM 3111B / SW 846-7000B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	EPA 200.7	ICP-OES	0.020 mg/L (ppm)	☐
Drinking Water Unpreserved ☐ Preserved with HNO3 ☐ PH<2	EPA 200.5	ICP-OES	0.003 mg/L (ppm)	☐
	EPA 200.8	ICP-MS	0.001 mg/L (ppm)	☐
TSP/SPM Filter	40 CFR Part 50	ICP-OES	12 µg/filter	☐
Other:				☐

Sample Number	Sample Location	Volume / Area	Date / Time Sampled
HW-01	Hanger Four Above Bay Door		3/13/24 9:00
02	Hanger Four NYC Sign		9:05
03	Hanger Three Above Bay Door		9:20
04	Hanger Three Cat Walk		9:30
05	Hanger Three Cat Walk		9:35

Method of Shipment:
Sample Condition Upon Receipt: ES 3-14 9am

Relinquished by: [signature]	Date/Time: 3/13/24	Received by: [signature]	Date/Time 3/13/24 3:18PM
Relinquished by:	Date/Time:	Received by: CPcr 3/13/24	Date/Time 5pm

Controlled Document - COC-25 Lead R16 4/19/2021

*6010C Available Upon Request

☐ **AGREE TO ELECTRONIC SIGNATURE** (By checking, I consent to signing this Chain of Custody document by electronic signature.)

EMSL Analytical, Inc.'s Laboratory Terms and Conditions are incorporated into this Chain of Custody by reference in their entirety. Submission of samples to EMSL Analytical, Inc. constitutes acceptance and acknowledgment of all terms and conditions by Customer.

EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

Lead Chain of Custody

EMSL Order Number / Lab Use Only

AC10700

EMSL Analytical, Inc.
200 Route 130 North

Cinnaminson, NJ 08077
PHONE: 1-800-220-3675
EMAIL: c@emsl.com

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information

Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

Sample Number	Sample Location	Volume / Area	Date / Time Sampled
06	Hanger Three Catwalk		3/13/24 9:40
07	Boiler Room		10:00
08	Boiler Room		10:05
09	Boiler Room Green Mechanical		10:10
10	Hanger three door (Inside)		10:30
11	Hanger four door (Inside)		10:40

Method of Shipment:		Sample Condition Upon Receipt:	
Relinquished by:	Date/Time:	Received by:	Date/Time
Relinquished by:	Date/Time:	Received by:	Date/Time

Controlled Document - COC-25 Lead R16 4/19/2021

☐ AGREE TO ELECTRONIC SIGNATURE (By checking, I consent to signing this Chain of Custody document by electronic signature.)

EMSL Analytical, Inc.'s Laboratory Terms and Conditions are incorporated into this Chain of Custody by reference in their entirety. Submission of samples to EMSL Analytical, Inc. constitutes acceptance and acknowledgment of all terms and conditions by Customer.

Appendix V

Test America PCB Laboratory Analytical Results, COC's, and Certifications

eurofins | Environment Testing

ANALYTICAL REPORT

PREPARED FOR

Attn: Dustin Zedaker
GHD Services Inc.
121 North 20th Street Ste A
Richmond, Virginia 23223

Generated 10/27/2023 4:27:34 PM

JOB DESCRIPTION

PCB Testing - NPS

JOB NUMBER

680-241772-1

Eurofins Savannah
5102 LaRoche Avenue
Savannah GA 31404

See page two for job notes and contact information.

my EOL

Eurofins Savannah

Job Notes

This report may not be reproduced except in full, and with written approval from the laboratory. The results relate only to the samples tested. For questions please contact the Project Manager at the e-mail address or telephone number listed on this page.

The test results in this report relate only to the samples as received by the laboratory and will meet all requirements of the methodology, with any exceptions noted. This report shall not be reproduced except in full, without the express written approval of the laboratory. All questions should be directed to the Eurofins Environment Testing Southeast, LLC Project Manager.

Authorization

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Authorized for release by
John Andros, Project Manager I
John.Andros@et.eurofinsus.com
(404)944-4744

Definitions/Glossary

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Qualifiers

GC Semi VOA

Qualifier	Qualifier Description
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
p	The %RPD between the primary and confirmation column/detector is >40%. The lower value has been reported.
S1-	Surrogate recovery exceeds control limits, low biased.
S1+	Surrogate recovery exceeds control limits, high biased.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

Sample Summary

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
680-241772-1	S-12617668-101023-SM-001	Solid	10/10/23 13:10	10/14/23 09:58
680-241772-2	S-12617668-101023-SM-002	Solid	10/10/23 13:40	10/14/23 09:58
680-241772-3	S-12617668-101023-SM-003	Solid	10/10/23 14:25	10/14/23 09:58
680-241772-4	S-12617668-101023-SM-004	Solid	10/10/23 14:40	10/14/23 09:58
680-241772-5	S-12617668-101123-SM-005	Solid	10/11/23 09:35	10/14/23 09:58
680-241772-6	S-12617668-101123-SM-006	Solid	10/11/23 09:55	10/14/23 09:58
680-241772-7	S-12617668-101123-SM-007	Solid	10/11/23 10:10	10/14/23 09:58
680-241772-8	S-12617668-101123-SM-008	Solid	10/11/23 10:25	10/14/23 09:58
680-241772-9	S-12617668-101123-SM-009	Solid	10/11/23 10:45	10/14/23 09:58
680-241772-10	S-12617668-101123-SM-010	Solid	10/11/23 10:55	10/14/23 09:58
680-241772-11	S-12617668-101123-SM-011	Solid	10/11/23 11:30	10/14/23 09:58
680-241772-12	S-12617668-101123-SM-012	Solid	10/11/23 12:55	10/14/23 09:58
680-241772-13	S-12617668-101123-SM-013	Solid	10/11/23 13:25	10/14/23 09:58
680-241772-14	S-12617668-101123-SM-014	Solid	10/11/23 15:25	10/14/23 09:58

Job ID: 680-241772-1

Laboratory: Eurofins Savannah

Narrative

Job Narrative
680-241772-1

Receipt
The samples were received on 10/14/2023 9:58 AM. Unless otherwise noted below, the samples arrived in good condition, and, where required, properly preserved and on ice. The temperature of the cooler at receipt time was 10.4°C

PCBs
Method 8082A: Due to the matrix, the initial volume(s) used for the following samples deviated from the standard procedure: S-12617668-101023-SM-003 (680-241772-3), S-12617668-101023-SM-004 (680-241772-4), S-12617668-101123-SM-005 (680-241772-5), S-12617668-101123-SM-006 (680-241772-6), S-12617668-101123-SM-007 (680-241772-7), S-12617668-101123-SM-008 (680-241772-8), S-12617668-101123-SM-009 (680-241772-9), S-12617668-101123-SM-011 (680-241772-11), S-12617668-101123-SM-012 (680-241772-12), S-12617668-101123-SM-013 (680-241772-13) and S-12617668-101123-SM-014 (680-241772-14). The reporting limits (RLs) have been adjusted proportionately.

Method 8082A: Due to the matrix, the initial volume(s) used for the following samples deviated from the standard procedure: S-12617668-101023-SM-001 (680-241772-1), S-12617668-101023-SM-002 (680-241772-2), S-12617668-101123-SM-010 (680-241772-10), (680-241772-A-10-A MS) and (680-241772-A-10-B MSD). The reporting limits (RLs) have been adjusted proportionately.

Method 8082A: The following samples were diluted due to the nature of the sample matrix: S-12617668-101023-SM-001 (680-241772-1), S-12617668-101023-SM-002 (680-241772-2), S-12617668-101123-SM-010 (680-241772-10), (680-241772-A-10-A MS) and (680-241772-A-10-B MSD). As such, surrogate recoveries are below the calibration range or are not reported, and elevated reporting limits (RLs) are provided.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

General Chemistry
No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

Client Sample Results

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Client Sample ID: S-12617668-101023-SM-001

Lab Sample ID: 680-241772-1

Date Collected: 10/10/23 13:10
Date Received: 10/14/23 09:58

Matrix: Solid
Percent Solids: 97.4

Method: SW846 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	<49000		160000	49000	ug/Kg	☼	10/25/23 15:45	10/27/23 11:54	1000
PCB-1221	<49000		160000	49000	ug/Kg	☼	10/25/23 15:45	10/27/23 11:54	1000
PCB-1232	<49000		160000	49000	ug/Kg	☼	10/25/23 15:45	10/27/23 11:54	1000
PCB-1242	<49000		160000	49000	ug/Kg	☼	10/25/23 15:45	10/27/23 11:54	1000
PCB-1248	<49000		160000	49000	ug/Kg	☼	10/25/23 15:45	10/27/23 11:54	1000
PCB-1254	<60000		160000	60000	ug/Kg	☼	10/25/23 15:45	10/27/23 11:54	1000
PCB-1260	<60000		160000	60000	ug/Kg	☼	10/25/23 15:45	10/27/23 11:54	1000

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*0*	*S1-*	*66 - 130*	*10/25/23 15:45*	*10/27/23 11:54*	*1000*
DCB Decachlorobiphenyl (Surr)	*0*	*S1-*	*66 - 130*	*10/25/23 15:45*	*10/27/23 11:54*	*1000*
Tetrachloro-m-xylene	*607*	*S1+*	*68 - 130*	*10/25/23 15:45*	*10/27/23 11:54*	*1000*
Tetrachloro-m-xylene	*696*	*S1+*	*68 - 130*	*10/25/23 15:45*	*10/27/23 11:54*	*1000*

Client Sample Results

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Client Sample ID: S-12617668-101023-SM-002

Lab Sample ID: 680-241772-2

Date Collected: 10/10/23 13:40
Date Received: 10/14/23 09:58

Matrix: Solid
Percent Solids: 97.1

Method: SW846 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	<210000		670000	210000	ug/Kg	☼	10/25/23 15:45	10/27/23 12:06	4000
PCB-1221	<210000		670000	210000	ug/Kg	☼	10/25/23 15:45	10/27/23 12:06	4000
PCB-1232	<210000		670000	210000	ug/Kg	☼	10/25/23 15:45	10/27/23 12:06	4000
PCB-1242	<210000		670000	210000	ug/Kg	☼	10/25/23 15:45	10/27/23 12:06	4000
PCB-1248	<210000		670000	210000	ug/Kg	☼	10/25/23 15:45	10/27/23 12:06	4000
PCB-1254	<250000		670000	250000	ug/Kg	☼	10/25/23 15:45	10/27/23 12:06	4000
PCB-1260	<250000		670000	250000	ug/Kg	☼	10/25/23 15:45	10/27/23 12:06	4000

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*0*	*S1-*	*66 - 130*	*10/25/23 15:45*	*10/27/23 12:06*	*4000*
DCB Decachlorobiphenyl (Surr)	*0*	*S1-*	*66 - 130*	*10/25/23 15:45*	*10/27/23 12:06*	*4000*
Tetrachloro-m-xylene	*2826*	*S1+*	*68 - 130*	*10/25/23 15:45*	*10/27/23 12:06*	*4000*
Tetrachloro-m-xylene	*3087*	*S1+*	*68 - 130*	*10/25/23 15:45*	*10/27/23 12:06*	*4000*

Client Sample Results

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Client Sample ID: S-12617668-101023-SM-003

Lab Sample ID: 680-241772-3

Date Collected: 10/10/23 14:25
Date Received: 10/14/23 09:58

Matrix: Solid
Percent Solids: 98.9

Method: SW846 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	<110		340	110	ug/Kg	☼	10/25/23 15:45	10/26/23 12:33	2
PCB-1221	<110		340	110	ug/Kg	☼	10/25/23 15:45	10/26/23 12:33	2
PCB-1232	<110		340	110	ug/Kg	☼	10/25/23 15:45	10/26/23 12:33	2
PCB-1242	<110		340	110	ug/Kg	☼	10/25/23 15:45	10/26/23 12:33	2
PCB-1248	<110		340	110	ug/Kg	☼	10/25/23 15:45	10/26/23 12:33	2
PCB-1254	<130		340	130	ug/Kg	☼	10/25/23 15:45	10/26/23 12:33	2
PCB-1260	<130		340	130	ug/Kg	☼	10/25/23 15:45	10/26/23 12:33	2

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*82*		*66 - 130*	*10/25/23 15:45*	*10/26/23 12:33*	*2*
DCB Decachlorobiphenyl (Surr)	*73*		*66 - 130*	*10/25/23 15:45*	*10/26/23 12:33*	*2*
Tetrachloro-m-xylene	*96*		*68 - 130*	*10/25/23 15:45*	*10/26/23 12:33*	*2*
Tetrachloro-m-xylene	*99*		*68 - 130*	*10/25/23 15:45*	*10/26/23 12:33*	*2*

Client Sample Results

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Client Sample ID: S-12617668-101023-SM-004

Lab Sample ID: 680-241772-4

Date Collected: 10/10/23 14:40
Date Received: 10/14/23 09:58

Matrix: Solid
Percent Solids: 99.4

Method: SW846 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	<51		160	51	ug/Kg	☼	10/25/23 15:45	10/26/23 12:45	1
PCB-1221	<51		160	51	ug/Kg	☼	10/25/23 15:45	10/26/23 12:45	1
PCB-1232	<51		160	51	ug/Kg	☼	10/25/23 15:45	10/26/23 12:45	1
PCB-1242	<51		160	51	ug/Kg	☼	10/25/23 15:45	10/26/23 12:45	1
PCB-1248	**120**	**J**	160	51	ug/Kg	☼	10/25/23 15:45	10/26/23 12:45	1
PCB-1254	<61		160	61	ug/Kg	☼	10/25/23 15:45	10/26/23 12:45	1
PCB-1260	<61		160	61	ug/Kg	☼	10/25/23 15:45	10/26/23 12:45	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*54*	*S1-*	*66 - 130*	*10/25/23 15:45*	*10/26/23 12:45*	*1*
DCB Decachlorobiphenyl (Surr)	*69*		*66 - 130*	*10/25/23 15:45*	*10/26/23 12:45*	*1*
Tetrachloro-m-xylene	*80*		*68 - 130*	*10/25/23 15:45*	*10/26/23 12:45*	*1*
Tetrachloro-m-xylene	*77*		*68 - 130*	*10/25/23 15:45*	*10/26/23 12:45*	*1*

Client Sample Results

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Client Sample ID: S-12617668-101123-SM-005

Lab Sample ID: 680-241772-5

Date Collected: 10/11/23 09:35
Date Received: 10/14/23 09:58

Matrix: Solid
Percent Solids: 98.8

Method: SW846 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	<49		160	49	ug/Kg	☼	10/25/23 15:45	10/26/23 12:57	1
PCB-1221	<49		160	49	ug/Kg	☼	10/25/23 15:45	10/26/23 12:57	1
PCB-1232	<49		160	49	ug/Kg	☼	10/25/23 15:45	10/26/23 12:57	1
PCB-1242	<49		160	49	ug/Kg	☼	10/25/23 15:45	10/26/23 12:57	1
PCB-1248	<49		160	49	ug/Kg	☼	10/25/23 15:45	10/26/23 12:57	1
PCB-1254	<59		160	59	ug/Kg	☼	10/25/23 15:45	10/26/23 12:57	1
PCB-1260	<59		160	59	ug/Kg	☼	10/25/23 15:45	10/26/23 12:57	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*64*	*S1-*	*66 - 130*	*10/25/23 15:45*	*10/26/23 12:57*	*1*
DCB Decachlorobiphenyl (Surr)	*68*		*66 - 130*	*10/25/23 15:45*	*10/26/23 12:57*	*1*
Tetrachloro-m-xylene	*94*		*68 - 130*	*10/25/23 15:45*	*10/26/23 12:57*	*1*
Tetrachloro-m-xylene	*78*		*68 - 130*	*10/25/23 15:45*	*10/26/23 12:57*	*1*

Client Sample Results

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Client Sample ID: S-12617668-101123-SM-006

Lab Sample ID: 680-241772-6

Date Collected: 10/11/23 09:55
Date Received: 10/14/23 09:58

Matrix: Solid
Percent Solids: 98.9

Method: SW846 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	<47		150	47	ug/Kg	☼	10/25/23 15:45	10/26/23 13:09	1
PCB-1221	<47		150	47	ug/Kg	☼	10/25/23 15:45	10/26/23 13:09	1
PCB-1232	<47		150	47	ug/Kg	☼	10/25/23 15:45	10/26/23 13:09	1
PCB-1242	<47		150	47	ug/Kg	☼	10/25/23 15:45	10/26/23 13:09	1
PCB-1248	<47		150	47	ug/Kg	☼	10/25/23 15:45	10/26/23 13:09	1
PCB-1254	<56		150	56	ug/Kg	☼	10/25/23 15:45	10/26/23 13:09	1
PCB-1260	<56		150	56	ug/Kg	☼	10/25/23 15:45	10/26/23 13:09	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*82*		*66 - 130*	*10/25/23 15:45*	*10/26/23 13:09*	*1*
DCB Decachlorobiphenyl (Surr)	*79*		*66 - 130*	*10/25/23 15:45*	*10/26/23 13:09*	*1*
Tetrachloro-m-xylene	*99*		*68 - 130*	*10/25/23 15:45*	*10/26/23 13:09*	*1*
Tetrachloro-m-xylene	*90*		*68 - 130*	*10/25/23 15:45*	*10/26/23 13:09*	*1*

Client Sample Results

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Client Sample ID: S-12617668-101123-SM-007

Lab Sample ID: 680-241772-7

Date Collected: 10/11/23 10:10
Date Received: 10/14/23 09:58

Matrix: Solid
Percent Solids: 98.7

Method: SW846 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	<50		160	50	ug/Kg	☼	10/25/23 15:45	10/26/23 13:20	1
PCB-1221	<50		160	50	ug/Kg	☼	10/25/23 15:45	10/26/23 13:20	1
PCB-1232	<50		160	50	ug/Kg	☼	10/25/23 15:45	10/26/23 13:20	1
PCB-1242	<50		160	50	ug/Kg	☼	10/25/23 15:45	10/26/23 13:20	1
PCB-1248	<50		160	50	ug/Kg	☼	10/25/23 15:45	10/26/23 13:20	1
PCB-1254	<60		160	60	ug/Kg	☼	10/25/23 15:45	10/26/23 13:20	1
PCB-1260	<60		160	60	ug/Kg	☼	10/25/23 15:45	10/26/23 13:20	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*87*		*66 - 130*	*10/25/23 15:45*	*10/26/23 13:20*	*1*
DCB Decachlorobiphenyl (Surr)	*86*		*66 - 130*	*10/25/23 15:45*	*10/26/23 13:20*	*1*
Tetrachloro-m-xylene	*92*		*68 - 130*	*10/25/23 15:45*	*10/26/23 13:20*	*1*
Tetrachloro-m-xylene	*91*		*68 - 130*	*10/25/23 15:45*	*10/26/23 13:20*	*1*

Client Sample Results

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Client Sample ID: S-12617668-101123-SM-008

Lab Sample ID: 680-241772-8

Date Collected: 10/11/23 10:25
Date Received: 10/14/23 09:58

Matrix: Solid
Percent Solids: 99.1

Method: SW846 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	<50		160	50	ug/Kg	☼	10/25/23 15:45	10/26/23 13:32	1
PCB-1221	<50		160	50	ug/Kg	☼	10/25/23 15:45	10/26/23 13:32	1
PCB-1232	<50		160	50	ug/Kg	☼	10/25/23 15:45	10/26/23 13:32	1
PCB-1242	<50		160	50	ug/Kg	☼	10/25/23 15:45	10/26/23 13:32	1
PCB-1248	<50		160	50	ug/Kg	☼	10/25/23 15:45	10/26/23 13:32	1
PCB-1254	<61		160	61	ug/Kg	☼	10/25/23 15:45	10/26/23 13:32	1
PCB-1260	<61		160	61	ug/Kg	☼	10/25/23 15:45	10/26/23 13:32	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*94*		*66 - 130*	*10/25/23 15:45*	*10/26/23 13:32*	*1*
DCB Decachlorobiphenyl (Surr)	*96*		*66 - 130*	*10/25/23 15:45*	*10/26/23 13:32*	*1*
Tetrachloro-m-xylene	*98*		*68 - 130*	*10/25/23 15:45*	*10/26/23 13:32*	*1*
Tetrachloro-m-xylene	*95*		*68 - 130*	*10/25/23 15:45*	*10/26/23 13:32*	*1*

Client Sample Results

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Client Sample ID: S-12617668-101123-SM-009

Lab Sample ID: 680-241772-9

Date Collected: 10/11/23 10:45
Date Received: 10/14/23 09:58

Matrix: Solid
Percent Solids: 99.3

Method: SW846 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	<53		170	53	ug/Kg	☼	10/25/23 15:45	10/26/23 13:44	1
PCB-1221	<53		170	53	ug/Kg	☼	10/25/23 15:45	10/26/23 13:44	1
PCB-1232	<53		170	53	ug/Kg	☼	10/25/23 15:45	10/26/23 13:44	1
PCB-1242	<53		170	53	ug/Kg	☼	10/25/23 15:45	10/26/23 13:44	1
PCB-1248	<53		170	53	ug/Kg	☼	10/25/23 15:45	10/26/23 13:44	1
PCB-1254	<64		170	64	ug/Kg	☼	10/25/23 15:45	10/26/23 13:44	1
PCB-1260	<64		170	64	ug/Kg	☼	10/25/23 15:45	10/26/23 13:44	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*95*		*66 - 130*	*10/25/23 15:45*	*10/26/23 13:44*	*1*
DCB Decachlorobiphenyl (Surr)	*98*		*66 - 130*	*10/25/23 15:45*	*10/26/23 13:44*	*1*
Tetrachloro-m-xylene	*91*		*68 - 130*	*10/25/23 15:45*	*10/26/23 13:44*	*1*
Tetrachloro-m-xylene	*92*		*68 - 130*	*10/25/23 15:45*	*10/26/23 13:44*	*1*

Client Sample Results

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Client Sample ID: S-12617668-101123-SM-010

Lab Sample ID: 680-241772-10

Date Collected: 10/11/23 10:55
Date Received: 10/14/23 09:58

Matrix: Solid
Percent Solids: 98.3

Method: SW846 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	<320000		1000000	320000	ug/Kg	☼	10/25/23 15:45	10/27/23 11:42	4000
PCB-1221	<320000		1000000	320000	ug/Kg	☼	10/25/23 15:45	10/27/23 11:42	4000
PCB-1232	<320000		1000000	320000	ug/Kg	☼	10/25/23 15:45	10/27/23 11:42	4000
PCB-1242	<320000		1000000	320000	ug/Kg	☼	10/25/23 15:45	10/27/23 11:42	4000
PCB-1248	<320000		1000000	320000	ug/Kg	☼	10/25/23 15:45	10/27/23 11:42	4000
PCB-1254	<390000		1000000	390000	ug/Kg	☼	10/25/23 15:45	10/27/23 11:42	4000
PCB-1260	<390000		1000000	390000	ug/Kg	☼	10/25/23 15:45	10/27/23 11:42	4000

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*0*	*S1-*	*66 - 130*	*10/25/23 15:45*	*10/27/23 11:42*	*4000*
DCB Decachlorobiphenyl (Surr)	*0*	*S1-*	*66 - 130*	*10/25/23 15:45*	*10/27/23 11:42*	*4000*
Tetrachloro-m-xylene	*2338*	*S1+*	*68 - 130*	*10/25/23 15:45*	*10/27/23 11:42*	*4000*
Tetrachloro-m-xylene	*3095*	*S1+*	*68 - 130*	*10/25/23 15:45*	*10/27/23 11:42*	*4000*

Client Sample Results

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Client Sample ID: S-12617668-101123-SM-011

Lab Sample ID: 680-241772-11

Date Collected: 10/11/23 11:30
Date Received: 10/14/23 09:58

Matrix: Solid
Percent Solids: 99.4

Method: SW846 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	<53		170	53	ug/Kg	☼	10/25/23 15:45	10/26/23 13:56	1
PCB-1221	<53		170	53	ug/Kg	☼	10/25/23 15:45	10/26/23 13:56	1
PCB-1232	<53		170	53	ug/Kg	☼	10/25/23 15:45	10/26/23 13:56	1
PCB-1242	<53		170	53	ug/Kg	☼	10/25/23 15:45	10/26/23 13:56	1
PCB-1248	<53		170	53	ug/Kg	☼	10/25/23 15:45	10/26/23 13:56	1
PCB-1254	<64		170	64	ug/Kg	☼	10/25/23 15:45	10/26/23 13:56	1
PCB-1260	<64		170	64	ug/Kg	☼	10/25/23 15:45	10/26/23 13:56	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*93*		*66 - 130*	*10/25/23 15:45*	*10/26/23 13:56*	*1*
DCB Decachlorobiphenyl (Surr)	*101*		*66 - 130*	*10/25/23 15:45*	*10/26/23 13:56*	*1*
Tetrachloro-m-xylene	*98*		*68 - 130*	*10/25/23 15:45*	*10/26/23 13:56*	*1*
Tetrachloro-m-xylene	*94*		*68 - 130*	*10/25/23 15:45*	*10/26/23 13:56*	*1*

Client Sample Results

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Client Sample ID: S-12617668-101123-SM-012

Lab Sample ID: 680-241772-12

Date Collected: 10/11/23 12:55
Date Received: 10/14/23 09:58

Matrix: Solid
Percent Solids: 98.1

Method: SW846 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	<53		170	53	ug/Kg	☼	10/25/23 15:45	10/26/23 14:08	1
PCB-1221	<53		170	53	ug/Kg	☼	10/25/23 15:45	10/26/23 14:08	1
PCB-1232	<53		170	53	ug/Kg	☼	10/25/23 15:45	10/26/23 14:08	1
PCB-1242	<53		170	53	ug/Kg	☼	10/25/23 15:45	10/26/23 14:08	1
PCB-1248	<53		170	53	ug/Kg	☼	10/25/23 15:45	10/26/23 14:08	1
PCB-1254	<64		170	64	ug/Kg	☼	10/25/23 15:45	10/26/23 14:08	1
PCB-1260	**97**	**J p**	170	64	ug/Kg	☼	10/25/23 15:45	10/26/23 14:08	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*99*		*66 - 130*	*10/25/23 15:45*	*10/26/23 14:08*	*1*
DCB Decachlorobiphenyl (Surr)	*103*		*66 - 130*	*10/25/23 15:45*	*10/26/23 14:08*	*1*
Tetrachloro-m-xylene	*100*		*68 - 130*	*10/25/23 15:45*	*10/26/23 14:08*	*1*
Tetrachloro-m-xylene	*94*		*68 - 130*	*10/25/23 15:45*	*10/26/23 14:08*	*1*

Client Sample Results

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Client Sample ID: S-12617668-101123-SM-013

Lab Sample ID: 680-241772-13

Date Collected: 10/11/23 13:25
Date Received: 10/14/23 09:58

Matrix: Solid
Percent Solids: 98.7

Method: SW846 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	<53		170	53	ug/Kg	☼	10/25/23 15:45	10/26/23 15:07	1
PCB-1221	<53		170	53	ug/Kg	☼	10/25/23 15:45	10/26/23 15:07	1
PCB-1232	<53		170	53	ug/Kg	☼	10/25/23 15:45	10/26/23 15:07	1
PCB-1242	<53		170	53	ug/Kg	☼	10/25/23 15:45	10/26/23 15:07	1
PCB-1248	**83**	**J**	170	53	ug/Kg	☼	10/25/23 15:45	10/26/23 15:07	1
PCB-1254	**86**	**J**	170	64	ug/Kg	☼	10/25/23 15:45	10/26/23 15:07	1
PCB-1260	<64		170	64	ug/Kg	☼	10/25/23 15:45	10/26/23 15:07	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*102*		*66 - 130*	*10/25/23 15:45*	*10/26/23 15:07*	*1*
DCB Decachlorobiphenyl (Surr)	*108*		*66 - 130*	*10/25/23 15:45*	*10/26/23 15:07*	*1*
Tetrachloro-m-xylene	*97*		*68 - 130*	*10/25/23 15:45*	*10/26/23 15:07*	*1*
Tetrachloro-m-xylene	*94*		*68 - 130*	*10/25/23 15:45*	*10/26/23 15:07*	*1*

Client Sample Results

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Client Sample ID: S-12617668-101123-SM-014

Lab Sample ID: 680-241772-14

Date Collected: 10/11/23 15:25
Date Received: 10/14/23 09:58

Matrix: Solid
Percent Solids: 99.1

Method: SW846 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	<46		150	46	ug/Kg	☼	10/25/23 15:45	10/26/23 15:18	1
PCB-1221	<46		150	46	ug/Kg	☼	10/25/23 15:45	10/26/23 15:18	1
PCB-1232	<46		150	46	ug/Kg	☼	10/25/23 15:45	10/26/23 15:18	1
PCB-1242	**300**		150	46	ug/Kg	☼	10/25/23 15:45	10/26/23 15:18	1
PCB-1248	<46		150	46	ug/Kg	☼	10/25/23 15:45	10/26/23 15:18	1
PCB-1254	<56		150	56	ug/Kg	☼	10/25/23 15:45	10/26/23 15:18	1
PCB-1260	<56		150	56	ug/Kg	☼	10/25/23 15:45	10/26/23 15:18	1

Surrogate	*%Recovery*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*97*		*66 - 130*	*10/25/23 15:45*	*10/26/23 15:18*	*1*
DCB Decachlorobiphenyl (Surr)	*102*		*66 - 130*	*10/25/23 15:45*	*10/26/23 15:18*	*1*
Tetrachloro-m-xylene	*90*		*68 - 130*	*10/25/23 15:45*	*10/26/23 15:18*	*1*
Tetrachloro-m-xylene	*90*		*68 - 130*	*10/25/23 15:45*	*10/26/23 15:18*	*1*

QC Sample Results

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Method: 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography

Lab Sample ID: MB 410-435616/1-A — **Client Sample ID: Method Blank**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 435862 — **Prep Batch: 435616**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
PCB-1016	<5.3		17	5.3	ug/Kg		10/25/23 15:45	10/26/23 08:20	1
PCB-1221	<5.3		17	5.3	ug/Kg		10/25/23 15:45	10/26/23 08:20	1
PCB-1232	<5.3		17	5.3	ug/Kg		10/25/23 15:45	10/26/23 08:20	1
PCB-1242	<5.3		17	5.3	ug/Kg		10/25/23 15:45	10/26/23 08:20	1
PCB-1248	<5.3		17	5.3	ug/Kg		10/25/23 15:45	10/26/23 08:20	1
PCB-1254	<6.4		17	6.4	ug/Kg		10/25/23 15:45	10/26/23 08:20	1
PCB-1260	<6.4		17	6.4	ug/Kg		10/25/23 15:45	10/26/23 08:20	1

Surrogate	*MB %Recovery*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
DCB Decachlorobiphenyl (Surr)	*84*		*66 - 130*	*10/25/23 15:45*	*10/26/23 08:20*	*1*
DCB Decachlorobiphenyl (Surr)	*101*		*66 - 130*	*10/25/23 15:45*	*10/26/23 08:20*	*1*
Tetrachloro-m-xylene	*89*		*68 - 130*	*10/25/23 15:45*	*10/26/23 08:20*	*1*
Tetrachloro-m-xylene	*94*		*68 - 130*	*10/25/23 15:45*	*10/26/23 08:20*	*1*

Lab Sample ID: LCS 410-435616/2-A — **Client Sample ID: Lab Control Sample**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 435862 — **Prep Batch: 435616**

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits		
PCB-1016			167	170		ug/Kg		102	68 - 121		
PCB-1260			167	146		ug/Kg		87	75 - 130		

Surrogate	*LCS %Recovery*	*LCS Qualifier*	*Limits*
DCB Decachlorobiphenyl (Surr)	*100*		*66 - 130*
DCB Decachlorobiphenyl (Surr)	*114*		*66 - 130*
Tetrachloro-m-xylene	*96*		*68 - 130*
Tetrachloro-m-xylene	*96*		*68 - 130*

Lab Sample ID: 680-241772-10 MS — **Client Sample ID: S-12617668-101123-SM-010**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 436448 — **Prep Batch: 435616**

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec Limits		
PCB-1016	<320000		2240	<280000		ug/Kg	☼	NC	68 - 121		
PCB-1260	<390000		2240	<340000		ug/Kg	☼	NC	75 - 130		

Surrogate	*MS %Recovery*	*MS Qualifier*	*Limits*
DCB Decachlorobiphenyl (Surr)	*0*	*S1-*	*66 - 130*
DCB Decachlorobiphenyl (Surr)	*0*	*S1-*	*66 - 130*
Tetrachloro-m-xylene	*2928*	*S1+*	*68 - 130*
Tetrachloro-m-xylene	*3096*	*S1+*	*68 - 130*

Lab Sample ID: 680-241772-10 MSD — **Client Sample ID: S-12617668-101123-SM-010**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 436448 — **Prep Batch: 435616**

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
PCB-1016	<320000		2440	<310000		ug/Kg	☼	NC	68 - 121	NC	50

Method: 8082A - Polychlorinated Biphenyls (PCBs) by Gas Chromatography (Continued)

Lab Sample ID: 680-241772-10 MSD
Client Sample ID: S-12617668-101123-SM-010
Matrix: Solid
Prep Type: Total/NA
Analysis Batch: 436448
Prep Batch: 435616

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
PCB-1260	<390000		2440	<370000		ug/Kg	☼	NC	75 - 130	NC	50

Surrogate	*MSD %Recovery*	*MSD Qualifier*	*Limits*
DCB Decachlorobiphenyl (Surr)	*0*	*S1-*	*66 - 130*
DCB Decachlorobiphenyl (Surr)	*0*	*S1-*	*66 - 130*
Tetrachloro-m-xylene	*2429*	*S1+*	*68 - 130*
Tetrachloro-m-xylene	*3148*	*S1+*	*68 - 130*

QC Association Summary

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

GC Semi VOA

Prep Batch: 435616

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
680-241772-1	S-12617668-101023-SM-001	Total/NA	Solid	3546	
680-241772-2	S-12617668-101023-SM-002	Total/NA	Solid	3546	
680-241772-3	S-12617668-101023-SM-003	Total/NA	Solid	3546	
680-241772-4	S-12617668-101023-SM-004	Total/NA	Solid	3546	
680-241772-5	S-12617668-101123-SM-005	Total/NA	Solid	3546	
680-241772-6	S-12617668-101123-SM-006	Total/NA	Solid	3546	
680-241772-7	S-12617668-101123-SM-007	Total/NA	Solid	3546	
680-241772-8	S-12617668-101123-SM-008	Total/NA	Solid	3546	
680-241772-9	S-12617668-101123-SM-009	Total/NA	Solid	3546	
680-241772-10	S-12617668-101123-SM-010	Total/NA	Solid	3546	
680-241772-11	S-12617668-101123-SM-011	Total/NA	Solid	3546	
680-241772-12	S-12617668-101123-SM-012	Total/NA	Solid	3546	
680-241772-13	S-12617668-101123-SM-013	Total/NA	Solid	3546	
680-241772-14	S-12617668-101123-SM-014	Total/NA	Solid	3546	
MB 410-435616/1-A	Method Blank	Total/NA	Solid	3546	
LCS 410-435616/2-A	Lab Control Sample	Total/NA	Solid	3546	
680-241772-10 MS	S-12617668-101123-SM-010	Total/NA	Solid	3546	
680-241772-10 MSD	S-12617668-101123-SM-010	Total/NA	Solid	3546	

Analysis Batch: 435862

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
680-241772-3	S-12617668-101023-SM-003	Total/NA	Solid	8082A	435616
680-241772-4	S-12617668-101023-SM-004	Total/NA	Solid	8082A	435616
680-241772-5	S-12617668-101123-SM-005	Total/NA	Solid	8082A	435616
680-241772-6	S-12617668-101123-SM-006	Total/NA	Solid	8082A	435616
680-241772-7	S-12617668-101123-SM-007	Total/NA	Solid	8082A	435616
680-241772-8	S-12617668-101123-SM-008	Total/NA	Solid	8082A	435616
680-241772-9	S-12617668-101123-SM-009	Total/NA	Solid	8082A	435616
680-241772-11	S-12617668-101123-SM-011	Total/NA	Solid	8082A	435616
680-241772-12	S-12617668-101123-SM-012	Total/NA	Solid	8082A	435616
680-241772-13	S-12617668-101123-SM-013	Total/NA	Solid	8082A	435616
680-241772-14	S-12617668-101123-SM-014	Total/NA	Solid	8082A	435616
MB 410-435616/1-A	Method Blank	Total/NA	Solid	8082A	435616
LCS 410-435616/2-A	Lab Control Sample	Total/NA	Solid	8082A	435616

Analysis Batch: 436448

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
680-241772-1	S-12617668-101023-SM-001	Total/NA	Solid	8082A	435616
680-241772-2	S-12617668-101023-SM-002	Total/NA	Solid	8082A	435616
680-241772-10	S-12617668-101123-SM-010	Total/NA	Solid	8082A	435616
680-241772-10 MS	S-12617668-101123-SM-010	Total/NA	Solid	8082A	435616
680-241772-10 MSD	S-12617668-101123-SM-010	Total/NA	Solid	8082A	435616

General Chemistry

Analysis Batch: 432419

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
680-241772-1	S-12617668-101023-SM-001	Total/NA	Solid	Moisture	
680-241772-2	S-12617668-101023-SM-002	Total/NA	Solid	Moisture	
680-241772-3	S-12617668-101023-SM-003	Total/NA	Solid	Moisture	
680-241772-4	S-12617668-101023-SM-004	Total/NA	Solid	Moisture	

General Chemistry (Continued)

Analysis Batch: 432419 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
680-241772-5	S-12617668-101123-SM-005	Total/NA	Solid	Moisture	
680-241772-6	S-12617668-101123-SM-006	Total/NA	Solid	Moisture	
680-241772-7	S-12617668-101123-SM-007	Total/NA	Solid	Moisture	
680-241772-8	S-12617668-101123-SM-008	Total/NA	Solid	Moisture	
680-241772-9	S-12617668-101123-SM-009	Total/NA	Solid	Moisture	
680-241772-10	S-12617668-101123-SM-010	Total/NA	Solid	Moisture	
680-241772-11	S-12617668-101123-SM-011	Total/NA	Solid	Moisture	
680-241772-12	S-12617668-101123-SM-012	Total/NA	Solid	Moisture	
680-241772-13	S-12617668-101123-SM-013	Total/NA	Solid	Moisture	
680-241772-14	S-12617668-101123-SM-014	Total/NA	Solid	Moisture	

Lab Chronicle

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Client Sample ID: S-12617668-101023-SM-001 — Lab Sample ID: 680-241772-1

Date Collected: 10/10/23 13:10 — **Matrix: Solid**
Date Received: 10/14/23 09:58

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1			432419	10/17/23 19:44	S9WT	ELLE

Instrument ID: NOEQUIP

Client Sample ID: S-12617668-101023-SM-001 — Lab Sample ID: 680-241772-1

Date Collected: 10/10/23 13:10 — **Matrix: Solid**
Date Received: 10/14/23 09:58 — **Percent Solids: 97.4**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3546			3.31 g	10 mL	435616	10/25/23 15:45	ZB3H	ELLE
Total/NA	Analysis	8082A		1000			436448	10/27/23 11:54	A2VL	ELLE

Instrument ID: 19843

Client Sample ID: S-12617668-101023-SM-002 — Lab Sample ID: 680-241772-2

Date Collected: 10/10/23 13:40 — **Matrix: Solid**
Date Received: 10/14/23 09:58

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1			432419	10/17/23 19:44	S9WT	ELLE

Instrument ID: NOEQUIP

Client Sample ID: S-12617668-101023-SM-002 — Lab Sample ID: 680-241772-2

Date Collected: 10/10/23 13:40 — **Matrix: Solid**
Date Received: 10/14/23 09:58 — **Percent Solids: 97.1**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3546			3.13 g	10 mL	435616	10/25/23 15:45	ZB3H	ELLE
Total/NA	Analysis	8082A		4000			436448	10/27/23 12:06	A2VL	ELLE

Instrument ID: 19843

Client Sample ID: S-12617668-101023-SM-003 — Lab Sample ID: 680-241772-3

Date Collected: 10/10/23 14:25 — **Matrix: Solid**
Date Received: 10/14/23 09:58

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1			432419	10/17/23 19:44	S9WT	ELLE

Instrument ID: NOEQUIP

Client Sample ID: S-12617668-101023-SM-003 — Lab Sample ID: 680-241772-3

Date Collected: 10/10/23 14:25 — **Matrix: Solid**
Date Received: 10/14/23 09:58 — **Percent Solids: 98.9**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3546			3.00 g	10 mL	435616	10/25/23 15:45	ZB3H	ELLE
Total/NA	Analysis	8082A		2			435862	10/26/23 12:33	A2VL	ELLE

Instrument ID: 19843

Lab Chronicle

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Client Sample ID: S-12617668-101023-SM-004 — Lab Sample ID: 680-241772-4

Date Collected: 10/10/23 14:40 — **Matrix: Solid**
Date Received: 10/14/23 09:58

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1			432419	10/17/23 19:44	S9WT	ELLE
	Instrument ID: NOEQUIP									

Client Sample ID: S-12617668-101023-SM-004 — Lab Sample ID: 680-241772-4

Date Collected: 10/10/23 14:40 — **Matrix: Solid**
Date Received: 10/14/23 09:58 — **Percent Solids: 99.4**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3546			3.15 g	10 mL	435616	10/25/23 15:45	ZB3H	ELLE
Total/NA	Analysis	8082A		1			435862	10/26/23 12:45	A2VL	ELLE
	Instrument ID: 19843									

Client Sample ID: S-12617668-101123-SM-005 — Lab Sample ID: 680-241772-5

Date Collected: 10/11/23 09:35 — **Matrix: Solid**
Date Received: 10/14/23 09:58

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1			432419	10/17/23 19:44	S9WT	ELLE
	Instrument ID: NOEQUIP									

Client Sample ID: S-12617668-101123-SM-005 — Lab Sample ID: 680-241772-5

Date Collected: 10/11/23 09:35 — **Matrix: Solid**
Date Received: 10/14/23 09:58 — **Percent Solids: 98.8**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3546			3.30 g	10 mL	435616	10/25/23 15:45	ZB3H	ELLE
Total/NA	Analysis	8082A		1			435862	10/26/23 12:57	A2VL	ELLE
	Instrument ID: 19843									

Client Sample ID: S-12617668-101123-SM-006 — Lab Sample ID: 680-241772-6

Date Collected: 10/11/23 09:55 — **Matrix: Solid**
Date Received: 10/14/23 09:58

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1			432419	10/17/23 19:44	S9WT	ELLE
	Instrument ID: NOEQUIP									

Client Sample ID: S-12617668-101123-SM-006 — Lab Sample ID: 680-241772-6

Date Collected: 10/11/23 09:55 — **Matrix: Solid**
Date Received: 10/14/23 09:58 — **Percent Solids: 98.9**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3546			3.45 g	10 mL	435616	10/25/23 15:45	ZB3H	ELLE
Total/NA	Analysis	8082A		1			435862	10/26/23 13:09	A2VL	ELLE
	Instrument ID: 19843									

Lab Chronicle

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Client Sample ID: S-12617668-101123-SM-007 — Lab Sample ID: 680-241772-7

Date Collected: 10/11/23 10:10 — **Matrix: Solid**
Date Received: 10/14/23 09:58

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1			432419	10/17/23 19:44	S9WT	ELLE
	Instrument ID: NOEQUIP									

Client Sample ID: S-12617668-101123-SM-007 — Lab Sample ID: 680-241772-7

Date Collected: 10/11/23 10:10 — **Matrix: Solid**
Date Received: 10/14/23 09:58 — **Percent Solids: 98.7**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3546			3.24 g	10 mL	435616	10/25/23 15:45	ZB3H	ELLE
Total/NA	Analysis	8082A		1			435862	10/26/23 13:20	A2VL	ELLE
	Instrument ID: 19843									

Client Sample ID: S-12617668-101123-SM-008 — Lab Sample ID: 680-241772-8

Date Collected: 10/11/23 10:25 — **Matrix: Solid**
Date Received: 10/14/23 09:58

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1			432419	10/17/23 19:44	S9WT	ELLE
	Instrument ID: NOEQUIP									

Client Sample ID: S-12617668-101123-SM-008 — Lab Sample ID: 680-241772-8

Date Collected: 10/11/23 10:25 — **Matrix: Solid**
Date Received: 10/14/23 09:58 — **Percent Solids: 99.1**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3546			3.20 g	10 mL	435616	10/25/23 15:45	ZB3H	ELLE
Total/NA	Analysis	8082A		1			435862	10/26/23 13:32	A2VL	ELLE
	Instrument ID: 19843									

Client Sample ID: S-12617668-101123-SM-009 — Lab Sample ID: 680-241772-9

Date Collected: 10/11/23 10:45 — **Matrix: Solid**
Date Received: 10/14/23 09:58

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1			432419	10/17/23 19:44	S9WT	ELLE
	Instrument ID: NOEQUIP									

Client Sample ID: S-12617668-101123-SM-009 — Lab Sample ID: 680-241772-9

Date Collected: 10/11/23 10:45 — **Matrix: Solid**
Date Received: 10/14/23 09:58 — **Percent Solids: 99.3**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3546			3.03 g	10 mL	435616	10/25/23 15:45	ZB3H	ELLE
Total/NA	Analysis	8082A		1	0 mL	1.0 mL	435862	10/26/23 13:44	A2VL	ELLE
	Instrument ID: 19843									

Lab Chronicle

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Client Sample ID: S-12617668-101123-SM-010 — Lab Sample ID: 680-241772-10

Date Collected: 10/11/23 10:55 — **Matrix: Solid**
Date Received: 10/14/23 09:58

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1			432419	10/17/23 19:44	S9WT	ELLE
	Instrument ID:	NOEQUIP								

Client Sample ID: S-12617668-101123-SM-010 — Lab Sample ID: 680-241772-10

Date Collected: 10/11/23 10:55 — **Matrix: Solid**
Date Received: 10/14/23 09:58 — **Percent Solids: 98.3**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3546			2.02 g	10 mL	435616	10/25/23 15:45	ZB3H	ELLE
Total/NA	Analysis	8082A		4000			436448	10/27/23 11:42	A2VL	ELLE
	Instrument ID:	19843								

Client Sample ID: S-12617668-101123-SM-011 — Lab Sample ID: 680-241772-11

Date Collected: 10/11/23 11:30 — **Matrix: Solid**
Date Received: 10/14/23 09:58

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1			432419	10/17/23 19:44	S9WT	ELLE
	Instrument ID:	NOEQUIP								

Client Sample ID: S-12617668-101123-SM-011 — Lab Sample ID: 680-241772-11

Date Collected: 10/11/23 11:30 — **Matrix: Solid**
Date Received: 10/14/23 09:58 — **Percent Solids: 99.4**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3546			3.01 g	10 mL	435616	10/25/23 15:45	ZB3H	ELLE
Total/NA	Analysis	8082A		1	0 mL	1.0 mL	435862	10/26/23 13:56	A2VL	ELLE
	Instrument ID:	19843								

Client Sample ID: S-12617668-101123-SM-012 — Lab Sample ID: 680-241772-12

Date Collected: 10/11/23 12:55 — **Matrix: Solid**
Date Received: 10/14/23 09:58

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1			432419	10/17/23 19:44	S9WT	ELLE
	Instrument ID:	NOEQUIP								

Client Sample ID: S-12617668-101123-SM-012 — Lab Sample ID: 680-241772-12

Date Collected: 10/11/23 12:55 — **Matrix: Solid**
Date Received: 10/14/23 09:58 — **Percent Solids: 98.1**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3546			3.06 g	10 mL	435616	10/25/23 15:45	ZB3H	ELLE
Total/NA	Analysis	8082A		1	0 mL	1.0 mL	435862	10/26/23 14:08	A2VL	ELLE
	Instrument ID:	19843								

Lab Chronicle

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Client Sample ID: S-12617668-101123-SM-013 — Lab Sample ID: 680-241772-13

Date Collected: 10/11/23 13:25 — **Matrix: Solid**
Date Received: 10/14/23 09:58

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1			432419	10/17/23 19:44	S9WT	ELLE
	Instrument ID: NOEQUIP									

Client Sample ID: S-12617668-101123-SM-013 — Lab Sample ID: 680-241772-13

Date Collected: 10/11/23 13:25 — **Matrix: Solid**
Date Received: 10/14/23 09:58 — **Percent Solids: 98.7**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3546			3.02 g	10 mL	435616	10/25/23 15:45	ZB3H	ELLE
Total/NA	Analysis	8082A		1			435862	10/26/23 15:07	A2VL	ELLE
	Instrument ID: 19843									

Client Sample ID: S-12617668-101123-SM-014 — Lab Sample ID: 680-241772-14

Date Collected: 10/11/23 15:25 — **Matrix: Solid**
Date Received: 10/14/23 09:58

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1			432419	10/17/23 19:44	S9WT	ELLE
	Instrument ID: NOEQUIP									

Client Sample ID: S-12617668-101123-SM-014 — Lab Sample ID: 680-241772-14

Date Collected: 10/11/23 15:25 — **Matrix: Solid**
Date Received: 10/14/23 09:58 — **Percent Solids: 99.1**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3546			3.49 g	10 mL	435616	10/25/23 15:45	ZB3H	ELLE
Total/NA	Analysis	8082A		1			435862	10/26/23 15:18	A2VL	ELLE
	Instrument ID: 19843									

Laboratory References:

ELLE = Eurofins Lancaster Laboratories Environment Testing, LLC, 2425 New Holland Pike, Lancaster, PA 17601, TEL (717)656-2300

Accreditation/Certification Summary

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Laboratory: Eurofins Lancaster Laboratories Environment Testing, LLC

The accreditations/certifications listed below are applicable to this report.

Authority	Program	Identification Number	Expiration Date
New York	NELAP	10670	04-01-24

Method Summary

Client: GHD Services Inc.
Project/Site: PCB Testing - NPS

Job ID: 680-241772-1

Method	Method Description	Protocol	Laboratory
8082A	Polychlorinated Biphenyls (PCBs) by Gas Chromatography	SW846	ELLE
Moisture	Percent Moisture	EPA	ELLE
3546	Microwave Extraction	SW846	ELLE

Protocol References:

EPA = US Environmental Protection Agency

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

ELLE = Eurofins Lancaster Laboratories Environment Testing, LLC, 2425 New Holland Pike, Lancaster, PA 17601, TEL (717)656-2300

Eurofins Lancaster Laboratories Environme
2425 New Holland Pike
Lancaster, PA 17601
Phone: 717-656-2300 Fax: 717-656-1681

Chain of Custody Record

eurofins Environment Testing

244- ATLANTA

Client Information	Sampler: Sean McEvoy	Lab PM: Andros, John	Carrier Tracking No(s):	COC No: 680-150491-54465.1
Client Contact: Dustin Zedaker	Phone: 716-491-1957	E-Mail: John.Andros@et.eurofinsus.com	State of Origin:	Page: Page 1 of 2
Company: GHD Services Inc.	PWSID:			Job #:
Address: 121 North 20th Street Ste A	Due Date Requested: 10/27/23			
City: Richmond	TAT Requested (days): 14			
State, Zip: VA, 23223	Compliance Project: Δ Yes Δ No			
Phone:	PO #: Purchase Order Requested			
Email: dustin.zedaker@ghd.com	WO #:			
Project Name: PCB Testing - NY	Project #: 68030033			
Site: NPS	SSOW#:			

Analysis Requested

Preservation Codes:
A - HCL, B - NaOH, C - Zn Acetate, D - Nitric Acid, E - NaHSO4, F - MeOH, G - Amchlor, H - Ascorbic Acid, I - Ice, J - DI Water, K - EDTA, L - EDA, M - Hexane, N - None, O - AsNaO2, P - Na2O4S, Q - Na2SO3, R - Na2S2O3, S - H2SO4, T - TSP Dodecahydrate, U - Acetone, V - MCAA, W - pH 4-5, Y - Trizma, Z - other (specify)
Other:

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	8082A, Moisture	Total Number of containers	Special Instructions/Note:
			Preservation Code:		X	X	N	X	
S-12617668-101023-SM-001	10/10/23	1310	G	Solid	N	N	✓	1	
S-12617668-101023-SM-002	10/10/23	1340					✓	1	
S-12617668-101023-SM-003	10/10/23	1425					✓	1	
S-12617668-101023-SM-004	10/10/23	1440					✓	1	
S-12617668-101123-SM-005	10/11/23	0935					✓	1	
S-12617668-101123-SM-006	10/11/23	0955					✓	1	
S-12617668-101123-SM-007	10/11/23	1010					✓	1	
S-12617668-101123-SM-008	10/11/23	1025					✓	1	
S-12617668-101123-SM-009	10/11/23	1045					✓	1	
S-12617668-101123-SM-010	10/11/23	1055					✓	1	
S-12617668-101123-SM-011	10/11/23	1130					✓	1	

Possible Hazard Identification
☑ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☑ Disposal By Lab ☐ Archive For ____ Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:			
Relinquished by:	Date/Time: 10/13/23 1730	Company: GHD	Received by:	Date/Time:	Company	
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company	
Relinquished by:	Date/Time:	Company	Received by:	Date/Time: 10/14/23 958	Company: EWET	

Custody Seals Intact: Δ Yes Δ No
Custody Seal No.:
Cooler Temperature(s) °C and Other Remarks: Raw 10.5 - COR 10.4

Ver: 06/08/2021

Eurofins Lancaster Laboratories Environme
2425 New Holland Pike
Lancaster, PA 17601
Phone: 717-656-2300 Fax: 717-6562681

Chain of Custody Record

eurofins | Environment Testing

Client Information	Sampler: Shawn McEvery	Lab PM: Andros, John	Carrier Tracking No(s):	COC No: 680-150491-54465 2
Client Contact: Dustin Zedaker	Phone: 716-583-9623	E-Mail: John.Andros@et.eurofinsus.com	State of Origin:	Page: Page 2 of 2
Company: GHD Services Inc.	PWSID:			Job #:
Address: 121 North 20th Street Ste A	Due Date Requested: ~~10/21~~ 10/27/23			
City: Richmond	TAT Requested (days): 14			
State, Zip: VA, 23223	Compliance Project: Δ Yes Δ No			
Phone:	PO #: Purchase Order Requested			
Email: dustin.zedaker@ghd.com	WO #:			
Project Name: PCB Testing - NY	Project #: 68030033			
Site:	SSOW#:			

Analysis Requested

Preservation Codes:
A - HCL, B - NaOH, C - Zn Acetate, D - Nitric Acid, E - NaHSO4, F - MeOH, G - Amchlor, H - Ascorbic Acid, I - Ice, J - DI Water, K - EDTA, L - EDA, M - Hexane, N - None, O - AsNaO2, P - Na2O4S, Q - Na2SO3, R - Na2S2O3, S - H2SO4, T - TSP Dodecahydrate, U - Acetone, V - MCAA, W - pH 4-5, Y - Trizma, Z - other (specify)
Other:

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	8082A, Moisture	Total Number of containers	Special Instructions/Note:
			Preservation Code:		X	X	N	X	
S-12617668-101123-SM-012	10/11/23	1255	G	solid	N	N	✓	1	
S-12617668-101123-SM-013	10/11/23	1325	G	solid	N	N	✓	1	
S-12617668-101123-SM-014	10/11/23	1525	G	solid	N	N	✓	1	

Possible Hazard Identification
☑ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☑ Disposal By Lab ☐ Archive For ____ Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:

Relinquished by	Date/Time	Company	Received by	Date/Time	Company
[signature]	~~10/12~~ 10/13/23 1730	GHD			
			[signature]	10/14/23 958	ELAT

Custody Seals Intact: Δ Yes Δ No
Custody Seal No.:

Cooler Temperature(s) °C and Other Remarks: Raw 10.5 - COR 10.4

Eurofins Lancaster Laboratories Environme
2425 New Holland Pike
Lancaster, PA 17601
Phone: 717-656-2300 Fax: 717-656-2681

Chain

680-241772 Chain of Custody

eurofins Environment Testing

244- ATLANTA

Client Information	Sampler: Shaun McEvoy	Andros, John	Carrier Tracking No(s):	COC No: 680-150491-54465.1
Client Contact: Dustin Zedaker	Phone: 716-491-1957	E-Mail: John.Andros@et.eurofinsus.com	State of Origin:	Page: Page 1 of 2
Company: GHD Services Inc.	PWSID:			Job #:
Address: 121 North 20th Street Ste A	Due Date Requested: 10/27/23			
City: Richmond	TAT Requested (days): 14			
State, Zip: VA, 23223	Compliance Project: Δ Yes Δ No			
Phone:	PO #: Purchase Order Requested			
Email: dustin.zedaker@ghd.com	WO #:			
Project Name: PCB Testing - NY	Project #: 68030033			
Site: NPS	SSOW#:			

Analysis Requested

Preservation Codes:
A - HCL, B - NaOH, C - Zn Acetate, D - Nitric Acid, E - NaHSO4, F - MeOH, G - Amchlor, H - Ascorbic Acid, I - Ice, J - DI Water, K - EDTA, L - EDA
M - Hexane, N - None, O - AsNaO2, P - Na2O4S, Q - Na2SO3, R - Na2S2O3, S - H2SO4, T - TSP Dodecahydrate, U - Acetone, V - MCAA, W - pH 4-5, Y - Trizma, Z - other (specify)
Other:

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	8082A, Moisture	Total Number of containers	Special Instructions/Note:
			Preservation Code:				N		
S-12617668-101023-SM-001	10/10/23	1310	G	solid	N	N	✓	1	
S-12617668-101023-SM-002	10/10/23	1340					✓	1	
S-12617668-101023-SM-003	10/10/23	1425					✓	1	
S-12617668-101023-SM-004	10/10/23	1440					✓	1	
S-12617668-101123-SM-005	10/11/23	0935					✓	1	
S-12617668-101123-SM-006	10/11/23	0955					✓	1	
S-12617668-101123-SM-007	10/11/23	1010					✓	1	
S-12617668-101123-SM-008	10/11/23	1025					✓	1	
S-12617668-101123-SM-009	10/11/23	1045					✓	1	
S-12617668-101123-SM-010	10/11/23	1055					✓	1	
S-12617668-101123-SM-011	10/11/23	1130					✓	1	

Possible Hazard Identification
☑ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☑ Disposal By Lab ☐ Archive For _____ Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by: | Date: | Time: | Method of Shipment:

Relinquished by	Date/Time	Company	Received by	Date/Time	Company
[signature]	10/13/23 1730	GHD	[signature]		
			[signature]	10/14/23 958	ELET

Custody Seals Intact: Δ Yes Δ No | Custody Seal No.:

Cooler Temperature(s) °C and Other Remarks: Raw 10.5 - COR 10.4 CB

mb

Ver: 06/08/2021

10/27/2023

Eurofins Lancaster Laboratories Environme
2425 New Holland Pike
Lancaster, PA 17601
Phone: 717-656-2300 Fax: 717-656-2681

Chain of Custody Record

eurofins | Environment Testing

Client Information	Sampler: Shawn McEvey	Lab PM: Andros, John	Carrier Tracking No(s):	COC No: 680-150491-54465.2
Client Contact: Dustin Zedaker	Phone: 716-583-9623	E-Mail: John.Andros@et.eurofinsus.com	State of Origin:	Page: Page 2 of 2
Company: GHD Services Inc.	PWSID:			Job #:
Address: 121 North 20th Street Ste A	Due Date Requested: ~~10/26~~ 10/27/23			
City: Richmond	TAT Requested (days): 14			
State, Zip: VA, 23223	Compliance Project: Δ Yes Δ No			
Phone:	PO #: Purchase Order Requested			
Email: dustin.zedaker@ghd.com	WO #:			
Project Name: PCB Testing - NY	Project #: 68030033			
Site:	SSOW#:			

Analysis Requested

Preservation Codes:
A - HCL, B - NaOH, C - Zn Acetate, D - Nitric Acid, E - NaHSO4, F - MeOH, G - Amchlor, H - Ascorbic Acid, I - Ice, J - DI Water, K - EDTA, L - EDA
M - Hexane, N - None, O - AsNaO2, P - Na2O4S, Q - Na2SO3, R - Na2S2O3, S - H2SO4, T - TSP Dodecahydrate, U - Acetone, V - MCAA, W - pH 4-5, Y - Trizma, Z - other (specify)
Other:

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	8082A, Moisture	Total Number of containers	Special Instructions/Note:
			Preservation Code:				N		
S-12617668-101123-SM-012	10/11/23	1255	G	solid	N	N	✓	1	
S-12617668-101123-SM-013	10/11/23	1325	G	solid	N	N	✓	1	
S-12617668-101123-SM-014	10/11/23	1525	G	solid	N	N	✓	1	

Possible Hazard Identification
☑ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☑ Disposal By Lab ☐ Archive For _____ Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by: | Date: | Time: | Method of Shipment:

Relinquished by	Date/Time	Company	Received by	Date/Time	Company
[signature]	~~10/12~~ 10/13/23 1730	GHD	[signature]		
			[signature]	10/14/23 958	ELAT

Custody Seals Intact: Δ Yes Δ No | Custody Seal No.:

Cooler Temperature(s) °C and Other Remarks: RAW 10.5 - COR 10.4

mB

Ver: 06/08/2021

Login Sample Receipt Checklist

Client: GHD Services Inc.

Job Number: 680-241772-1

Login Number: 241772
List Number: 2
Creator: Burkholder, Conrad

List Source: Eurofins Lancaster Laboratories Environment Testing, LLC
List Creation: 10/17/23 05:14 PM

Question	Answer	Comment
The cooler's custody seal is intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature acceptable,where thermal pres is required(</=6C, not frozen).	True	
Cooler Temperature is recorded.	True	
WV:Container Temp acceptable,where thermal pres is required (</=6C, not frozen).	N/A	
WV: Container Temperature is recorded.	N/A	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
There are no discrepancies between the containers received and the COC.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
There is sufficient vol. for all requested analyses.	True	
Is the Field Sampler's name present on COC?	True	Received project as a subcontract.
Sample custody seals are intact.	N/A	
VOA sample vials do not have headspace >6mm in diameter (none, if from WV)?	N/A	

Appendix VI

EMSL/ALS Laboratory Analytical Results, COC's, and Certifications

EMSL Analytical, Inc.

200 Route 130, Cinnaminson, NJ, 08077
Telephone: 856-858-4800 Fax:856-786-5974
EMSL-CIN-01

EMSL Order ID: 012410530
LIMS Reference ID: AC10530
EMSL Customer ID: CONE53Z

March 29, 2024

Dustin Zedaker
GHD [CONE53Z]
121 North 20th Street
Richmond, VA 23223

The following analytical report covers the analysis performed on samples submitted to EMSL Analytical, Inc. on 3/14/2024. The results are tabulated on the attached pages for the following client designated project:

Floyd Bennet Field/12617668

The reference number for these samples is EMSL Order #: AC10530 . Please use this reference when calling about these samples. If you have any questions, please do not hesitate to contact the lab at 856-858-4800.

Owen McKenna Laboratory Manager or other approved signatory

EMSL Analytical, Inc.

200 Route 130, Cinnaminson, NJ, 08077
Telephone: 856-858-4800 Fax:856-786-5974
EMSL-CIN-01

EMSL Order ID: 012410530
LIMS Reference ID: AC10530
EMSL Customer ID: CONE53Z

Attention: Dustin Zedaker
GHD [CONE53Z]
121 North 20th Street
Richmond, VA 23223
(804) 514-6365
dustin.zedaker@ghd.com

Project Name: Floyd Bennet Field/12617668

Customer PO:
EMSL Sales Rep: Jeromy Bish
Received: 03/14/2024 09:00
Reported: 03/29/2024 15:03

Positive Hits Summary

No positive results reported

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted."

EMSL ANALYTICAL, INC.
TESTING LABS • PRODUCTS • TRAINING

Environmental Chemistry - Sampling Event
Chain of Custody

EMSL Order Number / Lab Use Only: ACD530

EMSL Analytical, Inc.
200 Route 130 North
Cinnaminson, NJ 08077
PHONE: (800) 220-3675
EMAIL: EnvChemistry2@EMSL.com

Customer Information

Customer ID:	
Company Name:	GHD inc
Contact Name:	Dustin Zedaker
Street Address:	141 North 20th Street
City, State, Zip:	Richmond, VA 23223 Country: USA
Phone:	~~805-5317441~~ 804-237-0292
Email(s) for Report:	Dustin.Zedaker@ghd.com

Billing Information

Billing ID:	
Company Name:	Same
Billing Contact:	Same
Street Address:	2055 Niagara Falls blvd Suite 3
City, State, Zip:	Niagara Falls NY, 14304 Country: USA
Phone:	716-297-2160
Email(s) for Invoice:	

Project Name/No: Floyd Bennet Field / 12617668

Purchase Order:

EMSL LIMS Project ID: (If applicable, EMSL will provide)

US State where samples collected: NY

State of Connecticut (CT) must select project location: [ ] Commercial (Taxable) [ ] Residential (Non-Taxable)

Samples for Compliance? [ ] Yes [ ] No

If Yes, for NPDES? [ ] Yes [ ] No

Other (Specify): TCLP

PWS ID:

State Reporting Required? [ ] Yes [ ] No

Samples Collected by (Check One): [ ] EMSL [X] CLIENT

Samples Received Chilled? [ ] Yes [ ] No

Sample(s) Temperature Upon Receipt (LAB ONLY)

Sampled By Name: Kyle Wahlers

Sampled By Signature: [signature]

No. of Samples in Shipment:

Turn-Around-Time (TAT) Standard Turn-Around-Time: [X] **2 Weeks**

The following TAT's are subject to Lab approval. Call lab to confirm TAT before submittal: [ ] **1 Week** [ ] **4 Days** [ ] **3 Days** [ ] **2 Days** [ ] **1 Day**

Client Sample ID	Comp	Grab	Date / Time Collected	Matrix (W=Water, S=Soil, A=Air, SL=Sludge, O=Other)	Preservative (1 HCL, 2 HNO3, 3 H2SO4, 4 ICE, 5 Other – Describe below in Special Instructions)	Test 1: VOC	Test 2: SVOC	Test 3: Metals	Test 4:	Field PH	Field PH Test Time	Field Temp. Deg.C	Field Temp. Test Time	Comments
KW-01		X	3/13/24 10:40	SL	None	X	X	X						
KW-02		X	10:40	SL		X	X	X						
KW-03		X	10:40	SL		X	X	X						

Special Instructions and/or Regulatory Requirements (Sample Specifications, Processing Methods, Limits of Detection, etc.)

call/text any questions or concerns TCLP Samples, Need VOC, SVOC, and Metals analyzed. Email Results. (HAZ-WASTE)

Reporting Requirements: [ ] Results Only [ ] Results and QC [ ] Reduced Deliverables [ ] Hzresults EDD [ ] Excel [ ] Other (Describe Above)

Method of Shipment:

Sample Condition Upon Receipt: 6.6°C

Relinquished by: Kyle Wahlers	Date/Time: 3/13/24	Received by: [signature]	Date/Time 3/13/24 3:33 PM
Relinquished by:	Date/Time:	Received by: [signature]	Date/Time 3/13/24 20:00

Colleen Palladino 3/14/24 9AM

5.9°C on ice

[ ] **AGREE TO ELECTRONIC SIGNATURE** (By checking, I consent to signing this Chain of Custody document by electronic signature.)

EMSL Analytical, Inc.'s Laboratory Terms and Conditions are incorporated into this Chain of Custody by reference in their entirety. Submission of samples to EMSL Analytical, Inc. constitutes acceptance and acknowledgment of all terms and conditions by customer.

Main Site: 301 Fulling Mill Road | Middletown, PA 17057 | Phone: 717-944-5541 | Fax: 717-944-1430 | www.alsglobal.com
Associated Site: 20 Riverside Drive | Spring City, PA 19475 | Phone: 610-948-4903 | Fax: 717-944-1430 |

NELAP Certifications: NJ PA010 , NY 11759 , PA 22-293 DoD ELAP: PJLA 74618
State Certifications: FL E871113 , WA C999 , MD 128 , VA 460157 , WV DW 9961-C , WV 343, NJ PA101

Analytical Results Report For **EMSL Inc.**

Project	AC10530
Workorder	3350552
Report ID	309814 on 3/22/2024

Certificate of Analysis

Enclosed are the analytical results for samples received by the laboratory on Mar 15, 2024.

The ALS Environmental laboratory in Middletown, Pennsylvania is a National Environmental Laboratory Accreditation Program (NELAP) accredited laboratory and as such, certifies that all applicable test results meet the requirements of NELAP.

If you have any questions regarding this certificate of analysis, please contact Sarah Leung (Project Coordinator) at (717) 944-5541.

Analyses were performed according to our laboratory's NELAP-approved quality assurance program and any applicable state requirements. The test results meet requirements of the current NELAP standards or state requirements, where applicable. For a specific list of accredited analytes, refer to the certifications section of the ALS website at www.alsglobal.com/en/Our-Services/Life-Sciences/Environmental/Downloads.

This laboratory report may not be reproduced, except in full, without the written approval of ALS Global.
ALS Middletown: 301 Fulling Mill Road, Middletown, PA 17057 : 717-944-5541.

Recipient(s):
Reports - EMSL Inc.
Travis Albert - EMSL Analytical Inc.

This page is included as part of the Analytical Report and must be retained as a permanent record thereof.

Sarah Leung

Sarah Leung *(ALS Digital Signature)*
Project Coordinator

Sample Summary

Lab ID	Sample ID	Matrix	Date Collected	Date Received	Collector	Collection Company
3350552001	AC10530-001	Solid	03/05/2024 10:40	03/15/2024 08:37	CBC	Collected By Client
3350552002	AC10530-002	Solid	03/05/2024 10:40	03/15/2024 08:37	CBC	Collected By Client
3350552003	AC10530-003	Solid	03/05/2024 10:40	03/15/2024 08:37	CBC	Collected By Client

Reference

Notes

- Samples collected by ALS personnel are done so in accordance with the procedures set forth in the ALS Field Sampling Plan (20 - Field Services Sampling Plan).
- Except as qualified, Clean Water Act sample analyses are consistent with methodology requirements in 40 CFR Part 136, including but not limited to the following EPA Method reference revisions:
  EPA 300.1 Rev. 1.0-1997
  EPA 300.0 Rev. 2.1-1993
  EPA 353.2 Rev. 2.0-1993
  EPA 410.4 Rev. 1.0-1993
  EPA 420.4 Rev. 1.0-1993
  EPA 365.1 Rev. 2.0-1993
  EPA 200.7 Rev. 4.4-1994
  EPA 200.8 Rev. 5.4-1994
  EPA 245.1 Rev. 3.0-1994
- Except as qualified, Safe Drinking Water Act sample analyses are consistent with methodology requirements in 40 CFR Part 141.
- The Chain of Custody document is included as part of this report.
- All Library Search analytes should be regarded as tentative identifications based on the presumptive evidence of the mass spectra. Concentrations reported are estimated values.
- Parameters identified as "analyze immediately" require analysis within 15 minutes of collection. Any "analyze immediately" parameters not listed under the header "Field Parameters" are preformed in the laboratory and are therefore analyzed out of hold time.
- Method references listed on this report beginning with the prefix “S” followed by a method number (such as S2310B-97) refer to methods from “Standard Methods for the Examination of Water and Wastewater”.
- For microbiological analyses, the "Prepared" value is the date/time into the incubator and the "Analyzed" value is the date/time out the incubator.
- An Analysis-Prep Method Cross Reference Table is included after Analytical Results & Qualifiers section in this report.
- Unless otherwise noted, all quantitative results for soils are reported on a dry weight basis.

Standard Acronyms/Flags

J	Indicates an estimated value between the Method Detection Limit (MDL) and the Practical Quantitation Limit (PQL) for the analyte
U	Indicates that the analyte was Not Detected (ND) above the MDL
N	Indicates presumptive evidence of the presence of a compound
MDL	Method Detection Limit
PQL	Practical Quantitation Limit
RDL	Practical Quantitation Limit for this Project
ND	Not Detected - indicates that the analyte was Not Detected
Cntr	Analysis was performed using this container
RegLmt	Regulatory Limit
LCS	Laboratory Control Sample
MS	Matrix Spike
MSD	Matrix Spike Duplicate
DUP	Sample Duplicate
%Rec	Percent Recovery
RPD	Relative Percent Difference
LOD	DoD Limit of Detection
LOQ	DoD Limit of Quantitation
DL	DoD Detection Limit
I	Indicates reported value is greater than or equal to the Method Detection Limit (MDL) but less than the Report Detection Limit (RDL)
(S)	Surrogate Compound
NC	Not Calculated
*	Result outside of QC limits
#	Please reference the result in the Results Section for analyte-level flags.

Project Notations

Sample Notations

Lab ID	Sample ID

Result Notations

Notation Ref.	
1	The QC sample type MS for method SW846 8260C was outside the control limits for the analyte 1,1-Dichloroethene. The % Recovery was reported as 150 and the control limits were 63 to 128.
2	The QC sample type MSD for method SW846 8260C was outside the control limits for the analyte 1,1-Dichloroethene. The % Recovery was reported as 142 and the control limits were 63 to 128.
3	Analyte was analyzed past the 7 day holding time.
4	The surrogate Terphenyl-d14 for method SW846 8270E was outside of control limits. The % Recovery was reported as 33.5 and the control limits were 41 to 145. This result was reported at a dilution of 1.
5	The QC sample type MS for method SW846 8270E was outside the control limits for the analyte Pentachlorophenol. The % Recovery was reported as 28.2 and the control limits were 41 to 149.
6	The QC sample type MSD for method SW846 8270E was outside the control limits for the analyte Pentachlorophenol. The % Recovery was reported as 23.8 and the control limits were 41 to 149.
7	The surrogate Terphenyl-d14 for method SW846 8270E was outside of control limits in the matrix spike duplicate associated with this sample. The % Recovery was reported as 37.4 and the control limits were 41 to 145. This result was reported at a dilution of 1.
8	The surrogate Terphenyl-d14 for method SW846 8270E was outside of control limits. The % Recovery was reported as 35.7 and the control limits were 41 to 145. This result was reported at a dilution of 1.
9	The surrogate Terphenyl-d14 for method SW846 8270E was outside of control limits. The % Recovery was reported as 34.1 and the control limits were 41 to 145. This result was reported at a dilution of 1.

Detected Results Summary

Client Sample ID	AC10530-001	Collected	03/05/2024 10:40
Lab Sample ID	3350552001	Lab Receipt	03/15/2024 08:37

Compound	Result	Units	RDL	Method	Flag
TCLP EPA 1311 METALS					
Cadmium, Total	0.012	mg/L	0.0099	SW846 6010C	#
Lead, Total	0.27	mg/L	0.030	SW846 6010C	#
WET CHEMISTRY					
Moisture	39.3	%	0.1	S2540G-11	#
Total Solids	60.7	%	0.1	S2540G-11	#

Detected Results Summary

Client Sample ID	AC10530-002	Collected	03/05/2024 10:40
Lab Sample ID	3350552002	Lab Receipt	03/15/2024 08:37

Compound	Result	Units	RDL	Method	Flag
TCLP EPA 1311 METALS					
Lead, Total	0.038	mg/L	0.030	SW846 6010C	#
WET CHEMISTRY					
Moisture	57.2	%	0.1	S2540G-11	#
Total Solids	42.8	%	0.1	S2540G-11	#

Detected Results Summary

Client Sample ID	AC10530-003	Collected	03/05/2024 10:40
Lab Sample ID	3350552003	Lab Receipt	03/15/2024 08:37

Compound	Result	Units	RDL	Method	Flag
TCLP EPA 1311 METALS					
Cadmium, Total	0.34	mg/L	0.0099	SW846 6010C	#
Lead, Total	7.5	mg/L	0.030	SW846 6010C	#
TCLP EPA 1311 SEMI-VOLATILES					
Pentachlorophenol	62.9	ug/L	30.0	SW846 8270E	#
WET CHEMISTRY					
Moisture	25.3	%	0.1	S2540G-11	#
Total Solids	74.7	%	0.1	S2540G-11	#

Results

Client Sample ID	AC10530-001	Collected	03/05/2024 10:40
Lab Sample ID	3350552001	Lab Receipt	03/15/2024 08:37

TCLP EPA 1311 METALS

Compound	Result	Flag	Units	RDL	Method	Dilution	Analysis Date/Time	By	Cntr
Arsenic, Total	ND	ND	mg/L	0.13	SW846 6010C	1	03/19/2024 12:03	AXW	A1
Barium, Total	ND	ND	mg/L	2.5	SW846 6010C	1	03/19/2024 12:03	AXW	A1
Cadmium, Total	0.012		mg/L	0.0099	SW846 6010C	1	03/19/2024 12:03	AXW	A1
Chromium, Total	ND	ND	mg/L	0.025	SW846 6010C	1	03/19/2024 12:03	AXW	A1
Lead, Total	0.27		mg/L	0.030	SW846 6010C	1	03/19/2024 12:03	AXW	A1
Mercury, Total	ND	ND	mg/L	0.00020	SW846 7470A	1	03/21/2024 14:47	JSE	A
Selenium, Total	ND	ND	mg/L	0.099	SW846 6010C	1	03/19/2024 12:03	AXW	A1
Silver, Total	ND	ND	mg/L	0.020	SW846 6010C	1	03/19/2024 12:03	AXW	A1

TCLP EPA 1311 SEMI-VOLATILES

Compound	Result	Flag	Units	RDL	Method	Dilution	Analysis Date/Time	By	Cntr
1,4-Dichlorobenzene	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:08	S7M	A
2,4,5-Trichlorophenol	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:08	S7M	A
2,4,6-Trichlorophenol	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:08	S7M	A
2,4-Dinitrotoluene	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:08	S7M	A
Hexachlorobenzene	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:08	S7M	A
Hexachlorobutadiene	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:08	S7M	A
Hexachloroethane	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:08	S7M	A
mp-Cresol	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:08	S7M	A
Nitrobenzene	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:08	S7M	A
o-Cresol	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:08	S7M	A
Pentachlorophenol	ND	ND	ug/L	30.0	SW846 8270E	1	03/20/2024 09:08	S7M	A
Pyridine	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:08	S7M	A

SURROGATES

Compound	CAS No	Recovery	Limits(%)	Analysis Date/Time	Qualifiers
2,4,6-Tribromophenol	118-79-6	96.9%	23 – 131	03/20/2024 09:08	
2-Fluorobiphenyl	321-60-8	67.4%	24 – 116	03/20/2024 09:08	
2-Fluorophenol	367-12-4	42.8%	10 – 85	03/20/2024 09:08	
Nitrobenzene-d5	4165-60-0	68.2%	32 – 125	03/20/2024 09:08	
Phenol-d5	4165-62-2	31.4%	7 – 56	03/20/2024 09:08	
Terphenyl-d14	98904-43-9	33.5*%	41 – 145	03/20/2024 09:08	4

TCLP EPA 1311 VOLATILE ORGANIC

Compound	Result	Flag	Units	RDL	Method	Dilution	Analysis Date/Time	By	Cntr
1,1-Dichloroethene	ND	ND,1,2	ug/L	20.0	SW846 8260C	20	03/20/2024 01:37	BST	A
1,2-Dichloroethane	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 01:37	BST	A
2-Butanone	ND	ND	ug/L	200	SW846 8260C	20	03/20/2024 01:37	BST	A
Benzene	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 01:37	BST	A
Carbon Tetrachloride	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 01:37	BST	A
Chlorobenzene	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 01:37	BST	A
Chloroform	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 01:37	BST	A
Tetrachloroethene	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 01:37	BST	A

Results

Client Sample ID	AC10530-001	Collected	03/05/2024 10:40
Lab Sample ID	3350552001	Lab Receipt	03/15/2024 08:37

TCLP EPA 1311 VOLATILE ORGANIC (cont.)

Compound	Result	Flag	Units	RDL	Method	Dilution	Analysis Date/Time	By	Cntr
Trichloroethene	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 01:37	BST	A
Vinyl Chloride	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 01:37	BST	A

SURROGATES

Compound	CAS No	Recovery	Limits(%)	Analysis Date/Time	Qualifiers
1,2-Dichloroethane-d4	17060-07-0	98.9%	62 – 133	03/20/2024 01:37	
4-Bromofluorobenzene	460-00-4	105%	79 – 114	03/20/2024 01:37	
Dibromofluoromethane	1868-53-7	95.1%	78 – 116	03/20/2024 01:37	
Toluene-d8	2037-26-5	107%	76 – 127	03/20/2024 01:37	

WET CHEMISTRY

Compound	Result	Flag	Units	RDL	Method	Dilution	Analysis Date/Time	By	Cntr
Moisture	39.3		%	0.1	S2540G-11	1	03/15/2024 21:10	LMD	A
Total Solids	60.7	3	%	0.1	S2540G-11	1	03/15/2024 21:10	LMD	A

Results

Client Sample ID	AC10530-002	Collected	03/05/2024 10:40
Lab Sample ID	3350552002	Lab Receipt	03/15/2024 08:37

TCLP EPA 1311 METALS

Compound	Result	Flag	Units	RDL	Method	Dilution	Analysis Date/Time	By	Cntr
Arsenic, Total	ND	ND	mg/L	0.13	SW846 6010C	1	03/19/2024 12:04	AXW	A1
Barium, Total	ND	ND	mg/L	2.5	SW846 6010C	1	03/19/2024 12:04	AXW	A1
Cadmium, Total	ND	ND	mg/L	0.0099	SW846 6010C	1	03/19/2024 12:04	AXW	A1
Chromium, Total	ND	ND	mg/L	0.025	SW846 6010C	1	03/19/2024 12:04	AXW	A1
Lead, Total	0.038		mg/L	0.030	SW846 6010C	1	03/19/2024 12:04	AXW	A1
Mercury, Total	ND	ND	mg/L	0.00020	SW846 7470A	1	03/21/2024 14:48	JSE	A
Selenium, Total	ND	ND	mg/L	0.099	SW846 6010C	1	03/19/2024 12:04	AXW	A1
Silver, Total	ND	ND	mg/L	0.020	SW846 6010C	1	03/19/2024 12:04	AXW	A1

TCLP EPA 1311 SEMI-VOLATILES

Compound	Result	Flag	Units	RDL	Method	Dilution	Analysis Date/Time	By	Cntr
1,4-Dichlorobenzene	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:33	S7M	A
2,4,5-Trichlorophenol	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:33	S7M	A
2,4,6-Trichlorophenol	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:33	S7M	A
2,4-Dinitrotoluene	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:33	S7M	A
Hexachlorobenzene	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:33	S7M	A
Hexachlorobutadiene	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:33	S7M	A
Hexachloroethane	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:33	S7M	A
mp-Cresol	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:33	S7M	A
Nitrobenzene	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:33	S7M	A
o-Cresol	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:33	S7M	A
Pentachlorophenol	ND	ND,5,6	ug/L	30.0	SW846 8270E	1	03/20/2024 09:33	S7M	A
Pyridine	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 09:33	S7M	A

SURROGATES

Compound	CAS No	Recovery	Limits(%)	Analysis Date/Time	Qualifiers
2,4,6-Tribromophenol	118-79-6	90.3%	23 – 131	03/20/2024 09:33	
2-Fluorobiphenyl	321-60-8	62.4%	24 – 116	03/20/2024 09:33	
2-Fluorophenol	367-12-4	41.8%	10 – 85	03/20/2024 09:33	
Nitrobenzene-d5	4165-60-0	66.7%	32 – 125	03/20/2024 09:33	
Phenol-d5	4165-62-2	32.2%	7 – 56	03/20/2024 09:33	
Terphenyl-d14	98904-43-9	35.7*%	41 – 145	03/20/2024 09:33	7,8

TCLP EPA 1311 VOLATILE ORGANIC

Compound	Result	Flag	Units	RDL	Method	Dilution	Analysis Date/Time	By	Cntr
1,1-Dichloroethene	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 02:00	BST	A
1,2-Dichloroethane	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 02:00	BST	A
2-Butanone	ND	ND	ug/L	200	SW846 8260C	20	03/20/2024 02:00	BST	A
Benzene	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 02:00	BST	A
Carbon Tetrachloride	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 02:00	BST	A
Chlorobenzene	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 02:00	BST	A
Chloroform	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 02:00	BST	A
Tetrachloroethene	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 02:00	BST	A

Results

Client Sample ID	AC10530-002	Collected	03/05/2024 10:40
Lab Sample ID	3350552002	Lab Receipt	03/15/2024 08:37

TCLP EPA 1311 VOLATILE ORGANIC (cont.)

Compound	Result	Flag	Units	RDL	Method	Dilution	Analysis Date/Time	By	Cntr
Trichloroethene	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 02:00	BST	A
Vinyl Chloride	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 02:00	BST	A

SURROGATES

Compound	CAS No	Recovery	Limits(%)	Analysis Date/Time	Qualifiers
1,2-Dichloroethane-d4	17060-07-0	101%	62 – 133	03/20/2024 02:00	
4-Bromofluorobenzene	460-00-4	107%	79 – 114	03/20/2024 02:00	
Dibromofluoromethane	1868-53-7	95.7%	78 – 116	03/20/2024 02:00	
Toluene-d8	2037-26-5	106%	76 – 127	03/20/2024 02:00	

WET CHEMISTRY

Compound	Result	Flag	Units	RDL	Method	Dilution	Analysis Date/Time	By	Cntr
Moisture	57.2		%	0.1	S2540G-11	1	03/15/2024 21:10	LMD	A
Total Solids	42.8	3	%	0.1	S2540G-11	1	03/15/2024 21:10	LMD	A

Results

Client Sample ID	AC10530-003	Collected	03/05/2024 10:40
Lab Sample ID	3350552003	Lab Receipt	03/15/2024 08:37

TCLP EPA 1311 METALS

Compound	Result	Flag	Units	RDL	Method	Dilution	Analysis Date/Time	By	Cntr
Arsenic, Total	ND	ND	mg/L	0.13	SW846 6010C	1	03/19/2024 12:05	AXW	A1
Barium, Total	ND	ND	mg/L	2.5	SW846 6010C	1	03/19/2024 12:05	AXW	A1
Cadmium, Total	0.34		mg/L	0.0099	SW846 6010C	1	03/19/2024 12:05	AXW	A1
Chromium, Total	ND	ND	mg/L	0.025	SW846 6010C	1	03/19/2024 12:05	AXW	A1
Lead, Total	7.5		mg/L	0.030	SW846 6010C	1	03/19/2024 12:05	AXW	A1
Mercury, Total	ND	ND	mg/L	0.00020	SW846 7470A	1	03/21/2024 14:49	JSE	A
Selenium, Total	ND	ND	mg/L	0.099	SW846 6010C	1	03/19/2024 12:05	AXW	A1
Silver, Total	ND	ND	mg/L	0.020	SW846 6010C	1	03/19/2024 12:05	AXW	A1

TCLP EPA 1311 SEMI-VOLATILES

Compound	Result	Flag	Units	RDL	Method	Dilution	Analysis Date/Time	By	Cntr
1,4-Dichlorobenzene	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 10:47	S7M	A
2,4,5-Trichlorophenol	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 10:47	S7M	A
2,4,6-Trichlorophenol	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 10:47	S7M	A
2,4-Dinitrotoluene	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 10:47	S7M	A
Hexachlorobenzene	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 10:47	S7M	A
Hexachlorobutadiene	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 10:47	S7M	A
Hexachloroethane	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 10:47	S7M	A
mp-Cresol	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 10:47	S7M	A
Nitrobenzene	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 10:47	S7M	A
o-Cresol	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 10:47	S7M	A
Pentachlorophenol	62.9		ug/L	30.0	SW846 8270E	1	03/20/2024 10:47	S7M	A
Pyridine	ND	ND	ug/L	15.0	SW846 8270E	1	03/20/2024 10:47	S7M	A

SURROGATES

Compound	CAS No	Recovery	Limits(%)	Analysis Date/Time	Qualifiers
2,4,6-Tribromophenol	118-79-6	96.1%	23 – 131	03/20/2024 10:47	
2-Fluorobiphenyl	321-60-8	62.6%	24 – 116	03/20/2024 10:47	
2-Fluorophenol	367-12-4	40.2%	10 – 85	03/20/2024 10:47	
Nitrobenzene-d5	4165-60-0	64.8%	32 – 125	03/20/2024 10:47	
Phenol-d5	4165-62-2	30.1%	7 – 56	03/20/2024 10:47	
Terphenyl-d14	98904-43-9	34.1*%	41 – 145	03/20/2024 10:47	9

TCLP EPA 1311 VOLATILE ORGANIC

Compound	Result	Flag	Units	RDL	Method	Dilution	Analysis Date/Time	By	Cntr
1,1-Dichloroethene	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 02:23	BST	A
1,2-Dichloroethane	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 02:23	BST	A
2-Butanone	ND	ND	ug/L	200	SW846 8260C	20	03/20/2024 02:23	BST	A
Benzene	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 02:23	BST	A
Carbon Tetrachloride	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 02:23	BST	A
Chlorobenzene	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 02:23	BST	A
Chloroform	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 02:23	BST	A
Tetrachloroethene	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 02:23	BST	A

Results

Client Sample ID	AC10530-003	Collected	03/05/2024 10:40
Lab Sample ID	3350552003	Lab Receipt	03/15/2024 08:37

TCLP EPA 1311 VOLATILE ORGANIC (cont.)

Compound	Result	Flag	Units	RDL	Method	Dilution	Analysis Date/Time	By	Cntr
Trichloroethene	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 02:23	BST	A
Vinyl Chloride	ND	ND	ug/L	20.0	SW846 8260C	20	03/20/2024 02:23	BST	A

SURROGATES

Compound	CAS No	Recovery	Limits(%)	Analysis Date/Time	Qualifiers
1,2-Dichloroethane-d4	17060-07-0	99.9%	62 – 133	03/20/2024 02:23	
4-Bromofluorobenzene	460-00-4	104%	79 – 114	03/20/2024 02:23	
Dibromofluoromethane	1868-53-7	95.7%	78 – 116	03/20/2024 02:23	
Toluene-d8	2037-26-5	107%	76 – 127	03/20/2024 02:23	

WET CHEMISTRY

Compound	Result	Flag	Units	RDL	Method	Dilution	Analysis Date/Time	By	Cntr
Moisture	25.3		%	0.1	S2540G-11	1	03/15/2024 21:10	LMD	A
Total Solids	74.7	3	%	0.1	S2540G-11	1	03/15/2024 21:10	LMD	A

Sample - Method Cross Reference Table

Lab ID	Sample ID	Analysis Method	Preparation Method	Leachate Method
3350552001	AC10530-001	SW846 6010C	SW846 3015A	SW846 1311
		SW846 7470A	SW846 7470A	SW846 1311
		SW846 8270E	SW846 3510C	SW846 1311
		SW846 8260C	N/A	SW846 1311
		S2540G-11	N/A	
3350552002	AC10530-002	SW846 6010C	SW846 3015A	SW846 1311
		SW846 7470A	SW846 7470A	SW846 1311
		SW846 8270E	SW846 3510C	SW846 1311
		SW846 8260C	N/A	SW846 1311
		S2540G-11	N/A	
3350552003	AC10530-003	SW846 6010C	SW846 3015A	SW846 1311
		SW846 7470A	SW846 7470A	SW846 1311
		SW846 8270E	SW846 3510C	SW846 1311
		SW846 8260C	N/A	SW846 1311
		S2540G-11	N/A	

QUALITY CONTROL SAMPLES

TCLP EPA 1311 METALS

QC Batch

QC Batch	1159572	Prep Method	SW846 3015A
Date	03/19/2024 01:15	Analysis Method	SW846 6010C
Tech.	ANN		

Associated Samples

3350552002 3350552003 3350552001

Matrix Spike 3799896 (MS) 3350613001 (non-Project Sample) For QC Batch 1159572

****NOTE - The Original Result shown below is a raw result and is only used for the purpose of calculating Matrix Spike percent recoveries. This result is not a final value and cannot be used as such.

Matrix Spike Duplicate 3799897 (MSD) 3350613001 (non-Project Sample) For QC Batch 1159572

RESULTS

Compound	CAS No		Result (mg/L)	Orig. Result (mg/L)	Spk Added (mg/L)	Rec. (%)	Limits (%)	RPD Limit (%)	Qualifiers
Arsenic, Total	7440-38-2	MS	0.54	0.0055	0.50	107	50 - 150		
Arsenic, Total	7440-38-2	MSD	0.54	0.0055	0.50	107	50 - 150	RPD 0.28 (Max-20)	
Barium, Total	7440-39-3	MS	5.70	0.26	5	108	50 - 150		
Barium, Total	7440-39-3	MSD	5.70	0.26	5	109	50 - 150	RPD 0.78 (Max-20)	
Cadmium, Total	7440-43-9	MS	0.55	0.0015	0.50	109	50 - 150		
Cadmium, Total	7440-43-9	MSD	0.55	0.0015	0.50	110	50 - 150	RPD 0.82 (Max-20)	
Chromium, Total	7440-47-3	MS	0.55	0.0090	0.50	107	50 - 150		
Chromium, Total	7440-47-3	MSD	0.55	0.0090	0.50	109	50 - 150	RPD 1.28 (Max-20)	
Lead, Total	7439-92-1	MS	0.56	0.0150	0.50	109	50 - 150		
Lead, Total	7439-92-1	MSD	0.57	0.0150	0.50	110	50 - 150	RPD 1.42 (Max-20)	
Selenium, Total	7782-49-2	MS	5.70	0.0280	5	114	50 - 150		
Selenium, Total	7782-49-2	MSD	5.70	0.0280	5	114	50 - 150	RPD 0.27 (Max-20)	
Silver, Total	7440-22-4	MS	0.56	0	0.50	112	50 - 150		
Silver, Total	7440-22-4	MSD	0.57	0	0.50	115	50 - 150	RPD 2.29 (Max-20)	

Leachate Blank 3799389 (LB) Created on 03/17/2024 08:37 For QC Batch 1159572

RESULTS

Compound	CAS No		Result	Units	RDL	Qualifiers
Arsenic, Total	7440-38-2	BLK	ND	mg/L	.13	U
Barium, Total	7440-39-3	BLK	ND	mg/L	2.5	U
Cadmium, Total	7440-43-9	BLK	ND	mg/L	.0099	U
Chromium, Total	7440-47-3	BLK	ND	mg/L	.025	U
Lead, Total	7439-92-1	BLK	ND	mg/L	.03	U
Selenium, Total	7782-49-2	BLK	ND	mg/L	.099	U
Silver, Total	7440-22-4	BLK	ND	mg/L	.02	U

Method Blank 3799870 (MB) Created on 03/18/2024 21:12 For QC Batch 1159572

RESULTS

Compound	CAS No	Result	Units	RDL	Qualifiers

QUALITY CONTROL SAMPLES

TCLP EPA 1311 METALS (cont.)

RESULTS

Compound	CAS No		Result	Units	RDL	Qualifiers
Arsenic, Total	7440-38-2	BLK	ND	mg/L	0.028	ND
Barium, Total	7440-39-3	BLK	ND	mg/L	0.56	ND
Cadmium, Total	7440-43-9	BLK	ND	mg/L	0.0022	ND
Chromium, Total	7440-47-3	BLK	ND	mg/L	0.0056	ND
Lead, Total	7439-92-1	BLK	ND	mg/L	0.0067	ND
Selenium, Total	7782-49-2	BLK	ND	mg/L	0.022	ND
Silver, Total	7440-22-4	BLK	ND	mg/L	0.0044	ND

Lab Control Standard 3799871 (LCS) Created on 03/18/2024 21:12 For QC Batch 1159572

RESULTS

Compound	CAS No		Result (mg/L)	Orig. Result (mg/L)	Spk Added (mg/L)	Rec. (%)	Limits (%)	RPD Limit (%)	Qualifiers
Arsenic, Total	7440-38-2	LCS	0.12		0.11	106	80 - 120		
Barium, Total	7440-39-3	LCS	1.20		1.10	109	80 - 120		
Cadmium, Total	7440-43-9	LCS	0.12		0.11	108	80 - 120		
Chromium, Total	7440-47-3	LCS	0.12		0.11	108	80 - 120		
Lead, Total	7439-92-1	LCS	0.12		0.11	111	80 - 120		
Selenium, Total	7782-49-2	LCS	1.20		1.10	106	80 - 120		
Silver, Total	7440-22-4	LCS	0.12		0.11	110	80 - 120		

QC Batch

QC Batch	1160114	Prep Method	SW846 7470A
Date	03/21/2024 11:00	Analysis Method	SW846 7470A
Tech.	JSE		

Associated Samples

3350552003 3350552001 3350552002

Matrix Spike 3800983 (MS) 3349622018 (non-Project Sample) For QC Batch 1160114

****NOTE - The Original Result shown below is a raw result and is only used for the purpose of calculating Matrix Spike percent recoveries. This result is not a final value and cannot be used as such.

Matrix Spike Duplicate 3800984 (MSD) 3349622018 (non-Project Sample) For QC Batch 1160114

RESULTS

Compound	CAS No		Result (mg/L)	Orig. Result (mg/L)	Spk Added (mg/L)	Rec. (%)	Limits (%)	RPD Limit (%)	Qualifiers
Mercury, Total	7439-97-6	MS	0.0047	0	0.0050	93.4	70 - 130		
Mercury, Total	7439-97-6	MSD	0.0054	0	0.0050	108	70 - 130	RPD 14.30 (Max-20)	

QUALITY CONTROL SAMPLES

TCLP EPA 1311 METALS (cont.)

Matrix Spike 3800985 (MS) 3350704001 (non-Project Sample) For QC Batch 1160114

****NOTE - The Original Result shown below is a raw result and is only used for the purpose of calculating Matrix Spike percent recoveries. This result is not a final value and cannot be used as such.

Matrix Spike Duplicate 3800986 (MSD) 3350704001 (non-Project Sample) For QC Batch 1160114

RESULTS

Compound	CAS No		Result (mg/L)	Orig. Result (mg/L)	Spk Added (mg/L)	Rec. (%)	Limits (%)	RPD Limit (%)	Qualifiers
Mercury, Total	7439-97-6	MS	0.0055	0	0.0050	111	70 - 130		
Mercury, Total	7439-97-6	MSD	0.0052	0	0.0050	105	70 - 130	RPD 5.76 (Max-20)	

Method Blank 3800981 (MB) Created on 03/20/2024 15:30 For QC Batch 1160114

RESULTS

Compound	CAS No		Result	Units	RDL	Qualifiers
Mercury, Total	7439-97-6	BLK	ND	mg/L	0.00020	ND

Lab Control Standard 3800982 (LCS) Created on 03/20/2024 15:30 For QC Batch 1160114

RESULTS

Compound	CAS No		Result (mg/L)	Orig. Result (mg/L)	Spk Added (mg/L)	Rec. (%)	Limits (%)	RPD Limit (%)	Qualifiers
Mercury, Total	7439-97-6	LCS	0.0018		0.0020	89.5	85 - 115		

QUALITY CONTROL SAMPLES

TCLP EPA 1311 SEMI-VOLATILES

QC Batch

QC Batch	1159564	Prep Method	SW846 3510C
Date	03/19/2024 13:45	Analysis Method	SW846 8270E
Tech.	BNR		

Associated Samples

3350552002 3350552003 3350552001

Leachate Blank 3799389 (LB) Created on 03/17/2024 08:37 For QC Batch 1159564

RESULTS

Compound	CAS No		Result	Units	RDL	Qualifiers
1,4-Dichlorobenzene	106-46-7	BLK	ND	ug/L	15	U
2,4,5-Trichlorophenol	95-95-4	BLK	ND	ug/L	15	U
2,4,6-Trichlorophenol	88-06-2	BLK	ND	ug/L	15	U
2,4-Dinitrotoluene	121-14-2	BLK	ND	ug/L	15	U
Hexachlorobenzene	118-74-1	BLK	ND	ug/L	15	U
Hexachlorobutadiene	87-68-3	BLK	ND	ug/L	15	U
Hexachloroethane	67-72-1	BLK	ND	ug/L	15	U
mp-Cresol	108394/106445	BLK	ND	ug/L	15	U
Nitrobenzene	98-95-3	BLK	ND	ug/L	15	U
o-Cresol	95-48-7	BLK	ND	ug/L	15	U
Pentachlorophenol	87-86-5	BLK	ND	ug/L	30	U
Pyridine	110-86-1	BLK	ND	ug/L	15	U

Method Blank 3799856 (MB) Created on 03/18/2024 20:30 For QC Batch 1159564

RESULTS

Compound	CAS No		Result	Units	RDL	Qualifiers
1,4-Dichlorobenzene	106-46-7	BLK	ND	ug/L	3.0	ND
2,4,5-Trichlorophenol	95-95-4	BLK	ND	ug/L	3.0	ND
2,4,6-Trichlorophenol	88-06-2	BLK	ND	ug/L	3.0	ND
2,4-Dinitrotoluene	121-14-2	BLK	ND	ug/L	3.0	ND
Hexachlorobenzene	118-74-1	BLK	ND	ug/L	3.0	ND
Hexachlorobutadiene	87-68-3	BLK	ND	ug/L	3.0	ND
Hexachloroethane	67-72-1	BLK	ND	ug/L	3.0	ND
mp-Cresol	108394/106445	BLK	ND	ug/L	3.0	ND
Nitrobenzene	98-95-3	BLK	ND	ug/L	3.0	ND
o-Cresol	95-48-7	BLK	ND	ug/L	3.0	ND
Pentachlorophenol	87-86-5	BLK	ND	ug/L	6.0	ND
Pyridine	110-86-1	BLK	ND	ug/L	3.0	ND

SURROGATES

Compound	CAS No		Result (ug/L)	Expected (ug/L)	Rec. (%)	Limits (%)	Qualifiers
2,4,6-Tribromophenol	118-79-6	BLK	85.90	100	85.9	23 - 131	
2-Fluorobiphenyl	321-60-8	BLK	26.60	50	53.1	24 - 116	
2-Fluorophenol	367-12-4	BLK	41.50	100	41.5	10 - 85	
Nitrobenzene-d5	4165-60-0	BLK	31.60	50	63.3	32 - 125	

QUALITY CONTROL SAMPLES

TCLP EPA 1311 SEMI-VOLATILES (cont.)

SURROGATES

Compound	CAS No		Result (ug/L)	Expected (ug/L)	Rec. (%)	Limits (%)	Qualifiers
Phenol-d5	4165-62-2	BLK	30.30	100	30.3	7 - 56	
Terphenyl-d14	98904-43-9	BLK	30.60	50	61.2	41 - 145	

Lab Control Standard 3799857 (LCS) Created on 03/18/2024 20:30 For QC Batch 1159564

RESULTS

Compound	CAS No		Result (ug/L)	Orig. Result (ug/L)	Spk Added (ug/L)	Rec. (%)	Limits (%)	RPD Limit (%)	Qualifiers
1,4-Dichlorobenzene	106-46-7	LCS	25.50		50	50.9	5 - 116		
2,4,5-Trichlorophenol	95-95-4	LCS	90.60		100	90.6	44 - 148		
2,4,6-Trichlorophenol	88-06-2	LCS	89.40		100	89.4	41 - 148		
2,4-Dinitrotoluene	121-14-2	LCS	49.80		50	99.6	49 - 138		
Hexachlorobenzene	118-74-1	LCS	38.60		50	77.3	59 - 109		
Hexachlorobutadiene	87-68-3	LCS	21.20		50	42.3	5 - 126		
Hexachloroethane	67-72-1	LCS	19		50	37.9	5 - 111		
mp-Cresol	108394/106445	LCS	74.90		100	74.9	28 - 128		
Nitrobenzene	98-95-3	LCS	35.80		50	71.6	41 - 128		
o-Cresol	95-48-7	LCS	74.10		100	74.1	34 - 136		
Pentachlorophenol	87-86-5	LCS	96		100	96	41 - 149		
Pyridine	110-86-1	LCS	18.10		50	36.1	5 - 115		

SURROGATES

Compound	CAS No		Result (ug/L)	Expected (ug/L)	Rec. (%)	Limits (%)	Qualifiers
2,4,6-Tribromophenol	118-79-6	LCS	92.40	100	92.4	23 - 131	
2-Fluorobiphenyl	321-60-8	LCS	33.30	50	66.7	24 - 116	
2-Fluorophenol	367-12-4	LCS	48.70	100	48.7	10 - 85	
Nitrobenzene-d5	4165-60-0	LCS	37.90	50	75.8	32 - 125	
Phenol-d5	4165-62-2	LCS	37.20	100	37.2	7 - 56	
Terphenyl-d14	98904-43-9	LCS	31.90	50	63.9	41 - 145	

Matrix Spike 3799858 (MS) 3350552002 For QC Batch 1159564

****NOTE - The Original Result shown below is a raw result and is only used for the purpose of calculating Matrix Spike percent recoveries. This result is not a final value and cannot be used as such.

Matrix Spike Duplicate 3799859 (MSD) 3350552002 For QC Batch 1159564

RESULTS

Compound	CAS No		Result (ug/L)	Orig. Result (ug/L)	Spk Added (ug/L)	Rec. (%)	Limits (%)	RPD Limit (%)	Qualifiers
1,4-Dichlorobenzene	106-46-7	MS	125	0	250	50	5 - 116		
1,4-Dichlorobenzene	106-46-7	MSD	123	0	250	49.3	5 - 116	RPD 1.36 (Max-30)	
2,4,5-Trichlorophenol	95-95-4	MS	465	0	500	93	44 - 148		
2,4,5-Trichlorophenol	95-95-4	MSD	423	0	500	84.6	44 - 148	RPD 9.55 (Max-23)	

QUALITY CONTROL SAMPLES

TCLP EPA 1311 SEMI-VOLATILES (cont.)

RESULTS

Compound	CAS No		Result (ug/L)	Orig. Result (ug/L)	Spk Added (ug/L)	Rec. (%)	Limits (%)	RPD Limit (%)	Qualifiers
2,4,6-Trichlorophenol	88-06-2	MS	448	0	500	89.6	41 - 148		
2,4,6-Trichlorophenol	88-06-2	MSD	387	0	500	77.5	41 - 148	RPD 14.50 (Max-23)	
2,4-Dinitrotoluene	121-14-2	MS	265	0	250	106	49 - 138		
2,4-Dinitrotoluene	121-14-2	MSD	235	0	250	94.1	49 - 138	RPD 11.90 (Max-22)	
Hexachlorobenzene	118-74-1	MS	205	0	250	81.9	59 - 109		
Hexachlorobenzene	118-74-1	MSD	185	0	250	74	59 - 109	RPD 10.20 (Max-21)	
Hexachlorobutadiene	87-68-3	MS	123	0	250	49.1	5 - 126		
Hexachlorobutadiene	87-68-3	MSD	105	0	250	42.1	5 - 126	RPD 15.40 (Max-30)	
Hexachloroethane	67-72-1	MS	90.30	0	250	36.1	5 - 111		
Hexachloroethane	67-72-1	MSD	81.80	0	250	32.7	5 - 111	RPD 9.82 (Max-30)	
mp-Cresol	108394/106445	MS	394	0	500	78.8	28 - 128		
mp-Cresol	108394/106445	MSD	358	0	500	71.6	28 - 128	RPD 9.60 (Max-20)	
Nitrobenzene	98-95-3	MS	184	0	250	73.6	41 - 128		
Nitrobenzene	98-95-3	MSD	177	0	250	70.8	41 - 128	RPD 3.83 (Max-19)	
o-Cresol	95-48-7	MS	385	0	500	77	34 - 136		
o-Cresol	95-48-7	MSD	347	0	500	69.4	34 - 136	RPD 10.40 (Max-23)	
Pentachlorophenol	87-86-5	MS	141	0	500	28.2*	41 - 149		
Pentachlorophenol	87-86-5	MSD	119	0	500	23.8*	41 - 149	RPD 17.20 (Max-28)	
Pyridine	110-86-1	MS	96	0	250	38.4	5 - 115		
Pyridine	110-86-1	MSD	109	0	250	43.8	5 - 115	RPD 13.10 (Max-30)	

SURROGATES

Compound	CAS No		Result (ug/L)	Expected (ug/L)	Rec. (%)	Limits (%)	Qualifiers
2,4,6-Tribromophenol	118-79-6	MS	504	500	101	23 - 131	
2,4,6-Tribromophenol	118-79-6	MSD	452	500	90.4	23 - 131	
2-Fluorobiphenyl	321-60-8	MS	178	250	71.2	24 - 116	
2-Fluorobiphenyl	321-60-8	MSD	156	250	62.4	24 - 116	
2-Fluorophenol	367-12-4	MS	248	500	49.6	10 - 85	
2-Fluorophenol	367-12-4	MSD	233	500	46.5	10 - 85	
Nitrobenzene-d5	4165-60-0	MS	200	250	80	32 - 125	
Nitrobenzene-d5	4165-60-0	MSD	187	250	74.9	32 - 125	
Phenol-d5	4165-62-2	MS	192	500	38.4	7 - 56	
Phenol-d5	4165-62-2	MSD	181	500	36.2	7 - 56	
Terphenyl-d14	98904-43-9	MS	109	250	43.4	41 - 145	
Terphenyl-d14	98904-43-9	MSD	93.60	250	37.4*	41 - 145	

QUALITY CONTROL SAMPLES

TCLP EPA 1311 VOLATILE ORGANIC

QC Batch

QC Batch	1159887	Prep Method	N/A
Date	N/A	Analysis Method	SW846 8260C
Tech.			

Associated Samples

3350552001 3350552002 3350552003

Leachate Blank 3799616 (LB) Created on 03/18/2024 12:28 For QC Batch 1159887

RESULTS

Compound	CAS No		Result	Units	RDL	Qualifiers
1,1-Dichloroethene	75-35-4	BLK	ND	ug/L	20	U
1,2-Dichloroethane	107-06-2	BLK	ND	ug/L	20	U
2-Butanone	78-93-3	BLK	ND	ug/L	200	U
Benzene	71-43-2	BLK	ND	ug/L	20	U
Carbon Tetrachloride	56-23-5	BLK	ND	ug/L	20	U
Chlorobenzene	108-90-7	BLK	ND	ug/L	20	U
Chloroform	67-66-3	BLK	ND	ug/L	20	U
Tetrachloroethene	127-18-4	BLK	ND	ug/L	20	U
Trichloroethene	79-01-6	BLK	ND	ug/L	20	U
Vinyl Chloride	75-01-4	BLK	ND	ug/L	20	U

Method Blank 3800489 (MB) Created on 03/19/2024 21:59 For QC Batch 1159887

RESULTS

Compound	CAS No		Result	Units	RDL	Qualifiers
1,1-Dichloroethene	75-35-4	BLK	ND	ug/L	1.0	ND
1,2-Dichloroethane	107-06-2	BLK	ND	ug/L	1.0	ND
2-Butanone	78-93-3	BLK	ND	ug/L	10.0	ND
Benzene	71-43-2	BLK	ND	ug/L	1.0	ND
Carbon Tetrachloride	56-23-5	BLK	ND	ug/L	1.0	ND
Chlorobenzene	108-90-7	BLK	ND	ug/L	1.0	ND
Chloroform	67-66-3	BLK	ND	ug/L	1.0	ND
Tetrachloroethene	127-18-4	BLK	ND	ug/L	1.0	ND
Trichloroethene	79-01-6	BLK	ND	ug/L	1.0	ND
Vinyl Chloride	75-01-4	BLK	ND	ug/L	1.0	ND

SURROGATES

Compound	CAS No		Result (ug/L)	Expected (ug/L)	Rec. (%)	Limits (%)	Qualifiers
1,2-Dichloroethane-d4	17060-07-0	BLK	29.90	30	99.5	62 - 133	
4-Bromofluorobenzene	460-00-4	BLK	30.80	30	103	79 - 114	
Dibromofluoromethane	1868-53-7	BLK	28.70	30	95.7	78 - 116	
Toluene-d8	2037-26-5	BLK	32.10	30	107	76 - 127	

QUALITY CONTROL SAMPLES

TCLP EPA 1311 VOLATILE ORGANIC (cont.)

Lab Control Standard 3800490 (LCS) Created on 03/19/2024 21:59 For QC Batch 1159887

RESULTS

Compound	CAS No		Result (ug/L)	Orig. Result (ug/L)	Spk Added (ug/L)	Rec. (%)	Limits (%)	RPD Limit (%)	Qualifiers
1,1-Dichloroethene	75-35-4	LCS	25.50		20	127	63 - 128		
1,2-Dichloroethane	107-06-2	LCS	20.50		20	102	70 - 133		
2-Butanone	78-93-3	LCS	119		100	119	50 - 152		
Benzene	71-43-2	LCS	21.50		20	107	80 - 124		
Carbon Tetrachloride	56-23-5	LCS	21		20	105	62 - 132		
Chlorobenzene	108-90-7	LCS	20.10		20	100	85 - 117		
Chloroform	67-66-3	LCS	21.30		20	106	78 - 122		
Tetrachloroethene	127-18-4	LCS	19.20		20	96.2	72 - 124		
Trichloroethene	79-01-6	LCS	22.10		20	111	77 - 124		
Vinyl Chloride	75-01-4	LCS	16.40		20	81.9	27 - 138		

SURROGATES

Compound	CAS No		Result (ug/L)	Expected (ug/L)	Rec. (%)	Limits (%)	Qualifiers
1,2-Dichloroethane-d4	17060-07-0	LCS	29.90	30	99.5	62 - 133	
4-Bromofluorobenzene	460-00-4	LCS	29.40	30	97.9	79 - 114	
Dibromofluoromethane	1868-53-7	LCS	29.40	30	98.1	78 - 116	
Toluene-d8	2037-26-5	LCS	30.80	30	103	76 - 127	

Matrix Spike 3800491 (MS) 3350552001 For QC Batch 1159887

****NOTE - The Original Result shown below is a raw result and is only used for the purpose of calculating Matrix Spike percent recoveries. This result is not a final value and cannot be used as such.

Matrix Spike Duplicate 3800492 (MSD) 3350552001 For QC Batch 1159887

RESULTS

Compound	CAS No		Result (ug/L)	Orig. Result (ug/L)	Spk Added (ug/L)	Rec. (%)	Limits (%)	RPD Limit (%)	Qualifiers
1,1-Dichloroethene	75-35-4	MS	598	0	400	150*	63 - 128		
1,1-Dichloroethene	75-35-4	MSD	569	0	400	142*	63 - 128	RPD 5.04 (Max-21)	
1,2-Dichloroethane	107-06-2	MS	429	0	400	107	70 - 133		
1,2-Dichloroethane	107-06-2	MSD	419	0	400	105	70 - 133	RPD 2.26 (Max-19)	
2-Butanone	78-93-3	MS	2400	0	2000	120	50 - 152		
2-Butanone	78-93-3	MSD	2410	0	2000	121	50 - 152	RPD 0.40 (Max-16)	
Benzene	71-43-2	MS	478	0	400	120	80 - 124		
Benzene	71-43-2	MSD	453	0	400	113	80 - 124	RPD 5.40 (Max-26)	
Carbon Tetrachloride	56-23-5	MS	449	0	400	112	62 - 132		
Carbon Tetrachloride	56-23-5	MSD	448	0	400	112	62 - 132	RPD 0.14 (Max-17)	
Chlorobenzene	108-90-7	MS	428	0	400	107	85 - 117		
Chlorobenzene	108-90-7	MSD	418	0	400	104	85 - 117	RPD 2.45 (Max-15)	
Chloroform	67-66-3	MS	466	0	400	116	78 - 122		
Chloroform	67-66-3	MSD	445	0	400	111	78 - 122	RPD 4.46 (Max-16)	

QUALITY CONTROL SAMPLES

TCLP EPA 1311 VOLATILE ORGANIC (cont.)

RESULTS

Compound	CAS No		Result (ug/L)	Orig. Result (ug/L)	Spk Added (ug/L)	Rec. (%)	Limits (%)	RPD Limit (%)	Qualifiers
Tetrachloroethene	127-18-4	MS	414	0	400	103	72 - 124		
Tetrachloroethene	127-18-4	MSD	414	0	400	103	72 - 124	RPD 0.06 (Max-38)	
Trichloroethene	79-01-6	MS	471	0	400	118	77 - 124		
Trichloroethene	79-01-6	MSD	454	0	400	114	77 - 124	RPD 3.62 (Max-18)	
Vinyl Chloride	75-01-4	MS	496	0	400	124	27 - 138		
Vinyl Chloride	75-01-4	MSD	475	0	400	119	27 - 138	RPD 4.27 (Max-40)	

SURROGATES

Compound	CAS No		Result (ug/L)	Expected (ug/L)	Rec. (%)	Limits (%)	Qualifiers
1,2-Dichloroethane-d4	17060-07-0	MS	614	600	102	62 - 133	
1,2-Dichloroethane-d4	17060-07-0	MSD	599	600	99.8	62 - 133	
4-Bromofluorobenzene	460-00-4	MS	596	600	99.3	79 - 114	
4-Bromofluorobenzene	460-00-4	MSD	592	600	98.7	79 - 114	
Dibromofluoromethane	1868-53-7	MS	593	600	98.8	78 - 116	
Dibromofluoromethane	1868-53-7	MSD	587	600	97.8	78 - 116	
Toluene-d8	2037-26-5	MS	600	600	100	76 - 127	
Toluene-d8	2037-26-5	MSD	613	600	102	76 - 127	

QUALITY CONTROL SAMPLES

WET CHEMISTRY

QC Batch

QC Batch	1158517	Prep Method	N/A
Date	N/A	Analysis Method	S2540G-11
Tech.			

Associated Samples

3350552003 3350552001 3350552002

Duplicate 3799276 (DUP) 3350573002 (non-Project Sample) For QC Batch 1158517

****NOTE - The Original Result and Duplicate Result shown below are raw results and are only used for the purpose of calculating Sample Duplicate percent recoveries. This result is not a final value and cannot be used as such.

RESULTS

Compound	CAS No		Result (%)	Orig. Result (%)				Qualifiers
Moisture	MOISTURE	DUP	98.9085	98.9755	RPD	0.07	(Max-10)	
Total Solids	TSP	DUP	1.0914	1.0244	RPD	6.33*	(Max-5)	

Duplicate 3799277 (DUP) 3350551001 (non-Project Sample) For QC Batch 1158517

****NOTE - The Original Result and Duplicate Result shown below are raw results and are only used for the purpose of calculating Sample Duplicate percent recoveries. This result is not a final value and cannot be used as such.

RESULTS

Compound	CAS No		Result (%)	Orig. Result (%)				Qualifiers
Moisture	MOISTURE	DUP	1.3342	1.3406	RPD	0.48	(Max-10)	
Total Solids	TSP	DUP	98.6657	98.6593	RPD	0.0060	(Max-5)	

Duplicate 3799278 (DUP) 3350550001 (non-Project Sample) For QC Batch 1158517

****NOTE - The Original Result and Duplicate Result shown below are raw results and are only used for the purpose of calculating Sample Duplicate percent recoveries. This result is not a final value and cannot be used as such.

RESULTS

Compound	CAS No		Result (%)	Orig. Result (%)				Qualifiers
Moisture	MOISTURE	DUP	3.1365	3.2589	RPD	3.83	(Max-10)	
Total Solids	TSP	DUP	96.8634	96.7410	RPD	0.13	(Max-5)	

Duplicate 3799279 (DUP) 3350573009 (non-Project Sample) For QC Batch 1158517

****NOTE - The Original Result and Duplicate Result shown below are raw results and are only used for the purpose of calculating Sample Duplicate percent recoveries. This result is not a final value and cannot be used as such.

QUALITY CONTROL SAMPLES

WET CHEMISTRY (cont.)

RESULTS

Compound	CAS No		Result (%)	Orig. Result (%)			Qualifiers
Moisture	MOISTURE	DUP	99.4378	99.3472	RPD	0.09 (Max-10)	
Total Solids	TSP	DUP	0.5621	0.6527	RPD	14.90* (Max-5)	

Duplicate 3799280 (DUP) 3350594002 (non-Project Sample) For QC Batch 1158517

****NOTE - The Original Result and Duplicate Result shown below are raw results and are only used for the purpose of calculating Sample Duplicate percent recoveries. This result is not a final value and cannot be used as such.

RESULTS

Compound	CAS No		Result (%)	Orig. Result (%)			Qualifiers
Moisture	MOISTURE	DUP	60.0640	70.8353	RPD	16.50* (Max-10)	
Total Solids	TSP	DUP	39.9359	29.1646	RPD	31.20* (Max-5)	

Duplicate 3799281 (DUP) 3350643001 (non-Project Sample) For QC Batch 1158517

****NOTE - The Original Result and Duplicate Result shown below are raw results and are only used for the purpose of calculating Sample Duplicate percent recoveries. This result is not a final value and cannot be used as such.

RESULTS

Compound	CAS No		Result (%)	Orig. Result (%)			Qualifiers
Moisture	MOISTURE	DUP	2.9841	2.6233	RPD	12.90* (Max-10)	
Total Solids	TSP	DUP	97.0158	97.3766	RPD	0.37 (Max-5)	

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Lab ID	Sample ID	Preparation Method	Prep Batch	Prep Date/Time	By	Analysis Method	Anly Batch
3350552001	AC10530-001	SW846 3015A	1159572	03/19/2024 01:15	ANN	SW846 6010C	1159741
		SW846 7470A	1160114	03/21/2024 11:00	JSE	SW846 7470A	1160449
		SW846 3510C	1159564	03/19/2024 13:45	BNR	SW846 8270E	1159933
		N/A	N/A	N/A		SW846 8260C	1159887
		N/A	N/A	N/A		S2540G-11	1158517
3350552002	AC10530-002	SW846 3015A	1159572	03/19/2024 01:15	ANN	SW846 6010C	1159741
		SW846 7470A	1160114	03/21/2024 11:00	JSE	SW846 7470A	1160449
		SW846 3510C	1159564	03/19/2024 13:45	BNR	SW846 8270E	1159933
		N/A	N/A	N/A		SW846 8260C	1159887
		N/A	N/A	N/A		S2540G-11	1158517
3350552003	AC10530-003	SW846 3015A	1159572	03/19/2024 01:15	ANN	SW846 6010C	1159741
		SW846 7470A	1160114	03/21/2024 11:00	JSE	SW846 7470A	1160449
		SW846 3510C	1159564	03/19/2024 13:45	BNR	SW846 8270E	1159933
		N/A	N/A	N/A		SW846 8260C	1159887
		N/A	N/A	N/A		S2540G-11	1158517

EMSL Analytical, Inc.
Environmental Chemistry Lab Service
200 Route 130 North, Cinnaminson, NJ 08077
TEL: (856) 858-4800 FAX: (856) 786-5974

Chain of Custody / Analysis Request Form
Print ALL Information. Incomplete chain of custody could result in the delay of analysis.

EM
Acc
Indi

3350552
Logged By: MJE
PM: SSL

lected:

REPORT RESULTS TO:	SEND INVOICE TO:
Name: Travis Albert PO#:	Name: PO#:
Company EMSL Analytical, Inc.	Company EMSL Analytical, Inc.
Address: 200 Route 130 North	Address: 200 Route 130 North
City: Cinnaminson	City: Cinnaminson
State: NJ Zip: 08077	State: NJ Zip: 08077
Tel: 856-303-2548 ext. 2548 Fax: 856-854-2362	Tel: 800-220-3675 Fax: 856-854-2362
Email: sublab@emsl.com	# of Samples in Shipment: 3

Turnaround Time - 10 Business Days
Analytical Laboratory Services
Due 3/29
301 Fulling Mill Rd
Middletown, PA 17057
717-944-5541

PROJECT NAME:

Date of Sample Shipment: 3/14/24

Sampled by: (Signature) EMSL client

	Lab Sample Number (WBA24)	Client Sample ID	Comp	Grab	WATER	SOIL	AIR	SLUDGE	OTHER	HCl	HNO3	H2SO4	ICE	DATE	TIME	TCLP Volatiles	TCLP Semi-Volatiles	TCLP RCRA 8							
1.	AC10530-001							X					X	3/5/24	10:40a	~~X~~	~~X~~	~~X~~	MJE						
2.	AC10530-002							X					X	3/5/24	10:40a	~~X~~	~~X~~	~~X~~	3/15/24						
3.	AC10530-003							X					X	3/5/24	10:40a	~~X~~	~~X~~	~~X~~							

Released By Signature	Date & Time Released	Delivery Method	Received By Signature	Agency	Date & Time Received	Condition Note
[signature]	3/14/24	FedEx	FedEx			
FedEx 3/15/24 832						

Please indicate reporting requirements: ☐1. Results Only ☒2. Results and QC ☐3. Reduced Deliverables ☐4. Disk Deliverable ☐5. Other

Comments: Please analyze for TCLP Volatiles, TCLP Semi-Volatiles, TCLP RCRA 8 (As, Ba, Cd, Cr, Pb, Hg, Se, Ag)

Temp By:	WO Temp (°C)	Therm ID
MJE	0°	570

Receipt Info Completed By:	MJE
Cooler Custody Seal Intact	Y N NA
Sample Custody Seal Intact	Y N NA
Received on Ice	Y N NA
Cooler & Samples Intact	Y N
Correct Containers Provided	Y N
Sample Label/COC Agree	Y N
Adequate Sample Volumes	Y N
CR6 Samples Filtered	Y N NA
OP Samples Filtered	Y N NA
VOA Trip Blank	Y N NA
NJ≤ 4 Days?	Y N
Rad Screen (uCi)	—
Courier/Tracking #:	2727357 2443
SDWA Compliance	Y N
PWSID	
WV Containers 0-6°C	Y N NA

*No Samplers, Etc, Glass - MJE

0°C

Appendix VII

SGS Galson Lead Wipe Sampling Analytical Results, COCs, and Certifications

SGS GALSON

Jonathan West
GHD Services Inc.
550 E. Swedesford Road
Suite 140
Wayne, PA 19087

October 15, 2024

Account# 29016

Login# L639880

Dear Jonathan West:

Enclosed are the analytical results for the samples received by our laboratory on October 08, 2024. All samples on the chain of custody were received in good condition unless otherwise noted. Any additional observations will be noted on the chain of custody.

Please contact client services at (888) 432-5227 if you would like any additional information regarding this report. Thank you for using SGS Galson.

Sincerely,

SGS Galson

Lisa Swab

Lisa Swab
Laboratory Director

Enclosure(s)

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Analytical Disclaimers

- Unless otherwise noted within the report, all quality control results associated with the samples were within established control limits or did not impact reported results.

- Note: The findings recorded within this report were drawn from analysis of the sample(s) provided to the laboratory by the Client (or a third party acting at the Client's direction). The laboratory does not have control over the sampling process, including but not limited to the use of field equipment and collection media, as well as the sampling duration, collection volume or any other collection parameter used by the Client. The findings herein constitute no warranty of the sample's representativeness of any sampled environment, and strictly relate to the samples as they were presented to the laboratory. For recommended sampling collection parameters, please refer to the Sampling and Analysis Guide at www.sgsgalson.com.

- Unrounded results are carried through the calculations that yield the final result and the final result is rounded to the number of significant figures appropriate to the accuracy of the analytical method. Please note that results appearing in the columns preceding the final result column may have been rounded and therefore, if carried through the calculations, may not yield an identical final result to the one reported.

- The stated LOQs for each analyte represent the demonstrated LOQ concentrations prior to correction for desorption efficiency (if applicable).

- Unless otherwise noted within the report, results have not been blank corrected for any field blank or method blank data.

Accreditations SGS Galson holds a variety of accreditations and recognitions. Our quality management system conforms with the requirements of ISO/IEC 17025. Where applicable, samples may also be analyzed in accordance with the requirements of ELAP, NELAC, or LELAP under one of the state accrediting bodies listed below. Current Scopes of Accreditation can be viewed at http://www.sgsgalson.com in the accreditations section of the "About" page. To determine if the analyte tested falls under our scope of accreditation, please visit our website or call Client Services at (888) 432-5227.

National/International	Accreditation/Recognition	Lab ID#	Program/Sector
AIHA-LAP, LLC - IHLAP, ELLAP, EMLAP	ISO/IEC 17025 and USEPA NLLAP	Lab ID 100324	Industrial Hygiene, Environmental Lead, Environmental Microbiology

State	Accreditation/Recognition	Lab ID#	Program/Sector
New York (NYSDOH)	ELAP and NELAC (TNI)	Lab ID: 11626	Air Analysis, Solid and Hazardous Waste
Louisiana (LDEQ)	LELAP	Lab ID: 04083	Air Analysis, Solid Chemical Materials

Legend

< - Less than	mg - Milligrams	MDL - Method Detection Limit	ppb - Parts per Billion
> - Greater than	ug - Micrograms	NA - Not Applicable	ppm - Parts per Million
l - Liters	m3 - Cubic Meters	NS - Not Specified	ppbv - ppb Volume
LOQ - Limit of Quantitation	kg - Kilograms	ND - Not Detected	ppmv - ppm Volume
ft2 - Square Feet	cm2 - Square Centimeters	in2 - Square Inches	ng - Nanograms

LABORATORY ANALYSIS REPORT

6601 Kirkville Road
East Syracuse, NY 13057
(315) 432-5227
FAX: (315) 437-0571
www.sgsgalson.com

Client : GHD Services Inc.
Site : NS

Date Sampled : 03-SEP-24
Date Received : 08-OCT-24

Account No.: 29016
Login No. : L639880

Date Analyzed : 11-OCT-24 - 14-OCT-24
Report ID : 1453068

Lead

Sample ID	Lab ID	Area cm2	Total ug	Conc ug/cm2
NPS-093024-02	L639880-1	100	6600	66
NPS-093024-01	L639880-2	100	2600	26
NPS-093024-03	L639880-3	100	92	0.92
NPS-093024-04	L639880-4	100	120	1.2
NPS-093024-05	L639880-5	100	1900	19
NPS-093024-06	L639880-6	100	14000	140
NPS-093024-07	L639880-7	100	14000	140
NPS-093024-08	L639880-8	100	390	3.9
NPS-093024-09	L639880-9	100	470	4.7
NPS-093024-10	L639880-10	100	550	5.5

COMMENTS: Please see attached lab footnote report for any applicable footnotes.

Level of Quantitation: 0.50 ug
Analytical Method : mod SW846 3050B/6010C/NIOSH9102 ICP LDHB
Collection Media : Lead Wipe

Submitted by: DJL/CAW/MSC/GOM Approved by: JJL
Date : 15-OCT-24
Supervisor : JJL

LABORATORY FOOTNOTE REPORT

GALSON

6601 Kirkville Road
East Syracuse, NY 13057
(315) 432-5227
FAX: (315) 437-0571
www.sgsgalson.com

Client Name : GHD Services Inc.
Site :

Date Sampled : 03-SEP-24
Date Received: 08-OCT-24
Date Analyzed: 11-OCT-24 - 14-OCT-24

Account No.: 29016
Login No. : L639880

L639880 (Report ID: 1453068):
For applicable NYS sampling events, laboratory accreditation through NYSDOH applies only to Lead results.
Reported results reflect elemental analysis of the requested metals. Certain compounds may not be solubilized during digestion, resulting in data that is biased low.
SOPs: im-mwvleadwp(36), MT-SOP-27(22)

L639880 (Report ID: 1453068):
Accuracy and mean recovery data presented below is based on a 95% confidence interval (k=2). The estimated accuracy applies to the media, technology, and SOP referenced in this report and does not account for the uncertainty associated with the sampling process. The accuracy is based solely on spike recovery data from internal quality control samples. Where N/A appears below, insufficient data is available to provide statistical accuracy and mean recovery values for the associated analyte.

Parameter	Accuracy	Mean Recovery
Lead	+/-16.7%	95.9%

1Z10431787655182 34
Date: 10/08/24
Shipper: UPS
Initials: BCF
Prep: UNKNOWN

L639880

7

CHAIN OF CUSTODY

Turnaround Time (TAT)	Surcharge
☐ Standard	0%
☐ 4 Business Days	35%
☐ 3 Business Days	50%
☐ 2 Business Days	75%
☐ Next Day by 6pm	100%
☐ Next Day by Noon	150%
☐ Same Day	200%

Client Acct No.: 29016

Original Prep No.: PSY756321

Online COC No.: 307158

Report To: Jonathan West
Company Name: GHD Services Inc.
Address 1: 550 E. Swedesford Road
Address 2: Suite 140
City, State Zip: Wayne, PA 19087
Phone No.: 215-853-3382
Cell No.: 215-588-0092
Email reports to: jonathan.west@ghd.com, catherine.warner@ghd.com
Email EDD to: jonathan.west@ghd.com, catherine.warner@ghd.com
Comments:

Invoice To: ACCOUNTS PAYABLE
Company Name: GHD Services Inc.
Address 1: 2055 Niagara Falls Blvd
Address 2: Suite 3
Company Name: Niagara Falls, NY 14304
Phone No.: 716-297-6150
Email Address: katia.rosales@sgs.com
Comments:
P.O. No.:
Payment info.: ☐ I will call SGS to provide credit card info
☐ Card on File (enter the last five digits on the line below)

Comments:

State Sampled: ☐ MSHA

Site Name: | Project: | Sampled By: | List description of industry or Processes/Interfaces present in sampling area:

Sample ID (Maximum of 20 Characters)	Date Sampled	Collection Medium	Sample Volume Sample Time Sample Area	Liters Minutes in², cm², ft²	Analysis Requested	Method Reference	Internal Notes
NPS-090324-02	9/3/2024	Metals Wipe (Pb wipe)	11:05	100 cm²	Lead	mod SW846 3050B/6010C/NIOSH910 2 ICP LDHB	middle of [illegible]
NPS-090324-01	9/3/24	Metals Wipe (Pb wipe)	11:15	100cm²	Lead	mod SW846 3050B/6010C/NIOSH910 2 ICP LDHB	Shooter location

☐ If the method(s) indicated on the COC are not our routine/preferred method(s), we will substitute our routine/preferred methods. If this is not acceptable, check here to have us contact you.

Chain of Custody	Print Name / Signature		Date	Time		Print Name / Signature		Date	Time
Relinquished By:	Scott Walczyk	[signature]	10/4/24	9:00 AM	Received By:	Bill Fischer	Bill Fischer	08OCT24	1231
Relinquished By:					Received By:				

Samples received after 3pm will be considered as next day's business.

Correction: Sample Date 10/03/2024

Online COC No. :307158
Prep No. :PSY756321
Account No. :29016
Finalized :09/30/2024 12:12:57

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SGS CHAIN OF CUSTODY

Comments:

Sample ID (Maximum of 20 Characters)	Date Sampled	Collection Medium	Sample Volume Sample Time Sample Area	Liters Minutes in², cm², ft²	Analysis Requested	Method Reference	Internal Notes
NPS-090324-03	9/3/2024	Metals Wipe (Pb wipe)	11:25	100 cm²	Lead	mod SW846 3050B/6010C/NIOSH910 2 ICP LDHB	Range Left/North wall
NPS-090324-04		Metals Wipe (Pb wipe)	11:29		Lead	mod SW846 3050B/6010C/NIOSH910 2 ICP LDHB	Range Right/South wall
NPS-090324-05		Metals Wipe (Pb wipe)	11:36		Lead	mod SW846 3050B/6010C/NIOSH910 2 ICP LDHB	Adjacent room floor
NPS-090324-06		Metals Wipe (Pb wipe)	11:41		Lead	mod SW846 3050B/6010C/NIOSH910 2 ICP LDHB	Target Location
NPS-090324-07		Metals Wipe (Pb wipe)	11:49		Lead	mod SW846 3050B/6010C/NIOSH910 2 ICP LDHB	Bullet land location
NPS-090324-08		Metals Wipe (Pb wipe)	12:03		Lead	mod SW846 3050B/6010C/NIOSH910 2 ICP LDHB	Hallway floor (adj to range)
NPS-090324-09	↓	Metals Wipe (Pb wipe)	12:21	↓	Lead	mod SW846 3050B/6010C/NIOSH910 2 ICP LDHB	North hanger floor

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Chain of Custody	Print Name / Signature		Date	Time		Print Name / Signature		Date	Time
Relinquished By:	Scott Wallace	[signature]	10/4/24	9:00am	Received By:	Bill Fischer	Bill Fischer	08OCT24	1231
Relinquished By:					Received By:				

Samples received after 3pm will be considered as next day's business.

Correction: Sample Date 10/03/24

Online COC No. :307158
Prep No. :PSY756321
Account No. :29016
Finalized :09/30/2024 12:12:57

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Comments:

Sample ID (Maximum of 20 Characters)	Date Sampled	Collection Medium	Sample Volume Sample Time Sample Area	Liters Minutes in², cm², ft²	Analysis Requested	Method Reference	Internal Notes
NPS-090324	9/3/24	Metals Wipe (Pb wipe)	100cm²	12:26	Lead	mod SW846 3050B/6010C/NIOSH9102 ICP LDHB	South hangar floor

ID is NPS-090324-10
KMS 10/09/24

☐ If the method(s) indicated on the COC are not our routine/preferred method(s), we will substitute our routine/preferred methods. If this is not acceptable, check here to have us contact you.

Chain of Custody	Print Name / Signature		Date	Time		Print Name / Signature		Date	Time
Relinquished By:	Scott Walczyk		10/1/24	9:00AM	Received By:	Bill Fischer	Bill Fischer	080CT24	1231
Relinquished By:					Received By:				

Samples received after 3pm will be considered as next day's business.

Correction: Sample Date 10/03/24

Online COC No. :307158
Prep No. :PSY756321
Account No. :29016
Finalized :09/30/2024 12:12:57

All services are rendered in accordance with the applicable SGS General Conditions of Service accessible via: http://www.sgs.com/en/Terms-and-Conditions.aspx

SGS North America Inc. 6601 Kirkville Road E. Syracuse, NY 13057, USA t +1 888 432 5227 | +1 315 432 5227 www.galsonlabs.com | www.sgs.com

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The Power of Commitment

Geotechnical Investigation Report

NPS Floyd Bennett Field Hangars 3 & 4 Rehabilitation

Quinn Evans Architects, Inc.

June 25, 2025

The Power of Commitment

GHD
14501 George Carter Way
Chantilly, Virginia 20151, United States
T +1 571 325 5000 | **F** | **E** info-northamerica@ghd.com | **ghd.com**

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The Power of Commitment

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Figure 1	Site Location Map
Figure 2	Borehole Locations Map

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Appendix A	Borehole Logs
Appendix B	Geotechnical Laboratory Test Results
Appendix C	Corrosion Potential Laboratory Test Results

1. Introduction

GHD Services Inc. (GHD) was retained by Quinn Evans Architects, Inc. (QE) to conduct a geotechnical evaluation for the rehabilitation of Hangars 3 & 4 at Floyd Bennett Field in the Gateway National Recreation Area located at 3159 Flatbush Avenue in Jamaica Bay Unit, Brooklyn, New York (Site). A Site Location Map showing the project Site is included as Figure 1.

Per the Hangar Foundations Drawings dated November 15, 1929, the existing masonry walls of the hangars, lean-tos and the hangar door tracks bear on grade beams and pile caps supported by 14-inch square reinforced concrete piles driven to a depth of about 35 feet. The existing hangar floors are comprised of a 6-inch concrete slab-on-grade. Differential settlement of up to 6.5 inches of the slab-on-grade relative to the pile-supported elements has been documented. Existing masonry non-load bearing partitions in the lean-tos have also experienced some differential settlement. GHD understands that no signs of differential settlement between the pile-supported elements have been observed above-grade.

GHD was provided with the General Requirements for Subsurface Exploration and Analysis (GRSEA) document prepared by Matteo Ferran Structural Engineers (MFSE) and dated September 6, 2024. Per review of the GRSEA as well as subsequent e-mail correspondence and a project meeting with QE and MFSE on May 19, 2025, GHD understands the hangars will be restored to their original appearance and condition and the proposed rehabilitation will include the following:

- Existing exterior masonry walls will remain in place founded on the existing pile-supported foundation system.
- Removal and replacement of the existing slab-on-grade and interior walls and constructing a new slab-on-grade including thickening the slab edges and doweling the slab into the existing grade beams.
- Installation of mechanical and electrical equipment in the areas of the existing lean-tos.

The future use of the hangars is not presently known. The planned rehabilitation is to include an anticipated maximum floor loads of 150 pounds per square foot (psf) in slab-on-grade areas and less than 300 psf loading from the mechanical equipment pads. Future development of the interior space of the hangars could include various heavier structures and enclosures.

This report contains a description and findings of GHD's geotechnical evaluation, as well as professional opinions and geotechnical recommendations to assist others in the design and construction of the new slab-on-grade, pavements, mechanical and electrical foundations, as well as providing options for deep foundation support of heavier structures.

2. Field and Laboratory Programs

2.1 Field Program

The field work for this geotechnical investigation was carried out from April 15 to 18, 2025. ADT-Cascade completed the drilling, in-situ testing and sampling operations. A GHD geo professional provided oversight of the drilling operations and logged the boreholes. Four (4) geotechnical boreholes (B-1 to B-4) were advanced at the Site. The borehole locations are shown on the provided Borehole Locations Map, included as Figure 2. The borehole locations were estimated from measurements from existing Site features and ground surface elevations were estimated from topographic data prepared by VHB dated May 30, 2024.

At each borehole location, a Geoprobe 7822 DT track-mounted drill rig was used to advance the boreholes to a depth of 50 feet below ground surface (bgs).

Hand augering was performed to a depth of 5 feet bgs for verification of clearance of obstructions. Drilling then commenced using 4.25-inch I.D. hollow-stem augers to a depth of 10 feet bgs followed by wash rotary using a

3-7/8-inch tri-cone roller-bit with bentonite and water as drilling mud to advance the borehole to 50 feet bgs. The Standard Penetration Test (SPT) method per ASTM D1586 was performed continuously to a depth of 10 feet and at a maximum of 5-foot intervals thereafter. The results of the penetration tests from the split spoon samples are reported as N-values on the borehole logs at their corresponding depths. The split spoon sampler was driven 18 inches into the ground using a 140-pound hammer falling 30 inches. The sum of the number of blows required to advance the split spoon the second and third 6-inch intervals (last 12 inches) is termed the N-value.

Groundwater level observations were made prior to the introduction of drilling mud at 10 feet bgs. Upon completion of drilling, the boreholes were backfilled with soil cuttings and the surface patched to match the surrounding area.

Geotechnical soil samples obtained from the boreholes were field classified upon retrieval for type, texture, color, and moisture condition. The detailed results of the boreholes are recorded on the accompanying borehole logs in Appendix A.

2.2 Laboratory Program

The split spoon samples were sealed in clean, airtight, glass jars and transported to GHD's geotechnical laboratory in Farmington Hills, Michigan for further examination and testing. Grab samples from auger cuttings were obtained from the upper 10 feet of boreholes B-1 and B-4, which were transported to Geotechnics in East Pittsburg, Pennsylvania for testing for corrosion potential.

Geotechnical samples received in the GHD laboratory were visually examined by a geotechnical professional and classified based on type, texture, plasticity, color, and consistency in general accordance with the Unified Soil Classification System (ASTM D2487). Moisture content determinations were completed on all recovered split-spoon samples. Grain size analyses (ASTM D422) and Atterberg limit tests (liquid and plastic limits, ASTM D4318) were completed on select samples. Results of the moisture content and liquid and plastic limit tests are included on the individual borehole log at their respective depths.

Samples received by Geotechnics were tested for parameters to characterize the corrosion potential in accordance with the soil-test evaluation in the American Water Works Association (AWWA) C-105 Standard. Testing conducted by Geotechnics included pH (AASHTO T289-91), minimum resistivity (AASHTO T288-12), sulfate content (ASTM T290–95), and chloride content (ASTM T291-94). Geotechnics shipped portions of each sample to Eurofins' laboratory in Pittsburgh, PA for oxidation reduction (redox) potential (SM 2580B) and sulfide content (SW846 EPA 9034) testing. The results of the tests were used to designate a total aggressivity score and soil aggressivity classification for each sample. Geotechnics provided a Laboratory Test Results Transmittal dated May 12, 2025, which included a Eurofins Analytical Report also dated May 12, 2025.

The detailed results of the boreholes are recorded on the accompanying borehole logs in Appendix A. In addition, GHD's laboratory test results are provided in Appendix B, and the laboratory test results from Geotechnics and Eurofins are included in Appendix C.

3. Regional Geology

Jamaica Bay is located along the southern shore of Long Island, New York, and has a geological profile shaped by both natural processes and human activities. The area is primarily covered by Late Wisconsin an glacial outwash, consisting of unconsolidated sediments like sand and gravel, which are obscured by modern shore and urban deposits. The region features diverse depositional environments, including salt marshes, beaches, dunes, and urban fill. Beneath these sedimentary layers lies the southeastward dipping crystalline basement complex of the New York City series, with bedrock buried under significant thicknesses of sediment in Brooklyn and Queens. Geologic mapping indicates bedrock is located between Elevation -700 and -800 feet mean sea level (msl).

Human activities have significantly altered the geological processes in Jamaica Bay, impacting both the surface and subsurface geology. The GRSEA indicates the structures in the project vicinity were originally built between 1929 and 1938 on land created by infilling the channels located between Barren Island, several smaller islands and portions of Brooklyn with sand pumped from the bottom sediments of Jamaica Bay. The GRSEA also indicates Hangars 3 & 4 are not located within a flood zone but are located immediately adjacent to mapped flood zones.

4. Site and Subsurface Conditions

Details of the subsurface conditions encountered at the Site are summarized below, and are also presented on the accompanying borehole logs in Appendix A.

It should be noted that the conditions indicated on the borehole logs are for specific locations only and can vary beyond the borehole locations. The soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling and excavation. These boundaries are intended to reflect approximate transition zones and should not be interpreted as exact planes of geological change.

In addition, the descriptions provided on the borehole logs are inferred from a variety of factors, including visual observations of the soil samples retrieved, laboratory testing, and measurements prior to and after drilling.

4.1 Soil Conditions

4.1.1 Concrete Slab and Asphalt Pavement

At borehole location B-1 performed inside the existing hangars, approximately 6 inches of concrete slab was encountered at the ground surface. At borehole locations B-2 through B-4 performed just outside the hangars, approximately 3 to 6 inches of asphalt pavement was encountered at the ground surface.

4.1.2 Fill

Sand fill was encountered under the concrete slab and asphalt pavement and extended to approximately 13.5 to 18.5 feet bgs at all borehole locations. The sand fill consisted of variable amounts of silt and gravel. The fill was generally light brown to brown and gray. SPT ‘N’ values obtained within the sand fill ranged from 0 (weight of hammer) to 12 blows per foot (bpf), indicating a very loose to medium dense relative density. The sand was generally moist to wet with moisture content by weight ranging from 3% to 36%.

Sandy silt and sandy clay fill with variable amounts of organics, wood chips and roots were encountered under the sand fill layer at B-1 and B-3 and extended to depths ranging from 19.0 to 19.5 feet bgs. The sandy silt encountered at borehole B-3 had a high liquid limit value of 53 and a low plasticity index of eight, which is considered an elastic silt. The sandy silt and sandy clay fill were generally dark gray and gray. SPT ‘N’ values obtained within the sandy silt and sandy clay fill was 2 bpf, indicating a very soft consistency. The sandy silt and sandy clay fill were generally moist to wet with moisture content by weight ranging from 42% to 50%.

4.1.3 Sand (SP, SP-SC, SC, SM)

Sand (USCS classification of SP, SP-SC, SC, SM) with variable amounts of silt, clay, and gravel was encountered below the fill at all borehole locations and extended to the borehole termination depth of 50 feet bgs. Generally, the sand was gray and dark gray. Trace amounts of shells were encountered within the clayey sand at B-4 at a depth of 18.5 to 23.5 feet bgs. The SPT N values in the sand ranged from 0 (weight of hammer) to 5 bpf to depths ranging from 23.5 to 28.5 feet bgs indicating a very loose to loose relative density. Below these depths and extending to the borehole termination depths, the SPT N values increased to values ranging from 11 to 40 bpf, indicating a medium

dense to dense relative density. The sand was moist to wet with moisture content by weight measured between 15% and 44%.

4.2 Groundwater Conditions

The soils encountered in the investigation were generally moist to wet. Water was observed at the locations of boreholes B-2 through B-4 during drilling at a depth of 10 feet bgs. Water was not observed at the borehole location B-1 prior to introducing drilling mud (water and bentonite) for wash rotary drilling operations. Groundwater observations were not able to be made at the completion of drilling due to the drilling mud placement in the boreholes.

Groundwater observations during drilling are often not reliable indicators of the static water table due to the drilling methods employed that may seal off the natural paths for groundwater flow.

It should be noted that groundwater levels are transient and tend to fluctuate with the seasons and periods of precipitation and temperature. Typically, monitoring wells or piezometers are used to measure groundwater levels in soils over a long period of time. No monitoring wells were installed in the soil boreholes that pertain to this report.

4.3 Laboratory Results

Moisture content determinations were completed on all recovered samples. Grain size analyses and Atterberg limit tests were carried out on representative split-spoon samples. The test results are summarized below, and the detailed geotechnical laboratory test results are provided in Appendix B.

Table 1 Summary of Soil Laboratory Test Results

Borehole No.	Sample No.	Sample Depth (ft bgs)	% Passing No. 200 Sieve	W_n (%)	Atterberg Limits (%)			Soil Description
					LL	PL	PI	
B-1	SS-4	8.5	1	13	-	-	-	(SP) SAND
B-1	SS-7	23.5	1	44	-	-	-	(SP) SAND
B-2	SS-4	8.5	1	22	-	-	-	(SP) SAND
B-2	SS-6	18.5	9	24	NP	NP	NP	(SP-SC) SAND with clay/silt
B-2	SS-10	38.5	2	15	-	-	-	(SP) SAND
B-3	SS-5	13.5	53	50	53	45	8	(MH) Sandy SILT with clay
B-3	SS-8	28.5	1	27	-	-	-	(SP) SAND
B-4	SS-3	7.0	1	8	-	-	-	(SP) SAND
B-4	SS-6	18.5	48	32	35	21	14	(SC) Clayey SAND with silt
B-4	SS-9	33.5	1	26	-	-	-	(SP) SAND

Notes:
W_n – Natural Water Content; LL – Liquid Limit; PL – Plastic Limit; PI – Plasticity Index
Soil classification based on Unified Soil Classification System (ASTM D2487)

Table 2 Summary Results of Grain Size Analysis

Borehole No.	Sample No.	Sample Depth (feet bgs)	Soil Description	Percent Gravel	Percent Sand	Percent Fines
B-1	SS-4	8.5	(SP) SAND	4	95	1
B-1	SS-7	23.5	(SP) SAND	0	99	1
B-2	SS-4	8.5	(SP) SAND	0	99	1
B-2	SS-6	18.5	(SP-SC) SAND with clay/silt	0	91	9
B-2	SS-10	38.5	(SP) SAND	0	98	2
B-3	SS-5	13.5	(MH) Sandy SILT with clay	0	47	53
B-3	SS-8	28.5	(SP) SAND	0	99	1
B-4	SS-3	7.0	(SP) SAND	0	99	1
B-4	SS-6	18.5	(SC) Clayey SAND with silt	0	52	48
B-4	SS-9	33.5	(SP) SAND	0	99	1
Fines – passing the #200 sieve						

4.3.1 Testing for Corrosion Potential

Representative soil samples recovered from the boreholes were tested for parameters to characterize the corrosion potential in accordance with the soil-test evaluation in the American Water Works Association (AWWA) C-105 Standard. Geotechnics conducted pH, minimum resistivity, sulfate content and chloride content testing and Eurofins conducted oxidation reduction (redox) and sulfide content testing. The results of the tests were used to designate a total aggressivity score and soil aggressivity classification for each sample. The aggressivity scores are summarized below in Table 3. The detailed soil corrosion test results are provided in Appendix C.

Table 3 Summary of Test Results for Corrosion Potential

Borehole	Sample No.	Sample Depth (ft bgs)	pH	Minimum Resistivity (ohm-cm)	Sulfate Content (ppm)	Chloride Content (ppm)	Redox Potential (mV)	Sulfide Content (mg/kg)	Aggressivity Score
B-1	GS-1*	0 – 10	8.05	6,200	68.3	7.38	200	ND	1
B-4	GS-1*	0 – 10	7.67	32,000	42.6	2.78	180	ND	1
*Grab sample (GS-1) taken from auger cuttings from the upper 10 feet									

The AWWA assigns points based on the results of pH, resistivity, sulfides, redox potential, and the moisture condition of the soil. A soil that has a total point score of 10 or more may be potentially corrosive to ductile iron pipe. Based on the results obtained for the samples submitted, less than 10 points (aggressivity score, see Table 3) are assigned to each sample. Thus, the soils have a low corrosion potential.

Per Caltrans Corrosion Guidelines Version 3.2 dated May 2021, for structural elements, the Department considers a Site to be corrosive if one or more of the following conditions exist for the representative soil samples taken at the Site:

- Chloride concentration is 500 ppm or greater.
- Sulfate concentration is 1,500 ppm or greater.
- The pH is 5.5 or less.

Test results indicated chloride contents range from about 2.78 to 7.38 ppm, pH values range from 7.67 to 8.05 and sulfates contents range from about 42.6 to 68.3 ppm. Thus, the tested values fall below the range to be considered corrosive per Caltrans.

Minimum resistivity ranged from 6,200 to 32,000 ohm-cm indicative of mildly to negligible corrosive conditions per NACE (National Association of Corrosion Engineers) Corrosion Basics.

Based on laboratory test results, the subsurface conditions have a low potential for corrosion for buried ductile iron or steel elements.

According to ACI 318, soils containing less than 0.10% sulfates by weight are a “negligible” risk of sulfate exposure potential for concrete contacting soil. The sulfate content for the samples tested indicates less than 0.10% by weight. Therefore, normal Portland cement can be used for below grade concrete structures.

5. Discussion and Recommendations

5.1 General

The purpose of this investigation was to obtain geotechnical information regarding the subsurface and groundwater conditions and to provide geotechnical recommendations for the design and construction of the new slab-on-grade, pavements, mechanical and electrical foundations, as well as providing options for deep foundation support of heavier structures and enclosures.

Based upon the review of the GRSEA, subsequent e-mail correspondence and project meeting with QE and MFSE on May 19, 2025, GHD understands the hangars will be restored to their original appearance and condition. The existing exterior masonry walls will remain in place founded on the existing pile-supported foundation system including pile caps and grade beams. The existing slab-on-grade and interior walls will be removed and replaced. The new slab-on-grade is planned to include thickened slab edges that will be doweled into the existing grade beams. The anticipated maximum slab-on-grade load is 150 psf. New mechanical and electrical equipment are planned to be installed on 12-inch-thick concrete pads with the following proposed dimensions and maximum loads:

– Switchboard: 7,043 lb equipment on 108 square feet (sf) pad (4’-8” x 23’-0”), bearing pressure of 216 psf
– Transformer: 362 lb equipment on 6.7 sf pad (2’-6” x 2’-8”), bearing pressure of 205 psf
– Inverter: 4,063 lb equipment on 33.5 sf pad (3’-7” x 9’-4”), bearing pressure of 272 psf

The future use of the hangars is not presently known. Future development of the interior space of the hangars could include various heavier structures and enclosures.

Based on the above information summary and data obtained from the boreholes, and assuming it to be representative of the subsurface conditions, the following comments and recommendations are offered in relation to the proposed design and construction of the various Site improvements.

5.2 Earthwork

5.2.1 Site Preparation and Grading

GHD recommends that all existing asphalt pavement, concrete slab, surficial debris, surficial fill, existing structure foundations and other deleterious materials be completely removed from areas where the new pavements, slabs-on-grade and various structures will be constructed.

In planned pavement areas, the exposed subgrade should be compacted under the observation of qualified geotechnical personnel using a smooth vibratory roller if granular soils are present and a sheep’s foot roller if cohesive soils are present. The compacted subgrade should then be proof rolled to detect unstable areas under the observations of qualified geotechnical personnel. Proof rolling shall be performed by making a minimum of two complete passes in two perpendicular directions with a fully-loaded 20-ton minimum tandem-axle dump truck, or other approved rubber-tired vehicle. Areas showing excessive deflection or rutting (generally defined as greater than

½-inch) and as identified by the geotechnical personnel should be reworked to an appropriate moisture condition and re-compacted to a stable subgrade, or removed and replaced with engineered fill if judged to be unsuitable soil. If proof rolling is not feasible due to confined conditions, then visual inspection of the subgrade shall be performed by the geotechnical personnel to identify potentially unsuitable/unstable areas that require remediation. If necessary, use of geosynthetics (i.e., geogrid and/or geo-fabric) can reduce the thickness of the undercuts of unstable/unsuitable soils.

In slab-on-grade areas, the exposed subgrade should be undercut to a depth of 18 inches below the proposed base of slab. Then, InterAx NX750 geogrid (or engineer approved equivalent) should be placed in accordance with the manufacturer specifications including the required minimum overlaps. Backfill comprised of Type 4 crushed aggregate per Table 733-04A of the NYSDOT Standard Specifications should be placed per Section 5.2.2 over the geogrid to the planned top of subgrade. A final proof roll should be performed as described above prior to installation of the slab.

Refer to Sections 5.4 and 5.5 for subgrade preparation in foundation areas.

5.2.2 Backfilling

Engineered fill should consist of non-frozen, inorganic natural soils and/or granular fill free of deleterious materials or debris. The majority of the on-Site soils may be reused as engineered fill but may require moisture conditioning prior to reuse. Any silt, clay and/or soils that contain organics or deleterious materials are not suitable for reuse. Backfill should be as uniform as practical and mixing soil types should be avoided. An approved testing laboratory should be engaged to verify the proposed backfill material. Fine-grained backfill soils should be analyzed for plasticity to verify low to moderate plasticity and should have a liquid limit of less than 40 and a plasticity index of less than 20. The fill should be placed in maximum loose lifts of 10 inches (8 inches in foundation areas) and compacted by a heavy sheep's foot or smooth drum roller to a minimum of 95% of the maximum dry density as estimated by Modified Proctor (ASTM D1557). Engineered fill placement and compaction should be under the full-time observation of the on-Site Geotechnical Engineer or his/her designated representative (i.e., qualified geotechnical technician). In-situ density tests should be performed frequently to verify the specified degree of compaction has been met.

5.2.3 Utility Abandonment

For existing utilities encountered on-Site, if abandoned in place, it is recommended that utility pipes be bulk-headed and filled with flowable grout with a minimum compressive strength of 150 psi to avoid potential collapse in the future. Should the utility lines be removed from the Site, the resultant excavations should be properly backfilled and compacted as indicated above.

5.2.4 Excavation and Dewatering

All excavations should be carried out in accordance with Occupational Safety and Health Administration Regulations (Standards CFR 29). Temporary slopes in trenches greater than 4 feet in depth should be properly sloped or supported by means of a trench box or shield or other form of shoring. Excavations greater than 20 feet are required by OSHA to be designed by a professional engineer with bracing, shoring, or other appropriate method. A "competent person", as defined by OSHA, should continually evaluate soil conditions during trench excavation and decide on the appropriate trench protection on an ongoing and daily basis during excavation activities. OSHA regulations classify soils according to the following three categories:

Type A is meant for:

Cohesive soils with an unconfined compressive strength of 1.5 tsf or greater. However, no soil is Type A if:

- The soil is fissured.
- The soil is subject to vibration from heavy traffic, pile driving or similar effects.
- The soil has been previously disturbed.

– The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater.
– The material is subject to other factors that would require it to be classified as a less stable material.

Type B is meant for:

– Cohesive soil with an unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf.
– Granular cohesionless soils including angular gravel (similar to crushed rock), silt, silt loam, sandy loam, and, in some cases, silty clay loam and sandy clay loam.
– Previously disturbed soils except those which would otherwise be classified as Type C soil.
– Soil that meets the unconfined compressive strength or cementation requirements for Type A but is fissured or subject to vibration.
– Dry rock that is not stable.
– Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B.

Type C is meant for:

– Cohesive soils with an unconfined compressive strength of 0.5 tsf or less.
– Granular soils including gravel, sand, and loamy sand.
– Submerged soil or soil from which water is freely seeping.
– Submerged rock that is unstable.
– Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4H:1V) or steeper.

Using the above OSHA guidelines, the soils encountered at the borehole locations are anticipated to be classified as Type ‘C’. The excavation contractor’s ‘responsible person’ as defined by OSHA is responsible for determining the OSHA soil classifications.

Where workers must enter a trench or excavation carried deeper than 4 feet, it must be suitably sloped and/or shored in accordance with the regulation requirements. The regulation stipulates the following maximum slopes for the excavation:

Table 4 Maximum Allowable Excavation Slopes

Soil or Rock Type	Maximum Allowable Slopes (H:V) for Excavations Less than 20 feet deep
Stable Rock	Vertical (90°)
Type A	0.75:1 (53°)
Type B	1:1 (45°)
Type C	1.5:1 (34°)

OSHA allows a short-term maximum slope of 0.5H:1V (63º) in an excavation in Type A soil that is 12 feet or less in depth. If there is an excavation that is comprised of more than one type of soil and the lower (worse) soil classification is lower in the excavation than the higher (better) soil classification, then the whole excavation must be considered with the lower (worse) soil classification. For example, if a Type C soil underlies a Type B soil, then the whole excavation should be considered as Type C soil. OSHA provides procedures for classifying soils in the field which should be conducted by the "competent person" as defined by OSHA.

Temporary construction loads (including, but not limited to, equipment and soil stockpiles) should be placed no closer than 5 feet from the slope crest and considered in the final excavation plan. If the excavation cannot be constructed with open stepped cuts due to the proximity to existing machinery, equipment and/or building foundations, then

temporary earth retention support will be required. For stepped slopes, the height of each step layer should be less than 3 feet. The existing foundations should be shored or underpinned. Care should be taken during construction to avoid damage or undermining of the drilled shafts during construction activities.

There are areas where temporary control of groundwater or seepage will be necessary, where high or perched groundwater levels are encountered. Groundwater could be expected to be encountered in excavations because of the presence of water bearing granular layers at the Site. Free water was observed in the boreholes as shallow as 10 feet bgs. If groundwater is encountered in shallow excavations (above 10 feet bgs), the flow and volume could be controllable during construction with a system of sumps and pumps. In excavations that extend into granular layers below the water table, significant groundwater inflow could be anticipated which would require well points.

5.2.5 Grading and Drainage

Grading should be designed so that water is not allowed to pond in the areas of the proposed Site upgrades. Grades should slope away from the planned structures with a minimum grade of 2%. Utility or equipment trenches that will run beneath proposed structures should be sealed to prevent water intrusion into the trenches that could collect beneath the structures and adversely impact the foundational support.

5.3 Slabs-on-Grade

Section 5.2.1 provides recommendations for preparation of the slab-on-grade subgrade with geogrid reinforcement. A geogrid reinforced subgrade is only suitable for support of slabs-on-grade with loads of 150 psf or less. Subgrade soils prepared as discussed in Section 5.2.1 are recommended to be designed using a modulus of subgrade reaction (k) value of 115 pounds per cubic inch (pci).

As discussed in Section 5.1, the new slab-on-grade is planned to include thickened slab edges that will be doweled into the existing grade beams. Typically, it is recommended to isolate all foundations from slabs-on-grade to allow for differential movement between the slabs and the foundations to take place. If the slabs will be structurally connected to the existing grade beams, the grade beams should be assessed to verify they are able to accommodate the additional loading from the slab connections. Additionally, as differential movement would be anticipated between the slabs-on-grade and the existing foundation system, the slab-on-grade design and structural connections should account for this to avoid formation of cracks in the slab.

To minimize the potential damage due to concrete shrinkage, control joints and expansion joints should be provided at a proper timing and at suitable intervals, per ACI guidelines.

5.4 Pad Foundations

This section provides recommendations for foundation pads (mats) that may potentially support the mechanical and electrical equipment and other lightly loaded at-grade structures inside the hangar. The various planned equipment pad sizes and loadings are summarized in Section 5.1. It is anticipated the top of the pads will project above the adjacent slabs-on-grade with the base of the pads projecting slightly below the bearing elevation of the slabs-on-grade.

The pad foundation subgrades should be prepared as discussed in Section 5.2.1. In non-heated areas, it is recommended the pad bear directly on capillary resistant granular engineered fill that extends to a minimum depth of 4 feet below final Site grades to protect against frost heave. The base of the pad foundations should bear no less than 8 inches below final Site grades. Foundation subgrades are anticipated to consist of very loose to medium dense sand fill that is considered unsuitable for support of the proposed pad foundations. Therefore, as an alternate to deep undercuts and replacement with engineered fill, GHD recommends a geogrid reinforced pad be constructed as follows.

– Step 1 – Over excavate to a minimum depth of 18 inches below the bottom of the foundation. As discussed above, this over excavation should extend even further to a minimum depth of 4 feet in non-heated areas with

placement and compaction of capillary resistant granular engineered fill up to a depth of 18 inches below the bottom of the foundation. The over excavation should extend a minimum of 3 feet beyond the edges of the proposed foundation in all directions.

- Step 2 – Place a layer of InterAx NX750 geogrid at a depth of 18 inches below the bottom of the foundation.
- Step 3 – Place and compact 12 inches of Type 4 crushed aggregate per Table 733-04A of the NYSDOT Standard Specifications.
- Step 4 – Place another layer of InterAx NX750 geogrid.
- Step 5 – Place and compact 6 inches of Type 4 crushed aggregate per Table 733-04A.

Note that the base of the pads are anticipated to project slightly below the adjacent slabs-on-grade (around 2 inches). In this case, the layer of geogrid that will be installed 18 inches below the base of the slabs-on-grade can transition to a depth of 18 inches below the base of the pads within the 3-foot zone of geogrid extension beyond the edge of the pads to allow for one continuous layer of geogrid.

If a single roll of geogrid is not sufficiently wide enough to complete coverage with a single pass, overlapping seams of geogrid will be required. The geogrid overlaps need to be a minimum of 3 feet.

Prior to placement of the geogrid and aggregate, the exposed subgrade of the over excavation should be visually inspected by the on-Site geotechnical engineer or their designated representative (i.e., qualified geotechnical technician) to verify the condition and composition of the subgrade. Should the subgrade conditions encountered vary from those found in the boreholes, GHD requests to be notified immediately to permit a reassessment of the recommendations in this section.

Foundation pads with subgrades prepared as described in this section should be designed for a net allowable bearing capacity of 1,200 pounds per square foot (psf) and a coefficient of sliding friction of 0.35 between the concrete and foundation subgrade material. The net allowable bearing capacity is the pressure that can be transmitted to the bearing strata in excess of the final minimum overburden pressure near the footing. The pad foundation constructed as recommended herein is anticipated to have maximum total and differential settlement of 1 inch and 0.5 inch, respectively, provided the pad foundation has a maximum width of 6 feet and maximum length of 25 feet. If pad foundations larger than this are desired or pad loads will exceed 1,200 psf, then alternate foundation support options should be utilized. Refer to Section 5.5 for discussion of other potential support options.

The pad foundations should be structurally separate (isolated) from the adjacent slabs-on-grade and existing foundations.

Foundations should be constructed as soon as possible after foundation excavation activities. If foundation excavations will be left open for an extended period of time, it is recommended the foundation subgrades be protected from weather and construction activities by placement of a thin mat of lean concrete. Water should not be allowed to pond in foundation excavations and foundation concrete shall not be placed on frozen or flooded subgrades.

5.5 Alternate Subgrade Support Options

The following sections provide recommendations for alternate support options for various structures if the following loading and configurations apply:

- Slabs-on-grade with floor loads more than 150 psf
- Foundations pads with bearing pressures more than 1,200 psf and/or a width of greater than 6 feet and/or a length greater than 25 feet

5.5.1 Micropiles

5.5.1.1 Allowable Axial Capacity

The following recommendations are for general planning and cost estimating purposes. The micropiles should be designed by an experienced micropile design-build contractor.

Micropiles utilized to support foundations and/or slabs-on-grade should have a minimum length of 45 feet with minimum diameter of 6 inches and full-length pile reinforcement. It is also recommended to have a minimum of 20 feet of permanent steel casing measured from the top of the pile and a minimum 25 feet grouted length. The grouted length of the micropiles will support the new axial loads via frictional resistance between the soil and grout interface. The micropiles are recommended to bear a minimum of 15 feet into the medium dense to dense sand layer. The depth of medium dense to dense sand encountered in the boreholes was variable, between about 23 to 28 feet bgs. Based upon the above recommended micropile configuration, an allowable axial capacity of 40 kips per micropile can be achieved. Total settlement of less than 0.5 inches is anticipated not including the elastic compression of the pile. Micropiles should be spaced no closer than 3 pile diameters apart (minimum of 18 inches). Recommended soil parameters to use for design of micropiles based upon axial loading are provided in Table 5.

Portland cement grout with a minimum 28-day compressive strength of 5,000 psi is recommended to be used for the grouting of the micropiles.

5.5.1.2 Allowable Lateral Capacity

If lateral loads on the micropiles are anticipated, the micropiles should be designed to accommodate the lateral loads or a portion of the micropiles should be battered. If a lateral load analysis is required, GHD recommends conducting an LPILE analysis. Recommended soil parameters to use in an LPILE analysis are provided in Table 5.

5.5.1.3 Micropile Loading Testing Recommendations

Typically, verification load testing is completed on a minimum of one pre-production pile (e.g., test pile) to verify adequacy of the installation method and design assumptions. The test pile will be used under high loads as a “sacrificial” pile to test the ultimate capacity and should not be used as part of the final structure. It is recommended to complete one verification load test consisting of a static load test conducted in accordance with ASTM D1143 with compressive loads up to 2.5 times the design strength of the pile. It should be verified that acceptance criteria have been met for the verification loading per ASTM D1143 prior to construction of production piles.

Proof load-testing of production piles should also occur after the grouted piles reach at least 50% of the design strength to verify the piles can carry the design loads without excess movement. The proof tests should be completed with loads that will not cause failure or damage to the micropile. It is recommended that proof testing be completed on a minimum of 3 piles or 5 percent of the production piles, whichever is more, with compressive loads up to 160 percent of the design load. The results of the proof testing should be evaluated to verify acceptance criteria per FHWA NHI-05-39 have been met. The micropile design may need to be modified if the testing fails to meet the acceptance criteria.

Loading schedules for the verification and proof tests should follow Deep Foundation Institute codes (2004).

5.5.2 Helical Piers

Helical piers are a proprietary system and should be designed and installed by an experienced design-build contractor. The design should address axial and lateral loads and uplift forces. Installation depths are dependent on installation torque and may vary from location to location due to Site subsurface variability. It is anticipated the helical piers will need to penetrate a minimum of 10 feet into the medium dense to dense sand. Recommended soil parameters to develop the design of helical piers are provided in Table 5.

All helical piers should be torqued to the required capacity, which may occur as soon as the helix (helices) penetrate a competent soil layer. The helical piers should be installed in the presence of the on-Site Geotechnical Engineer to confirm that the appropriate torque has been achieved. Helical pier torque tests can be performed at the Site using a test pier that matches the anticipated production piers. This can aid in determining the average pier depth throughout the Site. Torque readings should be recorded at 1-foot increments until the required design torque value is achieved.

As groundwater will be in contact with the piers, it is recommended the piers be galvanized in accordance with either ASTM A164 or ASTM B633. If refusal conditions or issues arise at premature depths during advancement of the pier, the installation should be halted, and the galvanized coating inspected for damage. If there is no damage observed, the pier can be installed in an offset location.

Helical pier foundation systems, if designed using industry standard methods and installed to the required torque value, typically do not settle beyond the limits required by structural engineers.

5.5.3 Soil Remediation

Shallow foundations and slabs-on-grade can be supported on remediated soils using aggregate or grout columns to improve the soil bearing capacity and minimize settlements. Such remediation options include vibro stone columns (VSCs), rammed aggregate piers (RAPs) or controlled modulus columns (CMCs). This option could eliminate the need for geogrid reinforced subgrades and/or deep foundations support and can provide flexibility for future retrofits to the hangars.

During the installation of VSCs and RAPs, the aggregate and surrounding soil is compacted through vibration techniques and down pressure, or a dynamic ramming process for RAPs. This increases the lateral stress in the adjacent soils and stiffens the composite aggregate/soil mass. VSCs typically consist of 22 to 24-inch diameter holes created by inserting a vibratory probe into the soil and laterally displacing it and minimizing the production of spoils. Once the hole is open, open-graded aggregate is then placed in lifts down the hole and compacted with vibration and down pressure which produces dense stone columns. RAPs vary from VSCs in that the holes are drilled, not displaced, which produces spoils. The holes are backfilled with open-graded aggregate in lifts that are compacted by applying a high frequency impact ramming energy. A third option for soil improvement is the installation of CMCs which can be installed either by soil displacement or soil drilling methods similar to VSCs and RAPs except that grout or concrete is placed by low pressure injection through the hollow core of the drilling tool. This generates rigid inclusions in the soil that provide a stiffened composite soil mass.

Prior to installation of the VSCs, RAPs or CMCs, the Site should be brought to grade and a 24-inch aggregate pad (often referred to as the load transfer pad or LTP) should be installed in the building areas. This will provide a stable working platform for installation of the elements. The aggregate pad should consist of open-graded aggregate, placed in 8-to-12-inch lifts compacted to a minimum of 95% of the Modified Proctor value. VSCs, RAPs and CMCs can improve the allowable soil bearing capacity to 3,000 to 8,000 psf depending on the size, spacing and depths of the individual foundation elements. Based on soil conditions encountered in the boreholes, it is anticipated these elements would be installed to depths ranging from 30 to 40 feet bgs. Once installed, including the aggregate pad, shallow foundations and slabs-on-grade can be constructed to be supported on the stiffened composite soil matrix.

The vibrations generated by installation of these type of subgrade remediation elements are generally much less than vibrations generated by driving piles into the ground. Also, these soil improvement methods are typically more cost effective than traditional deep foundations such as driven piles, drilled shafts and auger cast-in-place piles. The design of VSCs, RAPs and CMCs are typically part of the foundation contractor’s design-build scope of work. The contractor should be responsible for providing detailed design calculations and plans sealed by a professional engineer licensed in the State of New York. Column/pier diameter, installation depth and spacing, aggregate or concrete/grout requirements, and settlement and bearing capacity evaluations should be included in the design. The contractor should be provided with this geotechnical report. The contractor may request that additional Site investigations and laboratory testing be performed to confirm their design. A qualified geotechnical consultant should be contracted to oversee the load tests and construction of the reinforcement elements. It is recommended that Menard and/or Geopier Foundation Company, Inc. be contacted to further explore the feasibility of this type of soil remediation method.

5.6 Geogrid Removal for Future Development

The future use of the rehabilitated hangars is not presently known. It may be possible that retrofits for heavier structures will be implemented that could require penetrations through and/or removal of geogrid reinforced subgrades. If removal of geogrid is required, it is recommended the removals include clean cuts of the geogrid with appropriate tooling and avoid rotary action that can result in torquing or pulling on the geogrid such as could occur with augering, helical pier advancement or other similar drilling advancement methodologies. Care should be taken if excavator buckets are used to remove the geogrid reinforced subgrades to avoid tugging or pulling on the geogrid.

5.7 Soil Parameters Summary

The recommended soil parameters for use in the design of the Site rehabilitation are as follows:

Table 5 Soil Parameters and Lateral Earth Pressure Coefficients

Soil Layer / LPILE p-y Curve Type	Depth (feet bgs)	Total Unit Weight (lb/ft^3)	Effective Unit Weight (lb/ft^3)	φ' – Drained Angle of Internal Friction (degrees)[1]	Undrained Shear Strength (psf)[1]	Strain at 50% Max. Stress (e_{50})[2]	Lateral Subgrade Modulus, k (pci)[2]	Earth Pressure Coefficients		
								K_a	K_o	K_p
Fill Sand / Sand (Reese)	0 – 15	115	53	29	--	N/A	25	0.35	0.52	2.88
Fill Very Soft Clay and Silt / Soft Clay (Matlock)	15 – 20	120	58	26	400	0.02	N/A	0.39	0.56	2.56
Native Very Loose to Loose Sand / Sand (Reese)	20 – 25	115	53	28	--	N/A	20	0.36	0.53	2.77
Native Medium Dense to Very Dense Sand / Sand (Reese)	25 – 50	120	58	36	--	N/A	110	0.26	0.41	3.85

Notes:

1. Drained angle of internal friction shall be used for drained analyses using a drained cohesion (c') of 0 psf. The undrained shear strength shall be used for undrained analyses using an angle of internal friction (φ) of 0 degrees.
2. Parameters specific to p-y curve models in LPILE

The calculation of the earth pressure coefficients is based on Rankine theory, which provides a conservative estimate as no friction between the soil and the structure is accounted for in the estimate. The earth pressure coefficients provided above are only applicable for flat ground surfaces beyond the structure and must be increased for sloping ground surfaces.

The pressure coefficients referenced within the above table are a function of the friction angle of the adjacent soil, and both the degree and direction of movement of the structure subjected to unbalanced lateral earth pressures. For structures that are restrained at the top, the at-rest earth pressure coefficient will apply. For structures that allow for 1 to 10% of exposed shoring height movement into the soil, the full passive earth pressure coefficient will apply.

5.8 Seismic Considerations

The International Building Code (IBC) requires the assignment of a Seismic Site Class, in accordance with ASCE 7–22, for calculations of earthquake design forces and the structural design based on a two percent probability of

exceedance in 50 years. The Seismic Site Class is a function of soil profile and is based on the average properties of the subsurface strata to a depth of 100 feet below the ground surface. The IBC provides the following three methods to obtain the average properties for the top 100 feet of the subsoil strata:

– Average shear wave velocity.
– Average SPT values (uncorrected for overburden).
– Average undrained shear strength.

The geotechnical data comprised of SPT N value measurements that extended to a maximum depth of 50 feet below existing grade. Based on this data obtained from the boreholes and GHD's knowledge of the local geology, the average SPT value $\overline{N}$ for the top 100 feet at the Site is estimated to be less than 15 bpf. Per the IBC 2024 and ASCE 7-22, Site Class E is recommended for seismic design of the Site.

Based on the Site location, Seismic Site Class E and an assumed Risk Category II, the mapped seismic design parameters for this Site are as follows:

– PGA = 0.160 g.
– S_S = 0.260 g.
– S_1 = 0.049 g.
– S_{DS} = 0.170 g.
– S_{D1} = 0.064 g.

5.9 Pavement

The following recommendations apply to pavements with subgrades prepared as outlined in Section 5.2.1.

5.9.1 Pavement Design Recommendations

The design criteria considered in our evaluation for flexible pavement for the Site is summarized in Table 6.

Table 6 Flexible Pavement Basis of Design

Pavement Design Parameter	Assumed Parameter Value
Basis of Design (yrs)	20
20 Year Standard Duty ESAL (18 kip)	25,000
20 Year Heavy Duty ESAL (18 kip)	200,000
Initial Serviceability	4.5
Terminal Serviceability	2.25
Standard Deviation	0.45
Reliability	85%

The following bituminous concrete and aggregate base thickness for a flexible pavement may be used for the design of the exterior pavement area. A California Bearing Ratio (CBR) value of 7 was used for pavement design based on the soil conditions encountered in the boreholes.

Table 7 Pavement Structure Summary - Flexible

Pavement Layer	Light Duty Pavement Design	Heavy Duty Pavement Design
Surface Course Asphalt Concrete	1.5	1.5
Base Course Asphalt Concrete	2.5	3.5
Sub-base (Type 4 crushed aggregate, Table 733-04A)	6.0	6.0

Asphaltic concrete is not designed for standing loads and if used can lead to major rutting under wheel loads over time, leading to water ponding and associated problems. A rigid pavement structure comprised of Portland cement concrete (PCC) is recommended to limit life-cycle costs where heavy-duty vehicles will be parked for a long-term basis. A 10-inch-thick PCC slab can be placed on a granular material (minimum of 6 inches of Type 4 crushed aggregate per Table 733-04A), compacted to 95% of the Modified Proctor maximum dry density to provide proper grade and cross fall to drainage facilities. The PCC should be 4,500 psi with maximum 1.5-inch nominal size aggregate with some air-entrainment to tolerate freeze-thaw cycles. Either plain concrete with suitably spaced construction/shrinkage joints and load-transfer dowels or continuously reinforced PCC pavement can be considered. The design of PCC slabs should be performed by a structural engineer, based on the anticipated loading conditions.

It is recommended underdrains be utilized where catch basins are proposed and other low-lying areas of the pavement to limit the accumulation of water below the pavement section. At curbs, surface edge drains should be used.

5.10 Construction Monitoring and Testing

Qualified geotechnical consulting personnel should inspect and test the subgrade surfaces during construction. Specifically, they should verify that the materials and conditions exposed at the subgrade depth are consistent with the findings of this geotechnical report. Should subsoil conditions be encountered that vary considerably from those described in this report, our office should be informed immediately so that in-situ conditions can be assessed, and appropriate recommendations can be made.

The conditions will vary across the Site depending on the final design grades and therefore, the preparation of the subgrade and compaction of all fill should be monitored at the time of construction to confirm their suitability. In addition, qualified geotechnical personnel should provide materials testing services prior to and during subgrade preparation (i.e., materials suitability assessment of on-Site and imported fills, compaction testing, etc.).

All backfilling should be supervised so that proper materials are used, and that adequate compaction is achieved. Field density testing can be performed on subgrade layers to verify proper compaction and readiness for concrete placement upon completion of the backfilling process. Strict quality control guidelines should be followed during the placement of fill materials.

6. Limitations of the Report

This report has been prepared by GHD for Quinn Evans Architects (Client) and other parties explicitly identified in the report and is prohibited for use by others without GHD’s prior written consent. GHD otherwise disclaims responsibility to any person other than Client and approved parties arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible. The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report. No portion of this report may be used as a separate entity; it is to be read in its entirety and shall include all supporting drawings and appendices.

The opinions, conclusions and any recommendations in this report are based on GHD's present understanding of the project, conditions encountered, current Site use, ground surface elevations, and information reviewed at the date of

preparation of the report. The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared. GHD should, however, be retained to review the recommendations when the drawings and specifications for the project are complete. Without this review, GHD will not be liable for any misunderstanding of the recommendations or their application and adaptation into the final design.

The services were performed in a manner consistent with that level of care and skill ordinarily exercised by members of geotechnical engineering professions currently practicing under similar conditions in the same locality. No other representations, and no warranties or representations of any kind, either expressed or implied, are made. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

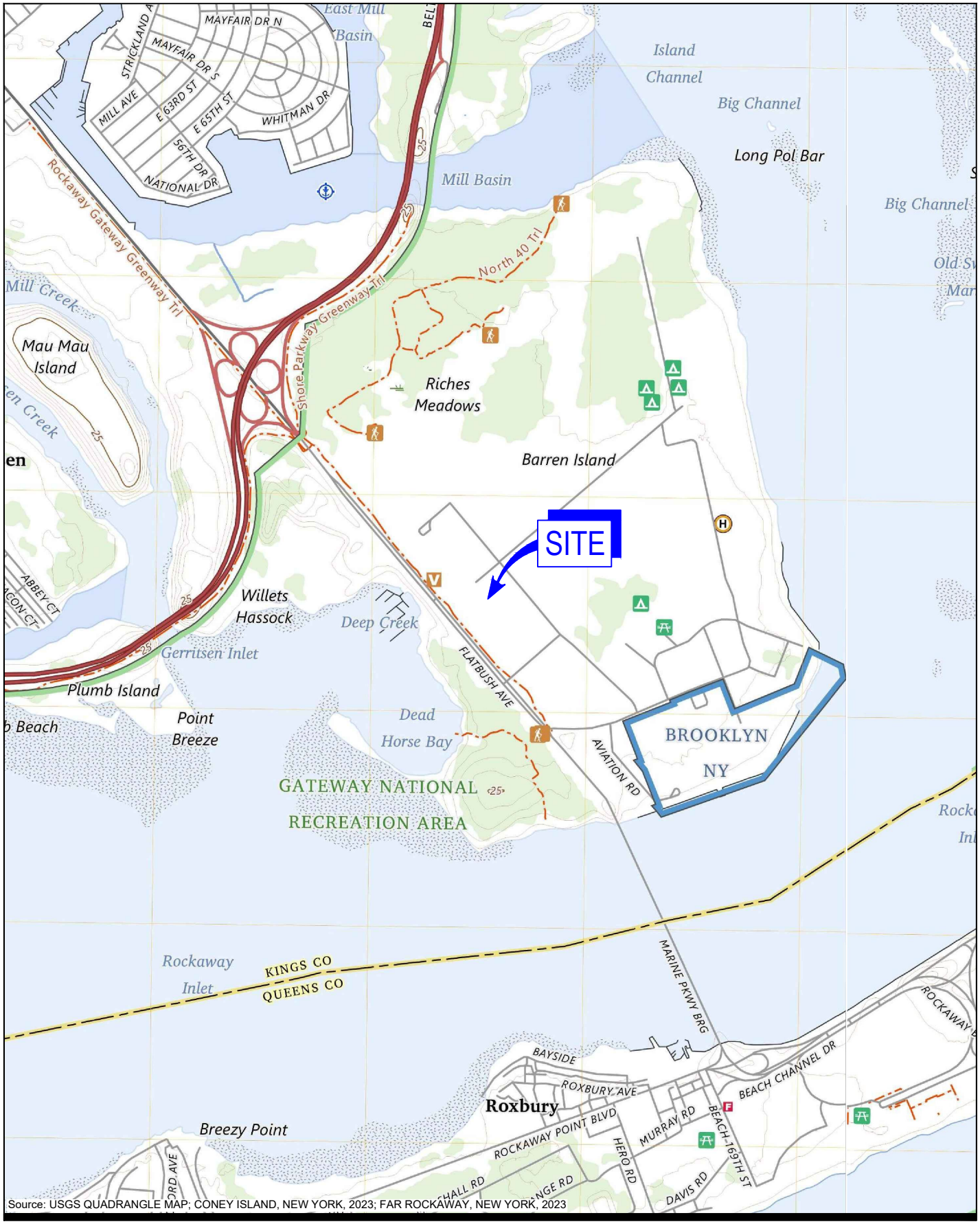
By issuing this report, GHD is the Geotechnical Engineer of Record. It is recommended that GHD be retained during construction and earthwork operations to confirm the conditions of the subsoil are actually similar to those observed during the study. The intent of this requirement is to verify that conditions encountered during construction are consistent with the findings in the report and that inherent knowledge developed as part of the study is correctly carried forward to the construction phases.

It is important to emphasize that a soil investigation is a random sampling of a Site and the comments included in this report are based on the results obtained at the test locations only (4 borehole locations). The subsurface conditions confirmed at the test locations may vary at other locations. The subsurface conditions can also be significantly modified by the construction activities on Site (excavation, dewatering and drainage, etc.). These conditions can also be modified by exposure of soils or bedrock to humidity, dry periods or frost. Soil and groundwater conditions beyond the test location may differ both horizontally and vertically from those encountered at the test location and conditions may become apparent during construction which could not be detected or anticipated at the time of GHD's investigation. Should any conditions at the Site be encountered which differ from those found at the test locations, GHD requests to be notified immediately to permit a reassessment of the recommendations in this report. If changed conditions are identified during construction, no matter how minor, the recommendations in this report shall be considered invalid until sufficient review and written assessment of said conditions by GHD is completed.

All of which is respectfully submitted,

Jeff Snyder
Senior Geotechnical Engineer

Scott Adamowski
Senior Engineer



Source: USGS QUADRANGLE MAP; CONEY ISLAND, NEW YORK, 2023; FAR ROCKAWAY, NEW YORK, 2023

0 1000 2000 ft

1" = 2000 ft

Coordinate System:
STATE PLANE
NY83-LIF

N

GHD

FLOYD BENNETT FIELD HANGARS
3&4 REHABILITATION
3159 FLATBUSH AVENUE
BROOKLYN, NEW YORK

SITE LOCATION

Project No. **12667502**
Date **April 2025**

FIGURE 1

Filename: N:\US\Detroit\Projects\563\12667502\Digital_Design\ACAD\Figures\RPT001\12667502-GHD-00-00-RPT-EN-D101_DE-001.dwg
Plot Date: 24 April 2025 11:06 AM

0 50 100 ft

1" = 100 ft

Coordinate System:
STATE PLANE
NY83-LIF

N

GHD

FLOYD BENNETT FIELD HANGARS
3&4 REHABILITATION
3159 FLATBUSH AVENUE
BROOKLYN, NEW YORK

BOREHOLE LOCATIONS

Project No. **12667502**
Date **April 2025**

FIGURE 2

Filename: N:\US\Detroit\Projects\563\12667502\Digital_Design\ACAD\Figures\RPT001\12667502-GHD-00-00-RPT-EN-D102_DE-001.dwg
Plot Date: 24 April 2025 11:07 AM

Appendices

Appendix A

Borehole Logs

USCS CLASSIFICATION OF SOILS (ASTM D2487)

Coarse grained or granular soils have more than 50% of their dry weight retained on a #200 sieve; they are described as boulders, cobbles, gravel or sand. Fine grained soils have less than 50% of their dry weight retained on a #200 sieve; they are described as clay or clayey silt if they are cohesive, and silt if they are non-cohesive. In addition to gradation, granular soils are defined on the bases of their relative in-place density and fine grained soils on the basis of their strength or consistency and their plasticity.

Major Division		Classification Criteria		Group Symbol and Name	Modified Descriptors*
Coarse Grained Soils >50% retained on No. 200 sieve	Gravel % Gravel > % Sand	< 5% Fines	Cu ≥ 4 and 1 ≤ Cc ≤ 3	**GW** - Well Graded GRAVEL	<5% fines = trace clay and/or silt <15% sand = trace sand 15% - 30% sand = with sand 30+% sand = sandy
			Cu < 4 and/or (Cc < 1 or Cc > 3)	**GP** - Poorly Graded GRAVEL	
		5% - 12% Fines	Use GW/GP gradation and GM/GC fines descriptors	**[GW or GP] - [GM or GC]** - Well or Poorly Graded GRAVEL with Silt or Clay or Silty Clay	
		>12% Fines	fines = ML or MH	**GM** - Silty GRAVEL	
			fines = CL or CH	**GC**- Clayey GRAVEL	
			fines = CL-ML	**GC-GM** - Silty, Clayey GRAVEL	
	Sand % Sand > % Gravel	< 5% Fines	Cu ≥ 6 and 1 ≤ Cc ≤ 3	**SW** - Well Graded SAND	<5% fines = trace clay and/or silt <15% gravel = trace gravel 15% - 30% gravel = with gravel >30% gravel = gravelly
			Cu < 6 and/or (Cc < 1 or Cc > 3)	**SP** - Poorly Graded SAND	
		5% - 12% Fines	Use SW/SP gradation and SM/SC fines descriptors	**[SW or SP] - [SM or SC]** - Well or Poorly Graded SAND with Silt or Clay or Silty Clay	
		>12% Fines	fines = ML or MH	**SM** - Silty SAND	
			fines = CL or CH	**SC** - Clayey SAND	
			fines = CL-ML	**SM-SC** - Silty, Clayey SAND	

NOTE: $C_u = \frac{D_{60}}{D_{10}}$; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

Grain Size Classification

Grain Type	Grain Size
Cobbles	Greater than 3 inches
Gravel	3 in - No. 4 (7.76 mm)
Sand	No. 4 (4.76 mm) - No. 200 (0.074 mm)
Silt	No. 200 (0.074 mm) - 0.002 mm
Clay	Less than 0.002 mm

Granular Soils Relative Density

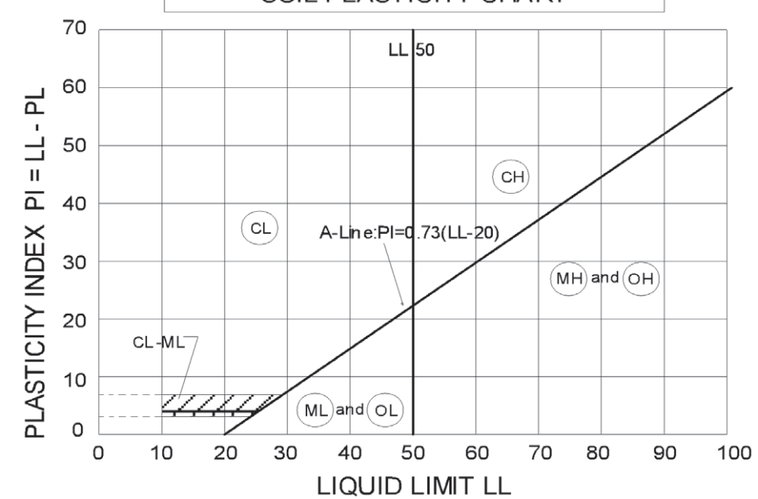
Relative Density	Blows Per Foot (N-Value)
Very Loose	<5
Loose	5 - 9
Medium Dense	10 - 29
Dense	30 - 50
Very Dense	>50

Cohesive (Clayey) Soils Consistency

Consistency	Unconfined Compressive Strength, Qu (tsf)
Very Soft	<0.25
Soft	0.25 - 0.49
Medium Stiff	0.50 - 0.99
Stiff	1.00 - 1.99
Very Stiff	2.00 - 3.99
Hard	>4.00

Major Division		Classification Criteria	Group Symbol and Name	Additional Descriptors		Modified Descriptors*
Fine Grained Soils > 50% passing No. 200 sieve	Clay Plots on or Above 'A'-Line	LL ≥ 50	**CH** - Fat CLAY	15% -29% plus No. 200: % Gravel > % Sand - with Gravel % Sand > % Gravel - with Sand	>30% plus No. 200 % Gravel > % Sand : Gravelly (with Sand if >15% sand) % Sand > % Gravel : Sandy (with Gravel if >15% gravel)	<15% sand/gravel = trace sand/gravel <15% silt/clay = trace silt/clay 15%-30% silt/clay = with silt/clay 30-50% silt/clay = silty/clayey 50%+ = and silt/clay
		LL < 50, PI > 7	**CL** - Lean CLAY			
	Silt Plots Below 'A'-Line	LL ≥ 50	**MH** - Elastic SILT			
		LL < 50, PI < 7	**ML** - SILT			
	Silty Clay Plots on or Above 'A'-Line	4 ≤ PI ≤ 7	**CL- ML** - SILTY CLAY			

SOIL PLASTICITY CHART



*Modified descriptions are not included in ASTM D2487 and provide additional information on the soil

REFERENCE No.: 12667502

ENCLOSURE No.:

BOREHOLE No.: B-1

ELEVATION: 13.7 ft

BOREHOLE REPORT

CLIENT: Quinn Evans Architects

PROJECT: NPS Hangars 3/4 Rehab Geotech

LOCATION: Brooklyn, NY

DESCRIBED BY: S. King

CHECKED BY: J. Snyder

DATE (START): April 15, 2025

DATE (FINISH): April 15, 2025

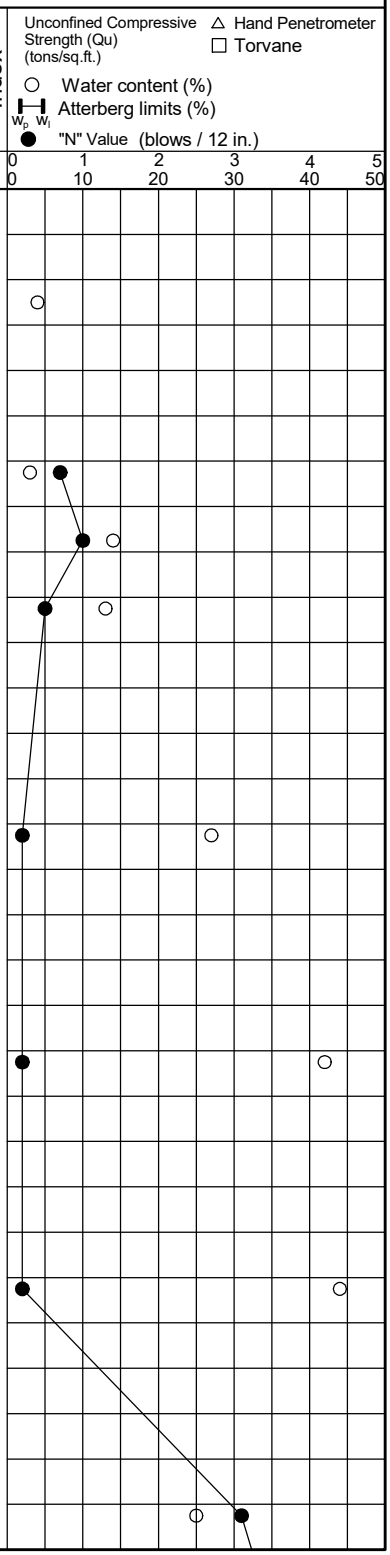
DRILLER: ADT-Cascade

DRILL RIG: Geoprobe 7822 DT

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- WATER LEVEL
- GS - GRAB SAMPLE

Depth (Feet)	Elevation (ft)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery (RQD) %	Moisture Content	Blows per 6 in.	Penetraion Index N
	13.70		GROUND SURFACE						
	13.20		0.5 CONCRETE SLAB						
			(FILL) SAND, trace silt, brown and light brown, loose to medium dense, moist		GS-1		4	--	--
5					SS-2	100	3	3-3-4	7
					SS-3	100	14	4-5-5	10
	5.20		8.5 (FILL) SAND, trace silt and gravel, brown, loose, moist to wet		SS-4	58	13	2-3-2	5
10									
	0.20		13.5 (FILL) Silty SAND, trace gravel, gray, very loose, wet		SS-5	94	27	1-1-1	2
	-0.90		14.6 (FILL) Sandy CLAY, trace organics, roots, debris and wood chips, dark gray, very soft, moist						
15									
	-5.80		19.5 (SP) Sand, trace silt, gray, very loose, moist to wet		SS-6	94	42	1-1-1	2
20									
					SS-7	44	44	1-1-1	2
25									
	-14.80		28.5 (SP) Sand, trace silt, gray, medium dense to dense, moist to wet		SS-8	61	25	10-15-16	31



SOIL LOG WITH GRAPH 12667502 NPS FLOYD BENNET FIELD.GPJ CRA PLYMOUTH.GDT 5/8/25

REFERENCE No.: 12667502

ENCLOSURE No.:

BOREHOLE No.: B-1

ELEVATION: 13.7 ft

BOREHOLE REPORT

CLIENT: Quinn Evans Architects

PROJECT: NPS Hangars 3/4 Rehab Geotech

LOCATION: Brooklyn, NY

DESCRIBED BY: S. King

CHECKED BY: J. Snyder

DATE (START): April 15, 2025

DATE (FINISH): April 15, 2025

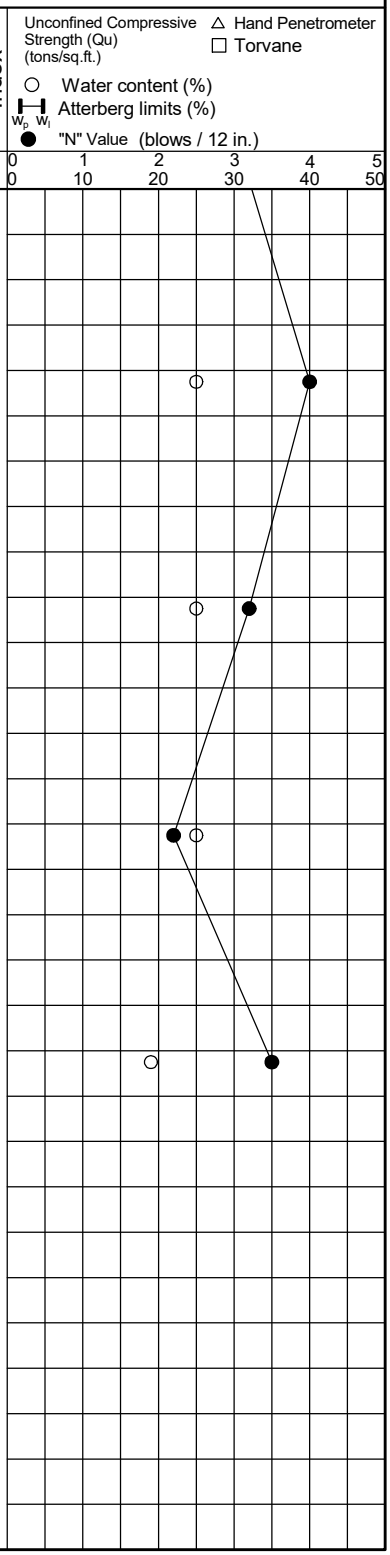
DRILLER: ADT-Cascade

DRILL RIG: Geoprobe 7822 DT

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- WATER LEVEL
- GS - GRAB SAMPLE

Depth	Elevation (ft)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery (RQD)	Moisture Content	Blows per 6 in.	Penetraion Index
Feet	13.70		GROUND SURFACE			%			N
35					SS-9	55	25	14-21-19	40
40					SS-10	55	25	9-15-17	32
45					SS-11	50	25	11-11-11	22
50	-36.30		50.0 END OF BOREHOLE AT 50 FT BELOW GROUND SURFACE (BGS). HAND AUGER USED TO A DEPTH OF 5 FT BGS. SAMPLE GS-1 TAKEN FROM HAND AUGER CUTTINGS. BOREHOLE THEN ADVANCED TO 10 FT BGS USING 4.25-IN I.D. HOLLOW STEM AUGERS. THEN SWITCHED TO WASH ROTARY USING 3-7/8-IN TRI-CONE ROLLER BIT WITH BENTONITE/WATER AS DRILLING MUD TO ADVANCE BOREHOLE TO 50 FT BGS. BOREHOLE BACKFILLED WITH SOIL CUTTINGS AND SURFACE PATCHED. WL: N/A ft. WL (AB): N/A ft.		SS-12	58	19	16-18-17	35
55									



SOIL LOG WITH GRAPH 12667502 NPS FLOYD BENNET FIELD.GPJ CRA PLYMOUTH.GDT 5/8/25

REFERENCE No.: 12667502

ENCLOSURE No.:

BOREHOLE No.: B-2

ELEVATION: 13.5 ft

BOREHOLE REPORT

CLIENT: Quinn Evans Architects

PROJECT: NPS Hangars 3/4 Rehab Geotech

LOCATION: Brooklyn, NY

DESCRIBED BY: S. King

CHECKED BY: J. Snyder

DATE (START): April 16, 2025

DATE (FINISH): April 17, 2025

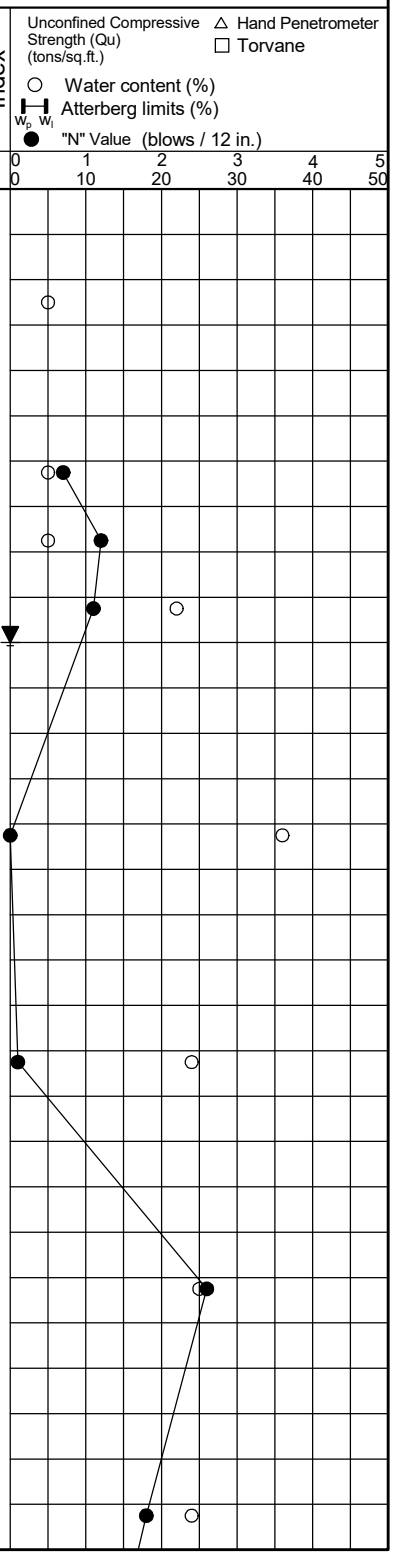
DRILLER: ADT-Cascade

DRILL RIG: Geoprobe 7822 DT

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- WATER LEVEL
- GS - GRAB SAMPLE

Depth (Feet)	Elevation (ft)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery (RQD) %	Moisture Content	Blows per 6 in.	Penetraion Index N
	13.50		GROUND SURFACE						
	13.25		0.3 ASPHALT						
			(FILL) SAND, trace silt, brown and light brown, very loose to medium dense, moist						
					GS-1		5	--	--
5					SS-2	89	5	3-3-4	7
					SS-3	100	5	17-5-7	12
					SS-4	78	22	6-5-6	11
10									
					SS-5	5	36	0-0-0	0
15									
	-5.00		18.5 (SP-SC) SAND with clay and silt, gray, very loose, moist to wet		SS-6	100	24	1-0-1	1
20									
	-10.00		23.5 (SP) SAND, trace silt and gravel, gray, medium dense to dense, moist to wet		SS-7	78	25	10-14-12	26
25									
					SS-8	67	24	8-10-8	18



REFERENCE No.: 12667502

ENCLOSURE No.:

BOREHOLE No.: B-2

ELEVATION: 13.5 ft

BOREHOLE REPORT

CLIENT: Quinn Evans Architects

PROJECT: NPS Hangars 3/4 Rehab Geotech

LOCATION: Brooklyn, NY

DESCRIBED BY: S. King

CHECKED BY: J. Snyder

DATE (START): April 16, 2025

DATE (FINISH): April 17, 2025

DRILLER: ADT-Cascade

DRILL RIG: Geoprobe 7822 DT

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- WATER LEVEL
- GS - GRAB SAMPLE

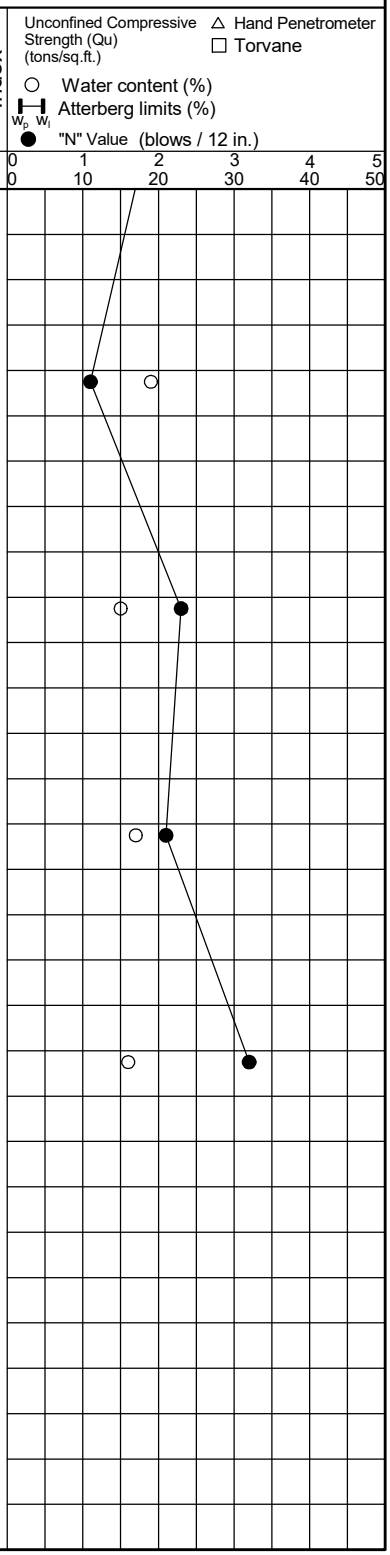
Depth	Elevation (ft)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery (RQD)	Moisture Content	Blows per 6 in.	Penetraion Index
Feet	13.50		GROUND SURFACE			%			N
35					SS-9	72	19	10-7-4	11
40					SS-10	78	15	10-11-12	23
45					SS-11	58	17	8-9-12	21
50	-36.50		50.0		SS-12	56	16	11-17-15	32
55									

END OF BOREHOLE AT 50 FT BELOW GROUND SURFACE (BGS). HAND AUGER USED TO A DEPTH OF 5 FT BGS. SAMPLE GS-1 TAKEN FROM HAND AUGER CUTTINGS. BOREHOLE THEN ADVANCED TO 10 FT BGS USING 4.25-IN I.D. HOLLOW STEM AUGERS. THEN SWITCHED TO WASH ROTARY USING 3-7/8-IN TRI-CONE ROLLER BIT WITH BENTONITE/WATER AS DRILLING MUD TO ADVANCE BOREHOLE TO 50 FT BGS.

BOREHOLE BACKFILLED WITH SOIL CUTTINGS AND SURFACE PATCHED.

WL: 10 ft.

WL (AB): N/A ft.



SOIL LOG WITH GRAPH 12667502 NPS FLOYD BENNET FIELD.GPJ CRA PLYMOUTH.GDT 5/8/25

REFERENCE No.: 12667502

ENCLOSURE No.:

BOREHOLE No.: B-3

ELEVATION: 13.5 ft

BOREHOLE REPORT

CLIENT: Quinn Evans Architects

PROJECT: NPS Hangars 3/4 Rehab Geotech

LOCATION: Brooklyn, NY

DESCRIBED BY: S. King

CHECKED BY: J. Snyder

DATE (START): April 18, 2025

DATE (FINISH): April 18, 2025

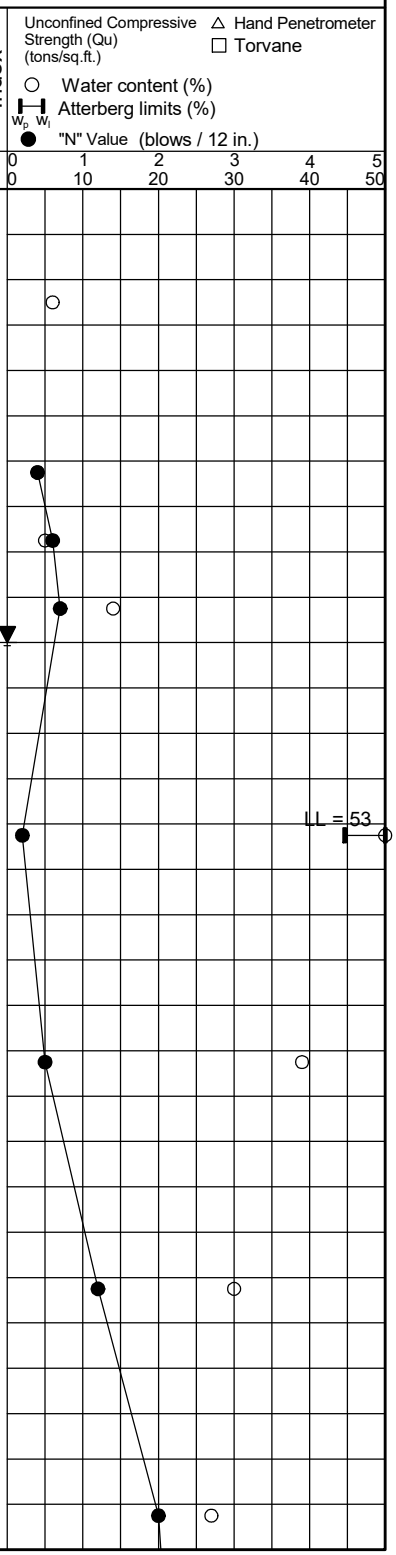
DRILLER: ADT-Cascade

DRILL RIG: Geoprobe 7822 DT

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- WATER LEVEL
- GS - GRAB SAMPLE

Depth (Feet)	Elevation (ft)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery (RQD) %	Moisture Content	Blows per 6 in.	Penetraion Index N
	13.50		GROUND SURFACE						
	13.00		0.5 ASPHALT						
			(FILL) SAND, trace silt, brown and light brown, very loose to loose, moist		GS-1		6	--	--
5					SS-2	83	4	3-2-2	4
					SS-3	89	5	3-3-3	6
					SS-4	94	14	4-3-4	7
10									
	0.00		13.5 (FILL) Sandy SILT with clay, trace organics, roots and wood chips, gray, very soft, moist to wet, LL=53, PL=45, PI=8		SS-5	100	50	2-1-1	2
15									
	-5.50		19.0 (SP) SAND, trace silt, gray, loose, moist to wet		SS-6	100	39	1-1-4	5
20									
	-10.00		23.5 (SP) SAND, trace silt, gray, medium dense to dense, moist to wet		SS-7	67	30	4-5-7	12
25									
					SS-8	81	27	10-10-10	20



REFERENCE No.: 12667502

ENCLOSURE No.:

BOREHOLE No.: B-3

ELEVATION: 13.5 ft

BOREHOLE REPORT

CLIENT: Quinn Evans Architects

PROJECT: NPS Hangars 3/4 Rehab Geotech

LOCATION: Brooklyn, NY

DESCRIBED BY: S. King

CHECKED BY: J. Snyder

DATE (START): April 18, 2025

DATE (FINISH): April 18, 2025

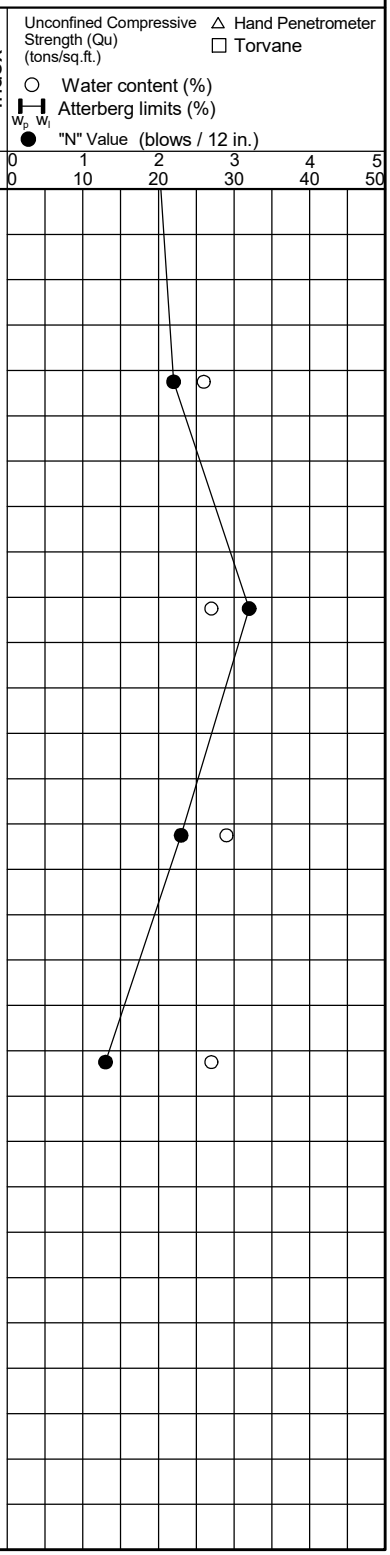
DRILLER: ADT-Cascade

DRILL RIG: Geoprobe 7822 DT

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- WATER LEVEL
- GS - GRAB SAMPLE

Depth	Elevation (ft)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery (RQD)	Moisture Content	Blows per 6 in.	Penetraion Index
Feet	13.50		GROUND SURFACE			%			N
35					SS-9	69	26	7-10-12	22
40					SS-10	69	27	10-13-19	32
45					SS-11	75	29	9-12-11	23
50	-36.50		50.0		SS-12	67	27	5-8-5	13
55									



END OF BOREHOLE AT 50 FT BELOW GROUND SURFACE (BGS). HAND AUGER USED TO A DEPTH OF 5 FT BGS. SAMPLE GS-1 TAKEN FROM HAND AUGER CUTTINGS. BOREHOLE THEN ADVANCED TO 10 FT BGS USING 4.25-IN I.D. HOLLOW STEM AUGERS. THEN SWITCHED TO WASH ROTARY USING 3-7/8-IN TRI-CONE ROLLER BIT WITH BENTONITE/WATER AS DRILLING MUD TO ADVANCE BOREHOLE TO 50 FT BGS.

BOREHOLE BACKFILLED WITH SOIL CUTTINGS AND SURFACE PATCHED.

WL: 10 ft.

WL (AB): N/A ft.

REFERENCE No.: 12667502

ENCLOSURE No.:

BOREHOLE No.: B-4

ELEVATION: 13.5 ft

BOREHOLE REPORT

CLIENT: Quinn Evans Architects

PROJECT: NPS Hangars 3/4 Rehab Geotech

LOCATION: Brooklyn, NY

DESCRIBED BY: S. King

CHECKED BY: J. Snyder

DATE (START): April 17, 2025

DATE (FINISH): April 17, 2025

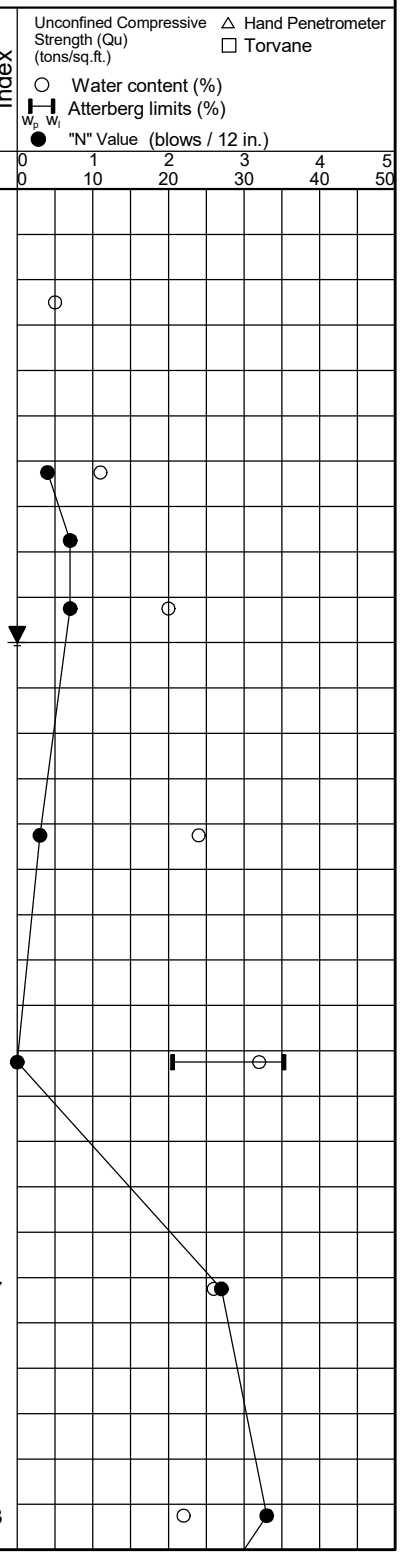
DRILLER: ADT-Cascade

DRILL RIG: Geoprobe 7822 DT

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- WATER LEVEL
- GS - GRAB SAMPLE

Depth (Feet)	Elevation (ft)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery (RQD) %	Moisture Content	Blows per 6 in.	Penetraion Index N
	13.50		GROUND SURFACE						
	13.25		0.3 ASPHALT						
			(FILL) SAND, trace silt, brown and light brown, very loose to loose, moist		GS-1		5	--	--
5					SS-2	100	11	2-2-2	4
					SS-3	89	7	3-3-4	7
					SS-4	78	20	6-4-3	7
10									
	0.00		13.5 (SM) Silty SAND, trace gravel, dark gray, very loose, moist to wet		SS-5	42	24	3-2-1	3
15									
	-5.00		18.5 (SC) Clayey SAND with silt, trace shells, gray, very loose, moist to wet		SS-6	100	32	0-0-0	0
20									
	-10.00		23.5 (SP) SAND, trace silt, gray, medium dense to dense, moist to wet		SS-7	83	26	11-14-13	27
25									
					SS-8	58	22	10-17-16	33



SOIL LOG WITH GRAPH 12667502 NPS FLOYD BENNET FIELD.GPJ CRA PLYMOUTH.GDT 5/8/25

REFERENCE No.: 12667502

ENCLOSURE No.:

BOREHOLE No.: B-4

ELEVATION: 13.5 ft

BOREHOLE REPORT

CLIENT: Quinn Evans Architects

PROJECT: NPS Hangars 3/4 Rehab Geotech

LOCATION: Brooklyn, NY

DESCRIBED BY: S. King

CHECKED BY: J. Snyder

DATE (START): April 17, 2025

DATE (FINISH): April 17, 2025

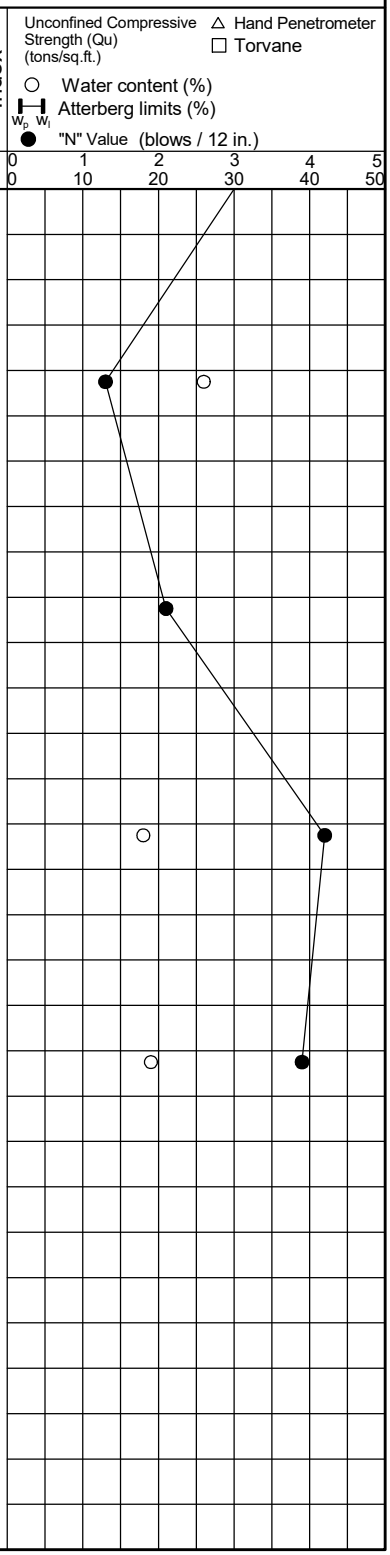
DRILLER: ADT-Cascade

DRILL RIG: Geoprobe 7822 DT

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- RC - ROCK CORE
- WATER LEVEL
- GS - GRAB SAMPLE

Depth	Elevation (ft)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery (RQD)	Moisture Content	Blows per 6 in.	Penetraion Index
Feet	13.50		GROUND SURFACE			%			N
35					SS-9	58	26	7-6-7	13
40					SS-10	39	21	7-11-10	21
45					SS-11	58	18	20-21-21	42
50	-36.50		50.0 END OF BOREHOLE AT 50 FT BELOW GROUND SURFACE (BGS). HAND AUGER USED TO A DEPTH OF 5 FT BGS. SAMPLE GS-1 TAKEN FROM HAND AUGER CUTTINGS. BOREHOLE THEN ADVANCED TO 10 FT BGS USING 4.25-IN I.D. HOLLOW STEM AUGERS. THEN SWITCHED TO WASH ROTARY USING 3-7/8-IN TRI-CONE ROLLER BIT WITH BENTONITE/WATER AS DRILLING MUD TO ADVANCE BOREHOLE TO 50 FT BGS. BOREHOLE BACKFILLED WITH SOIL CUTTINGS AND SURFACE PATCHED. WL: 10 ft. WL (AB): N/A ft.		SS-12	53	19	15-16-23	39
55									



Appendix B

Geotechnical Laboratory Test Results

Borehole	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Bulk Density (pcf)	Void Ratio
B-1	0							4.1			
B-1	5.5							2.9			
B-1	7							14.0			
B-1	8.5				9.375	1	SP	12.9			
B-1	13.5							26.9			
B-1	18.5							41.5			
B-1	23.5				2	1	SP	44.2			
B-1	28.5							25.1			
B-1	33.5							24.6			
B-1	38.5							24.5			
B-1	43.5							24.8			
B-1	48.5							18.9			
B-2	0							4.8			
B-2	5.5							4.5			
B-2	7							5.0			
B-2	8.5				2	1	SP	22.2			
B-2	13.5							35.8			
B-2	18.5	NP	NP	NP	2.36	9		24.4			
B-2	23.5							25.1			
B-2	28.5							24.2			
B-2	33.5							19.0			
B-2	38.5				9.375	2	SP	15.2			
B-2	43.5							16.5			
B-2	48.5							16.2			
B-3	0							5.9			
B-3	5.5							4.0			
B-3	7							4.8			
B-3	8.5							14.1			
B-3	13.5	53	45	8	4.75	53	MH	49.7			
B-3	18.5							39.3			
B-3	23.5							29.6			
B-3	28.5				2.36	1	SP	27.2			
B-3	33.5							25.9			
B-3	38.5							27.3			
B-3	43.5							28.9			
B-3	48.5							27.2			
B-4	0							4.9			
B-4	5.5							11.1			
B-4	7				4.75	1	SP	7.5			
B-4	8.5							20.1			
B-4	13.5							24.1			
B-4	18.5	35	21	14	4.75	48	SC	31.9			

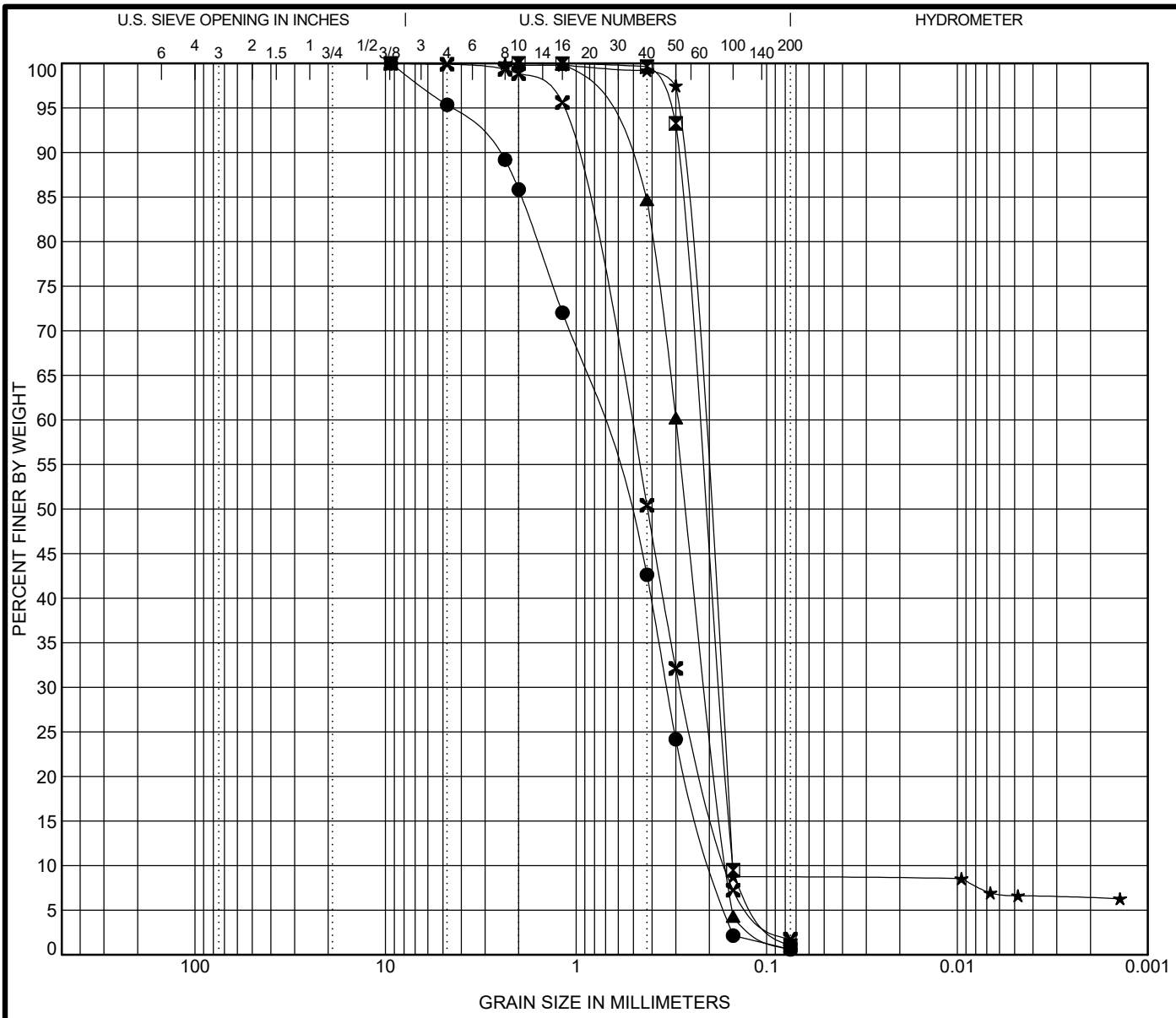
Summary of Laboratory Results

Project Name: NPS Hangars 3/4 Rehab Geotech
Project Number: 12667502
Client: Quinn Evans Architects
Location: Brooklyn, NY

Borehole	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Bulk Density (pcf)	Void Ratio
B-4	23.5							25.7			
B-4	28.5							22.4			
B-4	33.5				4.75	1	SP	26.3			
B-4	38.5							21.3			
B-4	43.5							18.2			
B-4	48.5							19.3			

Summary of Laboratory Results

Project Name: NPS Hangars 3/4 Rehab Geotech
Project Number: 12667502
Client: Quinn Evans Architects
Location: Brooklyn, NY



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	B-1	8.5	(SP) SAND, trace silt and gravel				0.75	4.05
⊠	B-1	23.5	(SP) SAND, trace silt				0.92	1.51
▲	B-2	8.5	(SP) SAND, trace silt				0.88	1.86
★	B-2	18.5	(SP-SC) SAND with clay and silt	NP	NP	NP	0.92	1.48
✕	B-2	38.5	(SP) SAND, trace silt and gravel				0.93	3.26

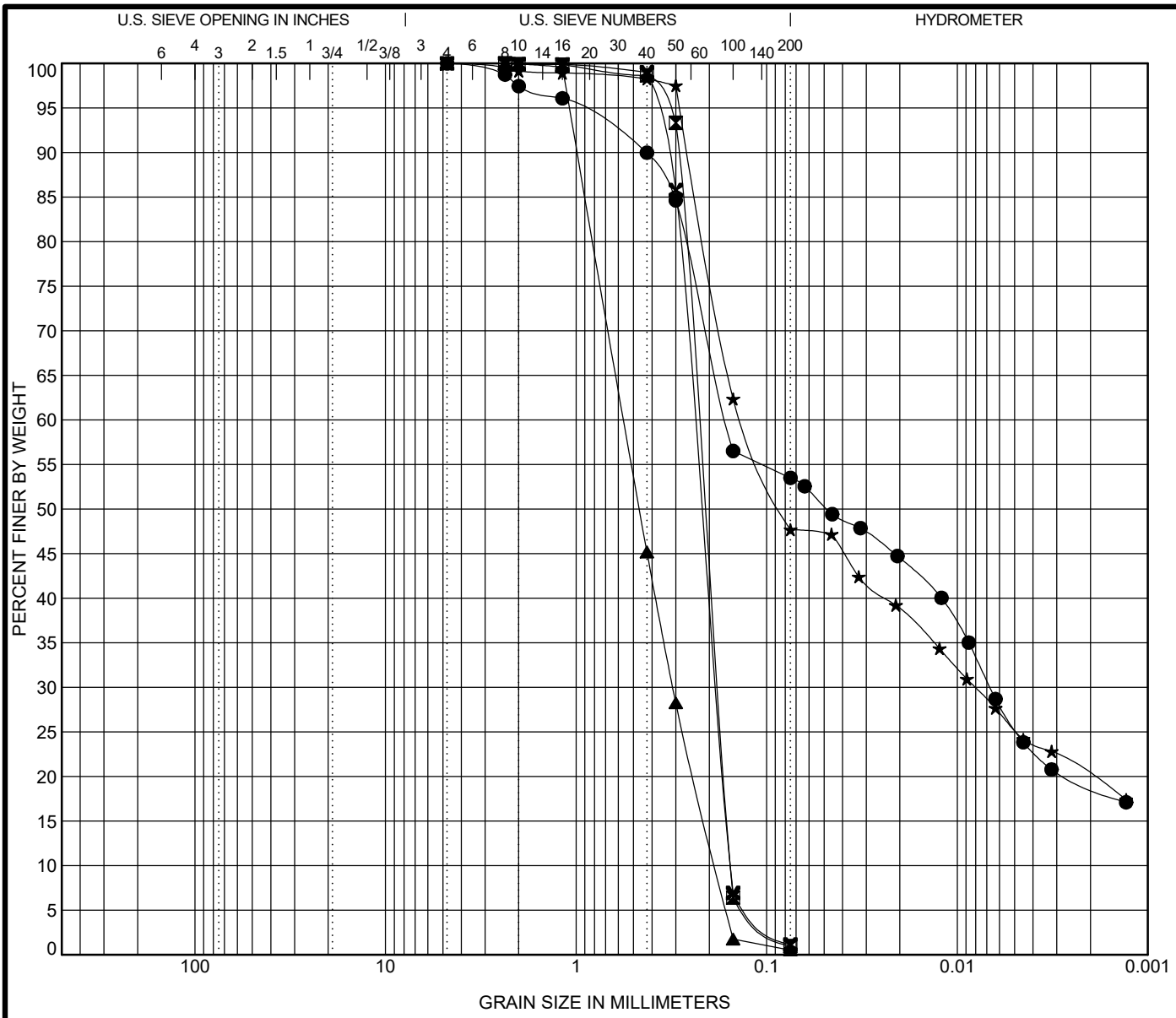
	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-1	8.5	9.375	0.777	0.335	0.192	4.6	94.8	0.6	
⊠	B-1	23.5	2	0.228	0.178	0.151	0.0	99.0	1.0	
▲	B-2	8.5	2	0.299	0.206	0.161	0.0	99.4	0.6	
★	B-2	18.5	2.36	0.224	0.177	0.151	0.0	91.3	2.3	6.4
✕	B-2	38.5	9.375	0.528	0.283	0.162	0.1	98.2	1.8	

GRAIN SIZE DISTRIBUTION (ASTM D422)

Project Name: NPS Hangars 3/4 Rehab Geotech
Project Number: 12667502
Client: Quinn Evans Architects
Location: Brooklyn, NY

Test by: K. Kube **Checked by:** J. Snyder **Test Date:** 5/5/2025

GRAIN SIZE 12667502 NPS FLOYD BENNET FIELD.GPJ GINT STD AGS 3_1.GDT 5/8/25



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	B-3	13.5	(MH) Sandy SILT with clay	53	45	8		
⊠	B-3	28.5	(SP) SAND, trace silt				0.92	1.49
▲	B-4	7	(SP) SAND, trace silt				0.93	3.02
★	B-4	18.5	(SC) Clayey SAND with silt	35	21	14		
✕	B-4	33.5	(SP) SAND, trace silt				0.92	1.55

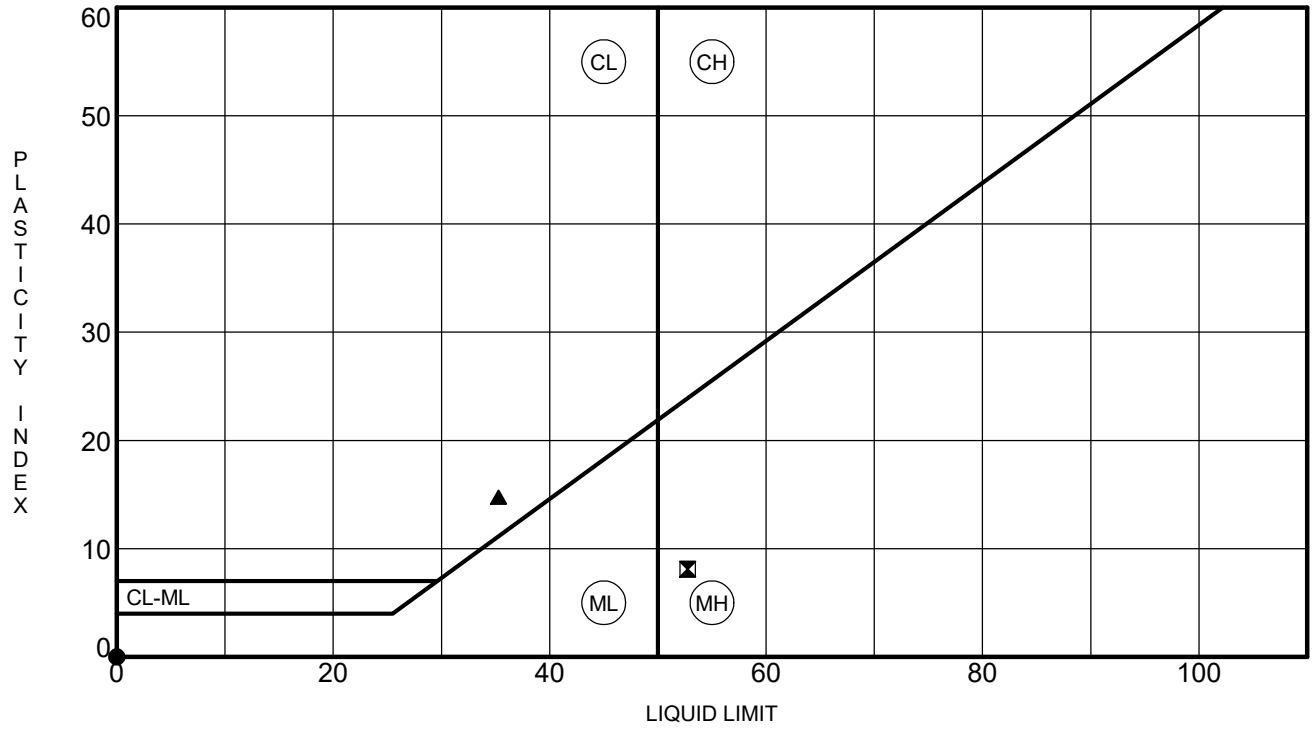
	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-3	13.5	4.75	0.163	0.007		0.0	46.5	34.6	18.9
⊠	B-3	28.5	2.36	0.23	0.181	0.154	0.0	99.0	1.0	
▲	B-4	7	4.75	0.561	0.311	0.186	0.0	99.5	0.5	
★	B-4	18.5	4.75	0.134	0.008		0.0	52.3	27.7	20.0
✕	B-4	33.5	4.75	0.239	0.184	0.154	0.0	98.8	1.2	

GRAIN SIZE DISTRIBUTION (ASTM D422)

Project Name: NPS Hangars 3/4 Rehab Geotech
Project Number: 12667502
Client: Quinn Evans Architects
Location: Brooklyn, NY

Test by: K. Kube **Checked by:** J. Snyder **Test Date:** 5/5/2025

GRAIN SIZE 12667502 NPS FLOYD BENNET FIELD.GPJ GINT STD AGS 3 1.GDT 5/8/25



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-2**	**18.5**	**NP**	**NP**	**NP**	**9**	**(SP-SC) SAND with clay and silt**
⊠	**B-3**	**13.5**	**53**	**45**	**8**	**53**	**(MH) Sandy SILT with clay**
▲	**B-4**	**18.5**	**35**	**21**	**14**	**48**	**(SC) Clayey SAND with silt**

ATTERBERG LIMITS RESULTS (ASTM D4318)

Project Name: NPS Hangars 3/4 Rehab Geotech
Project Number: 12667502
Client: Quinn Evans Architects
Location: Brooklyn, NY

Test By: K. Kube **Checked By:** J. Snyder **Test Date:** 5/6/2025

Appendix C

Corrosion Potential Laboratory Test Results

May 12, 2025

Project No. 2025-252-001

Jeff Snyder
GHD Services Inc.
26850 Haggerty Rd.
Farmington Hills, MI 48170

Transmittal
Laboratory Test Results
Brooklyn, NY 1266 7502

Please find attached the laboratory test results for the above referenced project. The tests were outlined on the Project Verification Form that was transmitted to your firm prior to the testing. The testing was performed in general accordance with the methods listed on the enclosed data sheets. The test results are believed to be representative of the samples that were submitted for testing and are indicative only of the specimens that were evaluated. We have no direct knowledge of the origin of the samples and imply no position with regard to the nature of the test results, i.e. pass/fail and no claims as to the suitability of the material for its intended use.

The test data and all associated project information provided shall be held in strict confidence and disclosed to other parties only with authorization by our Client. The test data submitted herein is considered integral with this report and is not to be reproduced except in whole and only with the authorization of the Client and Geotechnics. The remaining sample materials for this project will be retained for a minimum of 90 days as directed by the Geotechnics' Quality Program.

We are pleased to provide these testing services. Should you have any questions or if we may be of further assistance, please contact our office.

Respectfully submitted,
Geotechnics, Inc.

Nathan Melaro
Director of Operations

We understand that you have a choice in your laboratory services and we thank you for choosing Geotechnics.

DCN: Data Transmittal Letter Date: 1/28/05 Rev.: 1

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CHLORIDE ION CONTENT IN SOILS

AASHTO T 291 - 94 (2018) (*Method B*)

Client:	GHD Services, Inc.	Boring No.:	B-1
Client Reference:	Brooklyn, NY 1266 7502	Depth (ft):	0.0-10.0'
Project No.:	2025-252-001	Sample No.:	GS-1
Lab ID:	2025-252-001-001	Description:	Brown

(- # 10 Sieve material)

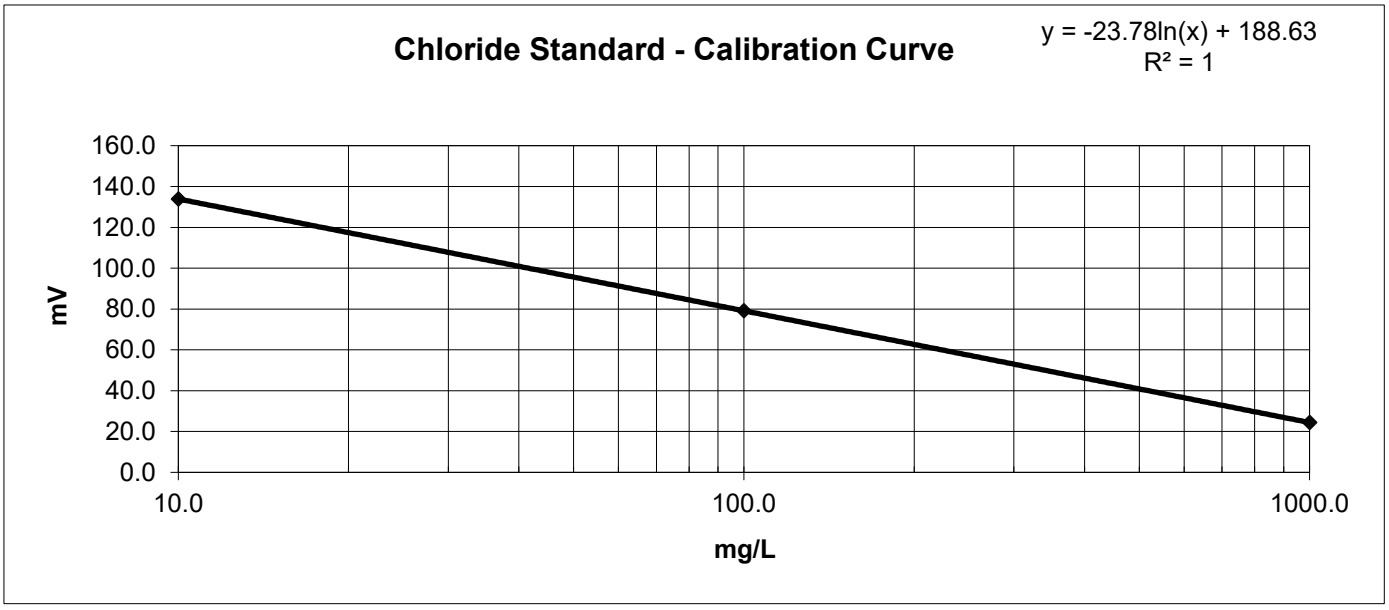
CHLORIDE STANDARD: CALIBRATION CURVE

STANDARD		MILLIVOLTS (mV)
10.0	mg/L	133.9
100.0	mg/L	79.1
1000.0	mg/L	24.4

MEASUREMENT OF CHLORIDES

		CONCENTRATION (mg/L)	CONCENTRATION (mg/kg)
Sample Weight (g):	100.0		
Water added to Sample (ml):	100.0		
Size of Sample Aliquot (ml):	25.0		
Sample Reading (mV):	141.1	7.38	7.38

Notes: 1) Samples and standards were buffered by the addition of an equal volume of the 0.2 M KNO_3 solution (1:1 volume).
2) Samples were dried for a minimum of 12 hours at 110 $^{+}/_{-}$ 5°C.



Notes:

Tested By	JAM	Date	5/8/25	Checked By	EG	Date	5/9/25

DCN: CT-S63A DATE: 6/2/14 REVISION: 1

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pH OF SOILS

AASHTO T 289-91 (2013)

Client:	GHD Services, Inc.
Client Reference:	Brooklyn, NY 1266 7502
Project No.:	2025-252-001

Lab ID:	001
Boring No.:	B-1
Depth (ft):	0.0-10.0'
Sample No.:	GS-1
Drying Tare No.:	2003
Testing Tare No.:	Z
Temperature (°C):	22.7
pH of Sample:	**8.05**

Meter Calibration (as used each day)		
Buffer pH	Meter Reading	Meter Model
4.00	4.00	ORION 720A
7.00	7.00	
10.00	10.00	

Tested By JAM Date 5/7/25 Checked By EG Date 5/8/25

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Minimum Resistivity

AASHTO T288-12

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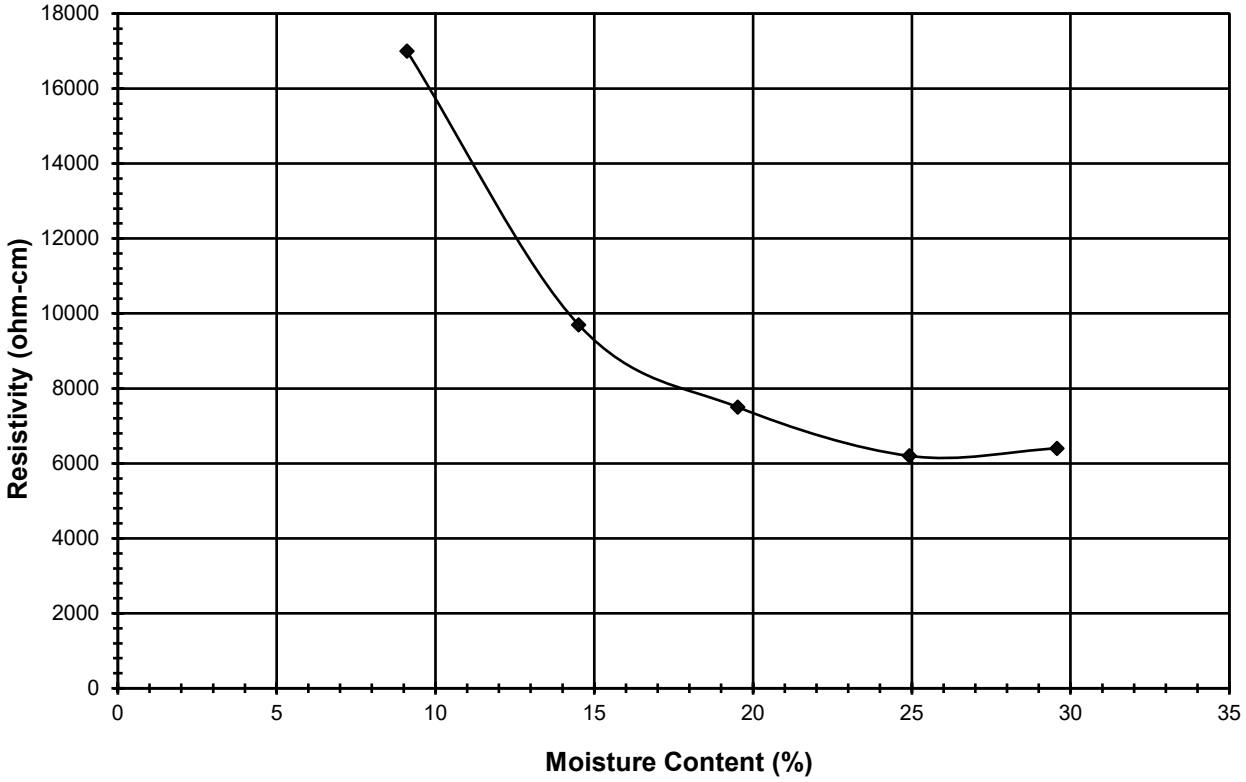
Client:	GHD Services, Inc	Boring No.:	B-1
Client Reference:	Brooklyn, NY 1266 7502	Depth (ft):	0.0-10.0'
Project No.:	2025-252-001	Sample No.:	GS-1
Lab ID:	2025-252-001-001	Visual Description:	Brown
		(- #10 Sieve material)	

Tare No.:	717	705	733	719	768
Tare & Wet Specimen (g):	53.71	47.05	46.15	43.25	45.23
Tare & Dry Specimen (g):	51.11	43.81	41.98	39.13	39.18
Tare Weight (g):	22.55	21.48	20.62	22.60	18.72
Moisture Content (%):	**9.1**	**14.5**	**19.5**	**24.9**	**29.6**
Resistance (ohm):	**17000**	**9700**	**7500**	**6200**	**6400**
Resistivity (ohm-cm):	**17000**	**9700**	**7500**	**6200**	**6400**

Note: The ratio of Miller Box area versus distance between electrodes is equal to 1.



Soil Class	*Corrosion Resistance*	*Specific Resistivity (ohm-cm)*
1	Excellent	10,000 - 6,000
2	Good	6,000 - 4,500
3	Fair	4,500 - 2,000
4	Bad	2,000 - 0

Tested By JAM *Date* 5/8/2025 *Checked By* EG *Date* 5/9/2025

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Water-Soluble Sulfate Ion Content in Soil

AASHTO T 290-95 (2020)

Client:	GHD Services, Inc.	Boring No.:	B-1
Client Reference:	Brooklyn NY 1266 7502	Depth (ft):	0.0-10.0'
Project No.:	2025-252-001	Sample No.:	GS-1
Lab ID:	2025-252-001-001	Soil Description:	Brown

Sulfate Standard - Calibration Curve Spectrophotometer Readings

Sulfate Ion Concentrations (mg/L)								
0.0	4.0	10.0	20.0	30.0	40.0	60.0	80.0	100.0
Spectrophotometer Readings (FAU)								
Underrange	Underrange	8	17	44	68	129	184	227

Measurement of Barium Chloride Turbidity

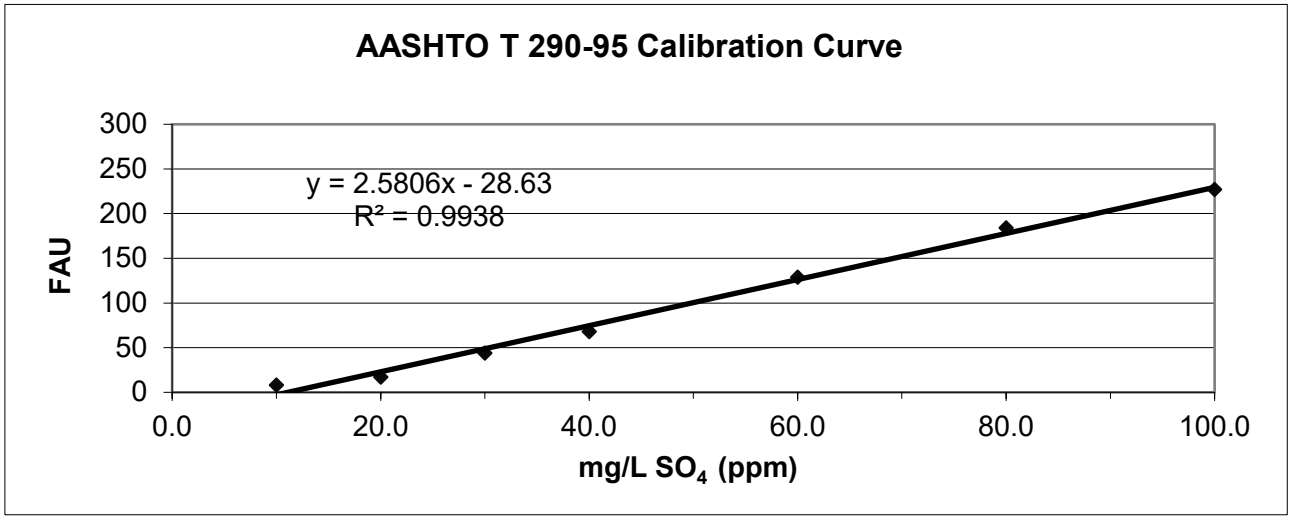
(Sample contains 5.0 mL NaCl solution and 0.3 g $BaCl_2 \cdot 2H_2O$)

Sample Weight (g):	100.0
Water added to Sample (mL):	300.0
Size of Sample Aliquot (mL):	50.0
Sample Reading (FAU):	30
Sample Diluted:	No
Sulfate Solution Added (ml):	0

Sample Moisture Content

Tare Number:	483
Weight of Tare & Wet Sample (g):	209.15
Weight of Tare & Dry Sample (g):	208.91
Weight of Tare (g):	97.30
Weight of Water (g):	0.24
Weight of Dry Sample (g):	111.61
Moisture Content (%):	0.22

Sample Sulfate Ion Concentration:	22.72	**mg/L SO_4 (ppm)**
Sample Sulfate Ion Content:	68.2	**mg/Kg SO_4 (not corrected for moisture)**
Sample Sulfate Ion Content:	68.3	**mg/Kg SO_4 (corrected for moisture)**



Tested by: JAM Date: 5/7/25 Checked by: EG Date: 5/8/2025

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CHLORIDE ION CONTENT IN SOILS

AASHTO T 291 - 94 (2018) (*Method B*)

Client:	GHD Services, Inc.	Boring No.:	B-4
Client Reference:	Brooklyn, NY 1266 7502	Depth (ft):	0.0-10.0'
Project No.:	2025-252-001	Sample No.:	GS-2
Lab ID:	2025-252-001-002	Description:	Brown

(- # 10 Sieve material)

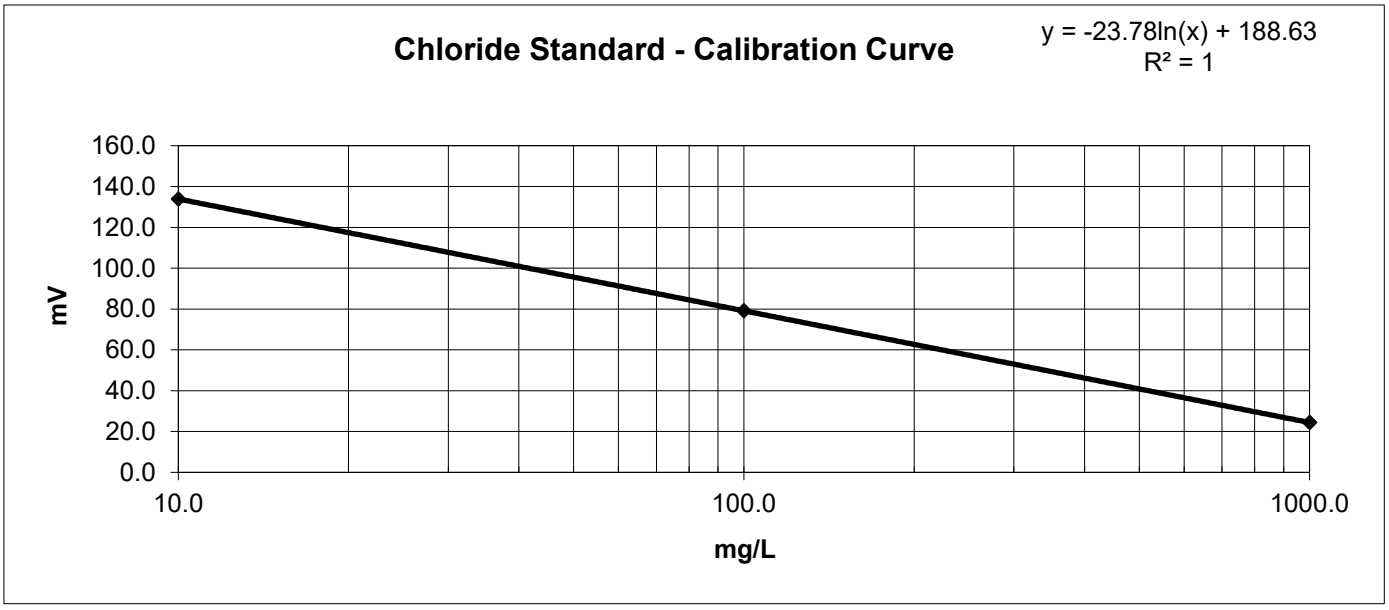
CHLORIDE STANDARD: CALIBRATION CURVE

STANDARD		MILLIVOLTS (mV)
10.0	mg/L	133.9
100.0	mg/L	79.1
1000.0	mg/L	24.4

MEASUREMENT OF CHLORIDES

		CONCENTRATION (mg/L)	CONCENTRATION (mg/kg)
Sample Weight (g):	100.0		
Water added to Sample (ml):	100.0		
Size of Sample Aliquot (ml):	25.0		
Sample Reading (mV):	164.3	2.78	2.78

Notes: 1) Samples and standards were buffered by the addition of an equal volume of the 0.2 M KNO_3 solution (1:1 volume).
2) Samples were dried for a minimum of 12 hours at 110 $^{+}/_{-}$ 5°C.



Notes:

Tested By	JAM	Date	5/8/25	Checked By	EG	Date	5/9/25

 DCN: CT-S63A DATE: 6/2/14 REVISION: 1

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pH OF SOILS

AASHTO T 289-91 (2013)

Client:	GHD Services, Inc.
Client Reference:	Brooklyn, NY 1266 7502
Project No.:	2025-252-001

Lab ID:	002
Boring No.:	B-4
Depth (ft):	0.0-10.0'
Sample No.:	GS-2
Drying Tare No.:	2004
Testing Tare No.:	Y
Temperature (°C):	22.7
pH of Sample:	**7.67**

Meter Calibration (as used each day)		
Buffer pH	Meter Reading	Meter Model
4.00	4.00	ORION 720A
7.00	7.00	
10.00	10.00	

Tested By JAM Date 5/7/25 Checked By EG Date 5/8/25

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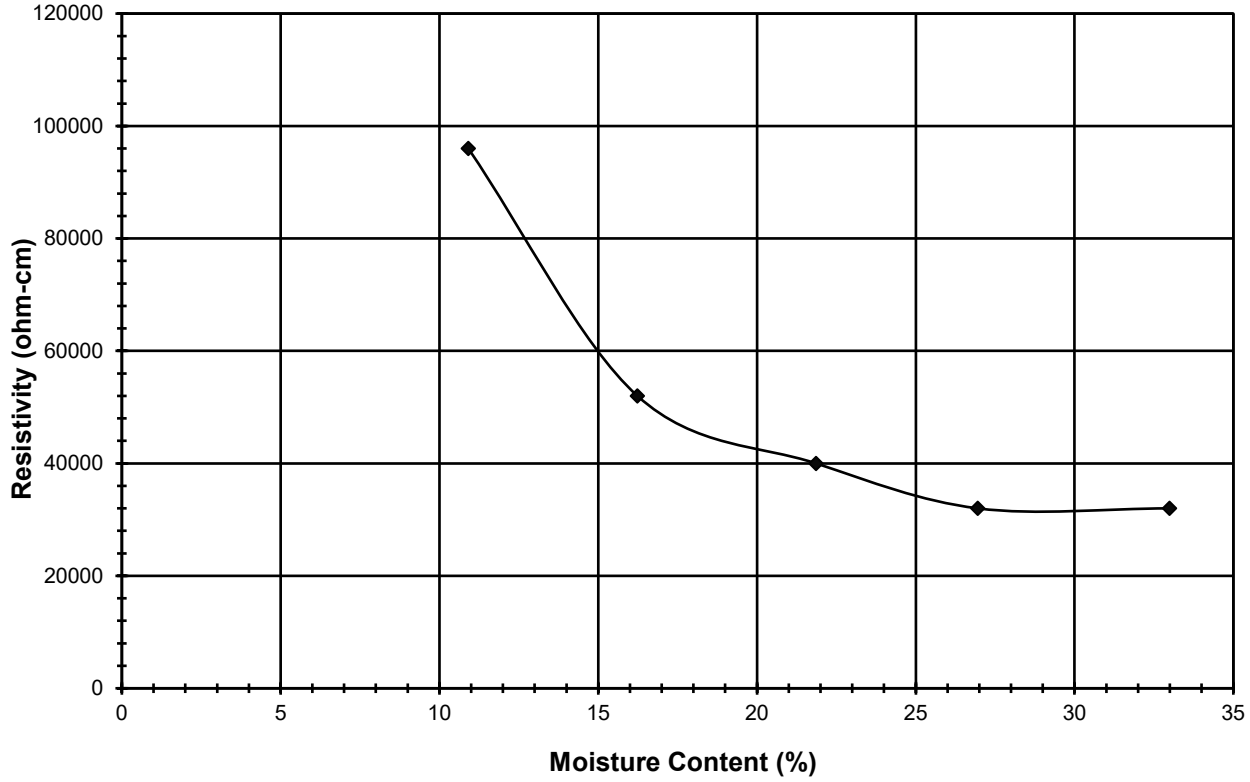
Minimum Resistivity

AASHTO T288-12

Client:	GHD Services, Inc.	Boring No.:	B-4
Client Reference:	Brooklyn, NY 1266 7522	Depth (ft):	0.0-10.0'
Project No.:	2025-252-001	Sample No.:	GS-2
Lab ID:	2025-252-001-002	Visual Description:	Brown
		(- #10 Sieve material)	

Tare No.:	329	292	168	279	290
Tare & Wet Specimen (g):	42.97	40.37	46.22	55.41	53.23
Tare & Dry Specimen (g):	40.61	37.54	41.17	48.27	44.47
Tare Weight (g):	18.98	20.11	18.07	21.78	17.92
Moisture Content (%):	**10.9**	**16.2**	**21.9**	**27.0**	**33.0**
Resistance (ohm):	**96000**	**52000**	**40000**	**32000**	**32000**
Resistivity (ohm-cm):	**96000**	**52000**	**40000**	**32000**	**32000**

Note: The ratio of Miller Box area versus distance between electrodes is equal to 1.



Soil Class	*Corrosion Resistance*	*Specific Resistivity (ohm-cm)*
1	Excellent	10,000 - 6,000
2	Good	6,000 - 4,500
3	Fair	4,500 - 2,000
4	Bad	2,000 - 0

Tested By DDA *Date* 5/7/2025 *Checked By* EG *Date* 5/9/2025

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Water-Soluble Sulfate Ion Content in Soil

AASHTO T 290-95 (2020)

Client:	GHD Services, Inc.	Boring No.:	B-4
Client Reference:	Brooklyn NY 1266 7502	Depth (ft):	0.0-10.0'
Project No.:	2025-252-001	Sample No.:	GS-2
Lab ID:	2025-252-001-002	Soil Description:	Brown

Sulfate Standard - Calibration Curve Spectrophotometer Readings

Sulfate Ion Concentrations (mg/L)								
0.0	4.0	10.0	20.0	30.0	40.0	60.0	80.0	100.0
Spectrophotometer Readings (FAU)								
Underrange	Underrange	8	17	44	68	129	184	227

Measurement of Barium Chloride Turbidity

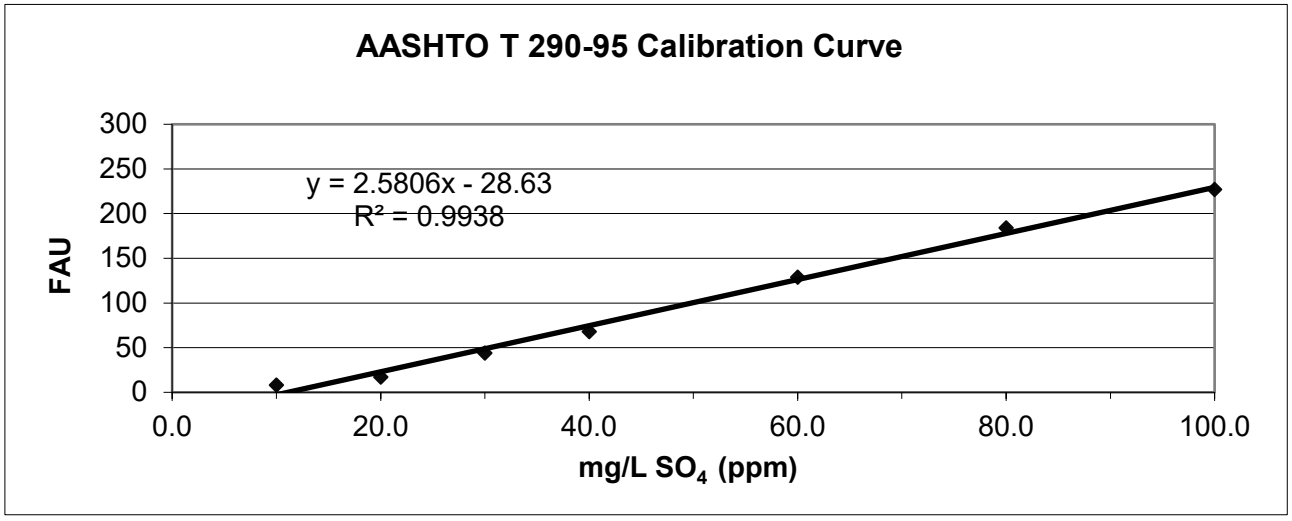
(Sample contains 5.0 mL NaCl solution and 0.3 g $BaCl_2 \cdot 2H_2O$)

Sample Weight (g):	100.0
Water added to Sample (mL):	300.0
Size of Sample Aliquot (mL):	50.0
Sample Reading (FAU):	8
Sample Diluted:	No
Sulfate Solution Added (ml):	0

Sample Moisture Content

Tare Number:	479
Weight of Tare & Wet Sample (g):	215.21
Weight of Tare & Dry Sample (g):	214.96
Weight of Tare (g):	47.73
Weight of Water (g):	0.25
Weight of Dry Sample (g):	167.23
Moisture Content (%):	0.15

Sample Sulfate Ion Concentration:	14.19	**mg/L SO_4 (ppm)**
Sample Sulfate Ion Content:	42.6	**mg/Kg SO_4 (not corrected for moisture)**
Sample Sulfate Ion Content:	42.6	**mg/Kg SO_4 (corrected for moisture)**



Tested by: JAM Date: 5/7/25 Checked by: EG Date: 5/8/2025

544 Braddock Avenue • East Pittsburgh, PA 15112 • Phone (412) 823-7600 • Fax (412) 823-8999 • www.geotechnics.net

eurofins | Environment Testing

ANALYTICAL REPORT

PREPARED FOR

Attn: Caleb Kyper
Geotechnics Inc.
544 Braddock Ave
East Pittsburgh, Pennsylvania 15112

Generated 5/12/2025 7:21:31 AM

JOB DESCRIPTION

Geotechnics, GHD Services, Inc.

JOB NUMBER

180-189869-1

Eurofins Pittsburgh
301 Alpha Drive
RIDC Park
Pittsburgh PA 15238

See page two for job notes and contact information.

my EOL

Eurofins Pittsburgh

Job Notes

This report may not be reproduced except in full, and with written approval from the laboratory. The results relate only to the samples tested. For questions please contact the Project Manager at the e-mail address or telephone number listed on this page.

PA Lab ID: 02-00416

The test results in this report relate only to the samples as received by the laboratory and will meet all requirements of the methodology, with any exceptions noted. This report shall not be reproduced except in full, without the express written approval of the laboratory. All questions should be directed to the Eurofins Pittsburgh Project Manager.

Authorization

Generated
5/12/2025 7:21:31 AM

Authorized for release by
David Dunlap, Senior Project Manager
David.Dunlap@et.eurofinsus.com
(412)963-2432

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Job Narrative
180-189869-1

Comments
The samples were received on the last day of the holding time for the sulfide analysis. At the direction of the client, the analysis was to be completed.

Receipt
The samples were received on 4/29/2025 4:00 PM. Unless otherwise noted below, the samples arrived in good condition. The temperature of the cooler at receipt was 21.9º C. The samples were not submitted on ice.

There was no initial relinquished/received time on the COC.

General Chemistry
Method 9034: The sulfide analysis was completed past the 7 day holding time.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Definitions/Glossary

Client: Geotechnics Inc.
Project/Site: Geotechnics, GHD Services, Inc.

Job ID: 180-189869-1

Qualifiers

General Chemistry

Qualifier	Qualifier Description
!	Laboratory is not accredited for this parameter.
H	Sample was prepped or analyzed beyond the specified holding time. This does not meet regulatory requirements.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
☼	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

Accreditation/Certification Summary

Client: Geotechnics Inc.
Job ID: 180-189869-1
Project/Site: Geotechnics, GHD Services, Inc.

Laboratory: Eurofins Pittsburgh

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
Pennsylvania	NELAP	02-00416	04-30-26

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
SM 2580B		Solid	Oxidation Reduction Potential

Sample Summary

Client: Geotechnics Inc.
Project/Site: Geotechnics, GHD Services, Inc.

Job ID: 180-189869-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
180-189869-1	2025-252-001-001	Solid	04/22/25 00:00	04/29/25 16:00
180-189869-2	2025-252-001-002	Solid	04/22/25 00:00	04/29/25 16:00

Method Summary

Client: Geotechnics Inc.
Project/Site: Geotechnics, GHD Services, Inc.

Job ID: 180-189869-1

Method	Method Description	Protocol	Laboratory
2540G	SM 2540G	SM22	EET PIT
EPA 9034	Sulfide, Acid soluble and Insoluble (Titrimetric)	SW846	EET PIT
SM 2580B	Reduction-Oxidation (REDOX) Potential	SM	EET PIT
9030B	Sulfide, Distillation (Acid Soluble and Insoluble)	SW846	EET PIT
DI Leach	Deionized Water Leaching Procedure	ASTM	EET PIT

Protocol References:

ASTM = ASTM International
SM = "Standard Methods For The Examination Of Water And Wastewater"
SM22 = Standard Methods For The Examination Of Water And Wastewater, 22nd Edition
SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

EET PIT = Eurofins Pittsburgh, 301 Alpha Drive, RIDC Park, Pittsburgh, PA 15238, TEL (412)963-7058

Lab Chronicle

Client: Geotechnics Inc.
Project/Site: Geotechnics, GHD Services, Inc.

Job ID: 180-189869-1

Client Sample ID: 2025-252-001-001 — Lab Sample ID: 180-189869-1

Date Collected: 04/22/25 00:00
Date Received: 04/29/25 16:00
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	2540G		1			494992	05/02/25 10:35	MTW	EET PIT
	Instrument ID: NOEQUIP									
Soluble	Leach	DI Leach			19.90 g	20 mL	495457	05/08/25 10:56	ELS	EET PIT
Soluble	Analysis	SM 2580B		1			495451	05/08/25 14:09	ELS	EET PIT
	Instrument ID: NOEQUIP									

Client Sample ID: 2025-252-001-001 — Lab Sample ID: 180-189869-1

Date Collected: 04/22/25 00:00
Date Received: 04/29/25 16:00
Matrix: Solid
Percent Solids: 92.4

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	9030B			5.02 g	50 mL	495269	05/06/25 12:57	BAB	EET PIT
Total/NA	Analysis	EPA 9034		1			495287	05/06/25 16:24	SNR	EET PIT
	Instrument ID: TITRAT1									

Client Sample ID: 2025-252-001-002 — Lab Sample ID: 180-189869-2

Date Collected: 04/22/25 00:00
Date Received: 04/29/25 16:00
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	2540G		1			494992	05/02/25 10:35	MTW	EET PIT
	Instrument ID: NOEQUIP									
Soluble	Leach	DI Leach			19.98 g	20 mL	495457	05/08/25 10:56	ELS	EET PIT
Soluble	Analysis	SM 2580B		1			495451	05/08/25 14:26	ELS	EET PIT
	Instrument ID: NOEQUIP									

Client Sample ID: 2025-252-001-002 — Lab Sample ID: 180-189869-2

Date Collected: 04/22/25 00:00
Date Received: 04/29/25 16:00
Matrix: Solid
Percent Solids: 95.1

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	9030B			4.98 g	50 mL	495269	05/06/25 12:57	BAB	EET PIT
Total/NA	Analysis	EPA 9034		1			495287	05/06/25 16:26	SNR	EET PIT
	Instrument ID: TITRAT1									

[1] This procedure uses a method stipulated length of time for the process. Both start and end times are displayed.

Laboratory References:

EET PIT = Eurofins Pittsburgh, 301 Alpha Drive, RIDC Park, Pittsburgh, PA 15238, TEL (412)963-7058

Lab Chronicle

Client: Geotechnics Inc.
Project/Site: Geotechnics, GHD Services, Inc.

Job ID: 180-189869-1

Analyst References:

Lab: EET PIT

- Batch Type: Leach
  - ELS = Edwin Shireman
- Batch Type: Prep
  - BAB = Brooke Batyi
- Batch Type: Analysis
  - ELS = Edwin Shireman
  - MTW = Michael Wesoloski
  - SNR = Sabra Richart

Client Sample Results

Client: Geotechnics Inc.
Project/Site: Geotechnics, GHD Services, Inc.

Job ID: 180-189869-1

Client Sample ID: 2025-252-001-001
Lab Sample ID: 180-189869-1
Date Collected: 04/22/25 00:00
Matrix: Solid
Date Received: 04/29/25 16:00

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (SM22 2540G)	7.6		0.1	0.1	%			05/02/25 10:35	1
Percent Solids (SM22 2540G)	92.4		0.1	0.1	%			05/02/25 10:35	1

General Chemistry - Soluble

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Oxidation Reduction Potential (SM 2580B)	200	!	10	10	millivolts			05/08/25 14:09	1

Client Sample ID: 2025-252-001-001
Lab Sample ID: 180-189869-1
Date Collected: 04/22/25 00:00
Matrix: Solid
Date Received: 04/29/25 16:00
Percent Solids: 92.4

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Sulfide (SW846 EPA 9034)	ND	H	32	11	mg/Kg	☼	05/06/25 12:57	05/06/25 16:24	1

Client Sample ID: 2025-252-001-002
Lab Sample ID: 180-189869-2
Date Collected: 04/22/25 00:00
Matrix: Solid
Date Received: 04/29/25 16:00

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (SM22 2540G)	4.9		0.1	0.1	%			05/02/25 10:35	1
Percent Solids (SM22 2540G)	95.1		0.1	0.1	%			05/02/25 10:35	1

General Chemistry - Soluble

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Oxidation Reduction Potential (SM 2580B)	180	!	10	10	millivolts			05/08/25 14:26	1

Client Sample ID: 2025-252-001-002
Lab Sample ID: 180-189869-2
Date Collected: 04/22/25 00:00
Matrix: Solid
Date Received: 04/29/25 16:00
Percent Solids: 95.1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Sulfide (SW846 EPA 9034)	ND	H	32	11	mg/Kg	☼	05/06/25 12:57	05/06/25 16:26	1

QC Sample Results

Client: Geotechnics Inc.
Project/Site: Geotechnics, GHD Services, Inc.

Job ID: 180-189869-1

Method: 2540G - SM 2540G

Lab Sample ID: 180-189869-1 DU
Matrix: Solid
Analysis Batch: 494992

Client Sample ID: 2025-252-001-001
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
Percent Moisture	7.6			7.1		%				6	10
Percent Solids	92.4			92.9		%				0.5	10

Method: EPA 9034 - Sulfide, Acid soluble and Insoluble (Titrimetric)

Lab Sample ID: MB 180-495269/2-A
Matrix: Solid
Analysis Batch: 495287

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 495269

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Sulfide	ND		30	9.9	mg/Kg		05/06/25 12:57	05/06/25 16:10	1

Lab Sample ID: LCS 180-495269/1-A
Matrix: Solid
Analysis Batch: 495287

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 495269

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits		
Sulfide			177	150		mg/Kg		85	85 - 115		

Method: SM 2580B - Reduction-Oxidation (REDOX) Potential

Lab Sample ID: LCS 180-495451/1
Matrix: Solid
Analysis Batch: 495451

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits		
Oxidation Reduction Potential			475	468		millivolts		99	98 - 102		

QC Association Summary

Client: Geotechnics Inc.
Project/Site: Geotechnics, GHD Services, Inc.

Job ID: 180-189869-1

General Chemistry

Analysis Batch: 494992

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-189869-1	2025-252-001-001	Total/NA	Solid	2540G	
180-189869-2	2025-252-001-002	Total/NA	Solid	2540G	
180-189869-1 DU	2025-252-001-001	Total/NA	Solid	2540G	

Prep Batch: 495269

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-189869-1	2025-252-001-001	Total/NA	Solid	9030B	
180-189869-2	2025-252-001-002	Total/NA	Solid	9030B	
MB 180-495269/2-A	Method Blank	Total/NA	Solid	9030B	
LCS 180-495269/1-A	Lab Control Sample	Total/NA	Solid	9030B	

Analysis Batch: 495287

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-189869-1	2025-252-001-001	Total/NA	Solid	EPA 9034	495269
180-189869-2	2025-252-001-002	Total/NA	Solid	EPA 9034	495269
MB 180-495269/2-A	Method Blank	Total/NA	Solid	EPA 9034	495269
LCS 180-495269/1-A	Lab Control Sample	Total/NA	Solid	EPA 9034	495269

Analysis Batch: 495451

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-189869-1	2025-252-001-001	Soluble	Solid	SM 2580B	495457
180-189869-2	2025-252-001-002	Soluble	Solid	SM 2580B	495457
LCS 180-495451/1	Lab Control Sample	Total/NA	Solid	SM 2580B	

Leach Batch: 495457

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-189869-1	2025-252-001-001	Soluble	Solid	DI Leach	
180-189869-2	2025-252-001-002	Soluble	Solid	DI Leach	

GEOTECHNICS TEST REQUEST

geotechnics

Date: 04/22/25
Laboratory: Eurofins Env. Testing Northeast, LLC
Disposal: By Lab
Total Samples: 2
Sampling Date: 4/22/25 (Perform testing regardless of hold time expiration)

DATE DATA NEEDED: **Normal TAT**

Send Report To: ckyper@geotechnics.net
kcummings@geotechnics.net

Client: GHD Services, Inc.
Client Project / Project No.: Brooklyn, NY 1266 7502
Geotechnics Project No.: 2025-252-001

Send Invoice To: Geotechnics, Inc.
544 Braddock Ave.
East Pittsburgh, PA 15112
pcummings@geotechnics.net

Geotechnics Contact: Caleb Kyper

BORING	DEPTH	SAMPLE No.	Lab ID No.	CONTAINER	QUANTITY	WATER	SOIL	AGGR	TESTING / REMARKS
B-1	0.0-10.0'	GS-1	2025-252-001-001	ZIP BAG	1		X		Sulfide Testing & Redox Potential
B-4	0.0-10.0'	GS-2	2025-252-001-002	ZIP BAG	1		X		Sulfide Testing & Redox Potential
									C6 #25 NoIce
									22.3 − 0.4 = 21.9°C
									CF

180-189869 Chain of Custody

RELINQUISHED BY	FIRM	DATE	RECEIVED BY	FIRM	DATE
Caleb Kyper	Geotechnics	4/22/25	John Muron	Geotechnics	4/29/25
John Muron	Geotechnics	4/29/25 11:00	[illegible]	EPNE	4/29/25 1600

Geotechnics, Inc. 544 Braddock Ave. East Pittsburgh, PA 15112
Phone: 412-823-7600 Fax: 412-823-8999 www.geotechnics.net

Login Sample Receipt Checklist

Client: Geotechnics Inc.

Job Number: 180-189869-1

Login Number: 189869
List Number: 1
Creator: Abernathy, Eric L

List Source: Eurofins Pittsburgh

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	False	
Cooler Temperature is acceptable.	False	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	False	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	False	rec. on last day of sulfide hold time
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	N/A	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

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→ The Power of Commitment

Matteo
Ferran
Structural
Engineers

NPS GATE Floyd Bennett Field Hangars 3 and 4

PMIS / PKG No. GATE 308504

Seismic Evaluation Report
Final Submission

MFSE Project No. 23-086.1
December 19, 2025

STATE OF NEW YORK
JOHN A. MATTEO
077905
LICENSED PROFESSIONAL ENGINEER

Prepared for:

Quinn Evans Architects
2101 L Street, NW, Suite 950
Washington, DC 20037

Submitted by:

Matteo Ferran Structural Engineers PLLC
210 N. Lee Street, Suite 210
Alexandria, VA 22314

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1.0 INTRODUCTION

This report provides an assessment of the expected seismic performance of the building containing Hangars 3 and 4 at Floyd Bennett Field, located at 3159 Flatbush Avenue in Brooklyn, New York. It includes an evaluation of the seismic load-resisting ability of the structural system(s), identifies potential deficiencies, and contains recommendations for seismic upgrades where appropriate.

2.0 SCOPE OF ASSESSMENT

This assessment is based on: visual observation of the building; a review of the available existing construction drawings; and limited structural analysis calculations. The assessment is primarily concerned with the performance of structural elements, although nonstructural elements are also addressed, as nonstructural elements may pose life safety hazards, such as by blocking a primary means of egress.

The seismic evaluation is based on the 2023 edition of American Society of Civil Engineers standard *Seismic Evaluation and Retrofit of Existing Buildings* (ASCE 41-23), which is the most recent edition and is the edition referenced by the 2024 *International Existing Building Code* (IEBC). This standard will typically be referred to subsequently in this report simply as ASCE 41; unless noted otherwise, the reference is to the 2023 edition. The criteria and methodology for the evaluation are discussed in greater detail later in the report, as well as other important background information on ASCE 41.

Although a retrofit to address seismic deficiencies is not within the scope of an evaluation, this report does contain some relevant background information on seismic retrofits and provides some recommendations to address deficiencies. As we understand that a proposed renovation in the near future will likely require a seismic retrofit due to a change in occupancy, MFSE has already designed some limited seismic upgrades prudent to include in the design of repairs to be performed prior to the future renovation; these upgrades are also discussed in this report.

3.0 DOCUMENT REVIEW

In order to obtain information relevant to the evaluation of the building, MFSE reviewed the original construction drawings, issued November 15, 1929, by The City of New York Department of Docks, as well as the construction drawings from a past rehabilitation, issued July 7, 1980, by Joseph Tonetti & Associates Architects.

4.0 BUILDING DESCRIPTION

Hangars 3 and 4 are located at Floyd Bennett Field in the Gateway National Recreation Area, a unit of the National Park Service. The last two of eight total hangars to be rehabilitated at the site, the structures were originally constructed between 1929 and 1938 on land created by infilling the channels between Barren Island and several smaller islands and the rest of Brooklyn with sand pumped from the bottom of Jamaica Bay. While the hangars do not sit within a flood zone, they are located directly adjacent to flood zones.

The formerly separate hangars are now part of a single building, which includes the two roughly 17,000 sf hangars, with a roughly 4000 sf one-story structure on the outside of each hangar—known as a “lean-to”—and a roughly 7,000 sf infill building between them, constructed several years later, known as the “WPA infill.” The building is currently unoccupied.

All portions of the building are a single story (with the exception of a mezzanine in the WPA infill); the average roof elevation of the hangars is about 34 ft, while the average roof elevation of the lean-tos is roughly 15 ft, and that of the WPA infill is roughly 22 ft. The variation in the roof elevations is significant from a seismic (or wind) perspective, because it results in discontinuities in the roof diaphragm, which complicate the load path for the structure to resist lateral load.

The east and west wall of each hangar is a steel frame with unreinforced brick masonry (URM) infill; the north and south walls are sliding doors, allowing these two sides to be completely open. The exterior walls of the lean-tos are URM, as are the exterior (north and south) walls of the WPA infill. The fact that two full sides of the hangars may be open (and even when closed, the doors are not structural load-resisting elements) is significant because it means that lateral seismic (or wind) load on the hangars in the direction parallel to the doors must be collected by the roof truss at the north and south edge of each hangar and delivered to the north and south exterior masonry walls of the WPA infill and/or the lean-tos in order to resist the load. In such a situation, there is the potential for a lack of a complete and/or adequate load path to do so. In general, the fact that the exterior walls are URM represents a seismic vulnerability, as URM lacks ductility to be able to dissipate energy and maintain its integrity under multiple cycles of ground motion, and is subject to brittle failure.

The upper portion of the east and west hangar walls contains clerestory windows, framed out with steel beams spanning between the columns. The hangar doors are constructed with aluminum wide flange and channel vertical members, with horizontal aluminum channels and tees spanning between them. The lower portion has solid aluminum panels; the upper portion is glazed. Each door panel has two wheels which bear on—and are guided by—steel rails embedded in a concrete grade beam.

The hangar roof framing consists of steel channel purlins spanning in the north-south direction, supporting 1½” thick tongue-and-groove (T&G) wood decking. The purlins bear on steel trusses that clear span 120 feet in the east-west direction to the wide-flange columns of the steel frames. Vertical cross-bracing or “bridging” connects the truss top and bottom chords at the centerline and two additional locations at roughly one-third of the span. Horizontal cross-bracing exists at the truss top chord level within the northernmost, southernmost, and center bays. At the truss bottom chord level, horizontal diagonal steel braces laterally support the top of the brick masonry infill walls at the steel frames and the top of the hangar doors/bottom of the friezes over the doors.

The columns of the steel frames at the east and west sides of the hangars are supported on reinforced concrete pile caps on 14” square reinforced concrete piles. The brick infill walls between columns are on pile-supported concrete grade beams, as are the exterior walls of the leant-tos. The hangar floors are a 6” thick concrete slab on grade.

The lean-to roof framing also consists of steel channel purlins spanning in the north-south direction, supporting 1½” thick T&G wood decking. The purlins are supported on steel wide-flange girders clear spanning in the east-west direction from the steel frame of the shared hangar wall to the 12” thick exterior URM wall of the lean-to. At the north and south walls of the

lean-tos, there is a pocket constructed of 8” thick URM walls to contain the hangar doors when they are opened.

The hangar door pocket walls are particularly vulnerable to damage from seismic load, as well as wind load. The front wall of each pocket is laterally unsupported for roughly 23 ft in the horizontal direction and roughly 27 ft in the vertical direction, which both far exceed the distance that 8” thick URM can span under out-of-plane seismic load or any significant wind load. The rear wall of each pocket projects roughly 12 ft above the lean-to roof diaphragm and, based on the existing construction, needs to brace the top of the front wall; again, this significantly exceeds the capacity of 8” URM. These conditions appear to have led to significant cracking of the pocket walls. Hangars 3 and 4 are unique in this respect, in that the other hangars on the site have two-story lean-to structures, such that the door pocket walls do not project above the lean-to roof diaphragm. This means that the pocket walls of the other hangars have a much more direct load path for out-of-plane bracing, and the walls do not experience the same out-of-plane seismic or wind demands.

The roof framing of the WPA infill is constructed similarly to the hangars and the lean-tos, except that the southernmost two bays of the roof is a concrete slab supported on concrete-encased steel framing. Elsewhere, the roof trusses clear span 50 feet in the east-west direction between the steel frames of the shared walls with the hangars and support T&G wood decking on steel channel purlins.

The seismic (and wind) load-resisting system, or “lateral” system of the building is a combination of three primary types of elements that would provide resistance to seismic ground motion: 1) URM exterior walls at the lean-tos and the north and south ends of the WPA infill, which would function as shear walls; 2) steel frames at the east and west sides of each hangar, which would function as moment frames—to the extent that the connections between beams and columns and between columns and foundations are able to resist moment; and 3) URM infill between the columns and beams of the steel frames, where it occurs, to the extent that its construction allows it to function as a shear wall integral with the frame. The other primary element of the existing lateral system of the building is the sawn lumber T&G decking, which functions as a diaphragm—of very limited capacity—to distribute the seismic (or wind) load to the walls and frames. (There is also a small, atypical area of concrete construction within the WPA infill, but the vast majority of the diaphragm is wood, and that largely governs the response of the building to lateral load.)

It is important to understand that the seismic load-resisting system of historic buildings like this one was likely never explicitly designed as such originally. If anything, wind load may have been considered by the building designers in a very limited way, but especially on the east coast—and especially prior to the late 1900s, even on the west coast—resistance to earthquakes would almost certainly not have been considered. Thus, while we may now refer to a URM “shear wall” or a steel “moment frame” in discussing the seismic load-resisting system, what we really mean is that effectively, the wall or frame will function as such when subjected to a seismic (or wind) event, even if it was originally intended only to support gravity loads.

Regarding the third type of lateral load-resisting system noted above, masonry infill within a steel or concrete frame is a type of “shear wall” construction that is distinct from a typical, freestanding shear wall, and its behavior is very different. U.S. codes and standards have long not recognized it as a permitted seismic load-resisting system for new buildings, though it is a very common form of construction in developing countries. Nevertheless, it is capable of resisting seismic (or wind) load, and this is recognized by ASCE 41. However, the exact

geometrical relationship of the infill to the frame, and their interface and/or physical connection (or lack thereof), are critical to the behavior of this kind of system. As will be discussed in more detail later in this report, in the case of this building, the existing construction is such that the infill may not be able to function as needed to resist seismic loading and—at least in its current state—may actually be more of a seismic vulnerability than an asset to the building.

5.0 GENERAL STRUCTURAL CONDITION

MFSE conducted multiple site visits to observe and document structural conditions. Our observations were limited to readily visible and accessible elements. Noted conditions included: significant settlement of slabs on grade due to poor soil conditions; significant corrosion of steel members, which has contributed to cracking of existing brick masonry in many cases; and water damage and decay of wood roof decking. As noted in the previous section, significant cracking was observed in the hangar door pockets, which is attributable to the lack of adequate lateral support from the lean-to roof diaphragm for out-of-plane wind load as well as torsion that the pocket construction may undergo due to wind loading parallel to the pocket.

6.0 INTRODUCTION TO SEISMIC EVALUATION AND RETROFIT

6.1 Seismic Evaluation

The analysis and design of new buildings is typically governed by the edition of the *International Building Code* (IBC) currently adopted by the Authority Having Jurisdiction (AHJ), including any adopted amendments. In this case, the AHJ is the National Park Service (NPS), and the code currently adopted by the NPS for design of new buildings is the 2024 IBC. The 2024 IBC references the 2022 edition of the American Society of Civil Engineers (ASCE) standard *Minimum Design Loads and Associated Criteria for Buildings and Other Structures* (ASCE 7-22) for seismic analysis and design provisions. However, codes and standards for new buildings are not specifically intended for the evaluation of existing buildings—particularly historic buildings constructed using structural materials and systems that are no longer in use—and are therefore often not appropriate for use in evaluation of existing buildings.

Codes and standards for new buildings contain three basic types of requirements: strength, stiffness, and detailing. The strength and stiffness requirements readily transfer to the analysis of existing buildings, but the detailing provisions do not. Detailing requirements (such as limits on the configuration of connections between structural steel members or the spacing of confining rebar in concrete construction) are intended to ensure ductility of the structural system—that it will maintain its integrity over the cycles of loading and deformation that occur in an earthquake. These requirements have been significantly revised over the years as knowledge of building performance has increased, either through post-earthquake field observation of existing buildings or based on experimental and analytical research programs.

Buildings constructed before such detailing requirements were established will generally not satisfy those requirements, and there is thus no possible way to demonstrate that they meet the current Building Code for new buildings (IBC/ASCE 7). Furthermore, in areas of high seismicity, some historic structural systems, such as URM walls, are explicitly prohibited to be used to resist seismic loading per current code. In any case, many of the seismic provisions of modern codes and standards would not apply because they implicitly depend on the ductility of the structure being ensured through the detailing requirements and are invalid otherwise. Therefore,

there was a need for a standard specifically for the seismic evaluation of existing buildings, which led to the development of ASCE 41.

6.2 Seismic Retrofit

If an existing building is found to be deficient based on the ASCE 41 evaluation process, then ASCE 41 also contains provisions that may be used to design a seismic retrofit of the building to address those deficiencies, provided that ASCE 41 is permitted to be used for that purpose by the AHJ and/or the *International Existing Building Code* (IEBC), as adopted by the AHJ. ASCE 41 provides design requirements for new elements within an existing building and includes provisions that are intended to ensure adequate performance of the existing elements that are relied upon to provide lateral resistance or to support gravity loads. It provides a rational method for combining the strength and stiffness of new and existing elements within a strengthened building and includes provisions for the interconnection of these elements to form a complete and adequate lateral load path.

A retrofit of an existing building may also be designed based on the current Building Code (IBC/ASCE 7), and in some cases, it is explicitly required by the AHJ and/or the IEBC to do so. However, since the existing seismic load-resisting elements in the building (shear walls, moment frames, etc.) generally do not satisfy current code detailing requirements, the only way to do so is by adding a new seismic load-resisting system to the building, and the existing system becomes redundant. Measures must also be taken to ensure deformation compatibility between the new and existing systems; if the new system would deflect laterally much more than the existing system, then the existing system would resist the seismic load first—and likely fail—before the new system would ever resist the load. This is extremely problematic if the existing system also supports gravity loads, as is normally the case. For this reason, the new structure must often visually obscure existing structure (e.g. shotcrete on the surface of a URM wall) and/or a supplemental system to support gravity loads if/when the existing system fails is necessary. This may be particularly undesirable for a historic building, when there is a goal to preserve and expose historic fabric.

ASCE 41 provisions may be used instead—again, if permitted by the AHJ and/or IEBC—to take advantage of the (generally limited) capacity of the existing structure to resist seismic loads despite a lack of detailing, such that an extensive intervention with new structural elements may not be required. However, particularly for existing systems like URM walls in areas of high seismicity, it still may not be feasible to demonstrate the adequacy of the existing structure without significant modification that could have particularly undesirable impacts on historic buildings.

7.0 APPLICABLE STANDARDS

ASCE 41 is the standard for seismic evaluation and retrofit of existing buildings referenced by the *Standards of Seismic Safety for Existing Federally Owned and Leased Buildings: ICSSC Recommended Practice 10* (RP 10), which is adopted by the NPS. The most recent edition of this document is RP 10-22, published in 2023, which references the 2017 edition of ASCE 41 (ASCE 41-17). However, we understand that there is an update to RP 10 planned for this year to align it with the 2024 IEBC, for which ASCE 41-23 is the referenced standard. In addition, following the list of referenced standards in the current RP 10-22, the document states that, “If an agency has adopted a newer edition of any of these references, the newer edition shall be

used." NPS adopted the 2024 IEBC and ASCE 41-23 as of January 1, 2024; therefore, ASCE 41-23 is the applicable standard for this evaluation.

The change from ASCE 41-17 to ASCE 41-23 is significant for the evaluation of this building (and the design of any subsequent retrofit) because, based on updated data from the United States Geological Survey (USGS), the seismic ground accelerations for the site of the building decreased by roughly 30% per ASCE 41-23 relative to ASCE 41-17 for Site Class D (typical soil conditions, characterized by medium dense sand or stiff clay). Furthermore, per the geotechnical report by GHD, dated June 25, 2025, the soil conditions at the site are such that it is classified as Site Class E, characterized by very loose sand or soft clay (which is consistent with the use of pile foundations for the original structure). Per ASCE 41-23, the ground accelerations as this site *decrease* for Site Class E relative to Site Class D, while they would increase per the USGS data used by ASCE 41-17 or older ASCE 41 standards, with the end result that, for Site Class E, the short-period spectral acceleration, S_{XS} = 0.170 g for the BSE-1N seismic hazard per ASCE 41-23 is 60% less than the value of 0.425 g that it would be per ASCE 41-17. The same is true for the short-period spectral acceleration, S_{DS}, used for the design of new buildings per the current ASCE 7-22 standard relative to the prior ASCE 7-16 standard. (Further explanation of spectral acceleration and the BSE-1N hazard are provided later in this report.)

The effect of the lower ground accelerations per the new standards is twofold. First, this decreases the magnitude of the seismic forces for which the structure must be analyzed (either for an evaluation or a retrofit). Second, it decreases the Level of Seismicity, as defined by ASCE 41, from "moderate" to "low," which means that the evaluation criteria for the building per ASCE 41 are not as extensive or rigorous. Similarly, it decreases the Seismic Design Category (SDC) for the design of new buildings per the ASCE 7 standard from "C" to "B." If a future renovation or retrofit were designed in accordance with ASCE 7, that means that there would be less stringent design and detailing requirements. (As it is anticipated that the future occupancy or use of the building will increase its Risk Category, as defined by IBC/ASCE 7, from II to III, it is likely that the renovation would need to be designed in accordance with the ASCE 7 seismic provisions for new buildings.)

Per RP 10, a mandatory seismic evaluation for this building would be triggered by either of two possible conditions: 1) a change in occupancy or use of the building resulting in an increase in the Risk Category; or 2) an addition or alteration that increases the seismic demand on—or decreases the capacity of—any existing seismic load-resisting structural element by more than 10%, or that results in a structural irregularity, as defined by ASCE 7. We understand that a future renovation of the building is intended to accommodate a change of occupancy or use that would result in an increase from Risk Category II to Risk Category III, thus triggering a mandatory seismic evaluation (and potentially a full seismic retrofit). However, we understand that at this time, the building is to remain unoccupied, and that the only intended construction is repairs of existing damage that does not qualify as "substantial structural damage," as defined by the IEBC, so this seismic evaluation is voluntary per RP 10. Moreover, RP 10 exempts buildings designated as Risk Category II in SDC B from any seismic evaluation; as the building is in SDC B and currently does not exceed Risk Category II, it is therefore technically exempt from any requirement for a seismic evaluation at this time (until the intended future renovation). However, given the expected increase in Risk Category due to the planned renovation, a seismic evaluation is certainly prudent.

8.0 ASCE 41 SEISMIC EVALUATION PROCEDURE

8.1 Overview

ASCE 41 provides a method to assess an existing building's expected response to earthquakes of a certain frequency/magnitude, based on a selected Performance Objective. The ASCE 41 methodology consists of three phases, or “tiers.” The first phase is used to screen for any potential deficiencies in the seismic load-resisting system. Any potential deficiencies identified may then be examined in more detail during the second phase, and if necessary, a rigorous, full-building analysis can be performed as a third phase.

The first phase, known as Tier 1, is a simple screening process that utilizes a series of checklists designed to identify potential flaws or weaknesses common to certain building types. Each checklist is a collection of evaluation statements describing building characteristics considered to be necessary to achieve the desired Performance Objective.

A separate checklist has been developed in ASCE 41 for buildings constructed using 17 different common types of vertical seismic load-resisting elements (URM walls, steel frames, etc.) The checklists are further broken down by the type of horizontal seismic load-resisting element (the type of diaphragm). Thus, there is a separate checklist for a steel moment frame building with a flexible diaphragm (typically wood-framed or bare metal deck) and for a steel moment frame building with a “rigid” or “stiff” diaphragm (typically a solid concrete or concrete-on-metal-deck slab). As will be discussed at greater length later in this report, a building may not always fit neatly into one of these standard construction types, which can complicate the use of the checklists. There is also a general structural checklist applicable to all buildings, and a checklist for nonstructural elements. With a few basic exceptions—referred to as “quick checks” by ASCE 41—structural analysis calculations are not included in the Tier 1 screening process.

The second phase, known as Tier 2, involves further evaluation of any deficiencies identified during the Tier 1 screening, if desired. This analysis is typically performed only on those elements identified as being non-compliant with the Tier 1 acceptance criteria. The Tier 2 evaluation is more quantitative and less conservative; therefore, it is possible that elements that were non-compliant in the Tier 1 screening could be demonstrated to be compliant by Tier 2 evaluation procedures. In some cases, further evaluation of the entire building may be included in a Tier 2 evaluation, depending on the building type, number of stories, desired performance level, and site seismicity.

The final phase, known as Tier 3, is not usually performed for an evaluation. It involves performing a very detailed, rigorous, and time-consuming quantitative structural analysis of the entire building. In general, if the building were found to have significant deficiencies based on a Tier 2 evaluation, it is not likely that a Tier 3 analysis would demonstrate otherwise. Thus, Tier 3 procedures are typically only used to design a seismic retrofit of the building, after there has been a decision made to do so based on deficiencies identified by a Tier 1 and/or Tier 2 evaluation.

8.2 Performance Objectives

In traditional and current codes for new buildings, seismic performance is considered implicitly. Specified seismic force levels to be used in the design are based on an implicit performance objective, and prescriptive detailing requirements are used to provide a high degree of confidence that the performance objective will be achieved. As indicated previously, this method

is not applicable for existing buildings because the detailing cannot be controlled in most cases. For this reason, ASCE 41 seismic evaluation and rehabilitation guidelines are based on explicit performance objectives; such an approach is also known as "performance-based design."

A Performance Objective in ASCE 41 consists of two parts: a target building Performance Level(s) and a Seismic Hazard Level(s), or magnitude or frequency of earthquake under which it must achieve that Performance Level. The Performance Objective includes target performance levels for both structural and nonstructural elements. The appropriate set of performance levels and seismic hazards is chosen based on the Risk Category of the building, as defined by the IBC/ASCE 7.

8.2.1 Performance Levels

Table 2-1 in ASCE 41, reproduced below, summarizes the various target structural performance levels that might be used in a seismic evaluation or retrofit—on the spectrum from Immediate Occupancy as the highest level, to Collapse Prevention as the lowest—and the expected post-earthquake condition of a building associated with each level.

Table 2-1. Structural Performance Levels.

Structural Performance Level	Designation	Post-Earthquake Damage State Description
Immediate Occupancy	S-1	The structure remains safe to occupy and essentially retains its pre-earthquake strength and stiffness.
Damage Control	S-2	A damage state between Performance Levels S-3 and S-1. Acceptance criteria for evaluation or retrofit based on the Damage Control Structural Performance Level shall be taken as halfway between those for Immediate Occupancy and Life Safety.
Life Safety	S-3	The structure has damaged components but retains a margin of safety against the onset of partial or total collapse.
Limited Safety	S-4	A damage state between Performance Levels S-3 and S-5. Acceptance criteria for evaluation or retrofit based on the Limited Safety Structural Performance Level shall be taken halfway between those for Life Safety and Collapse Prevention.
Collapse Prevention	S-5	The structure has damaged components and continues to support gravity loads but retains no margin against collapse.
Structural Performance Not Considered	S-6	Used where an evaluation or retrofit does not address the structure.

Although ASCE 41 defines two intermediate performance levels that could be selected, as shown in Table 2-1, the three primary performance levels are—again, from highest to lowest—Immediate Occupancy, Life Safety, and Collapse Prevention. The following provides a more in-depth description of the expected post-earthquake condition of a building associated with each of these three main levels than is provided in Table 2-1:

> Immediate Occupancy: Only minor structural damage is expected to occur in the design-level earthquake. The risks to life safety are very low, and any minor structural repairs that may be required could be performed while the building is occupied, following the seismic event.
>
> Life Safety: Significant structural damage could occur, but there is some margin against either partial or total structural collapse in the design-level earthquake. It is expected that the risk of life-threatening injury is low and that building occupants can safely exit the building, albeit potentially with some minor injuries. It would likely be prudent to implement structural repairs or install temporary bracing before the building is

reoccupied. It is important to stress that although complete repair of the building is likely feasible, it may not be economically practical.

Collapse Prevention: Substantial structural damage is expected, and the building may be on the verge of partial or total collapse following the design-level earthquake. Significant risk of injury may exist, and the building will not be safe to occupy after the seismic event. It is likely that the repair of the building will not be feasible or economically practical.

Table 2-2 in ASCE 41, reproduced below, summarizes the various target performance levels for nonstructural components of a building that might be used in an evaluation or retrofit—on the spectrum from Operational as the highest level, to Hazards Reduced as the lowest—and the expected post-earthquake condition of those components associated with each level.

Table 2-2. Nonstructural Performance Levels.

Nonstructural Performance Level	Designation	Post-Earthquake Damage State Description
Operational	N-A	Nonstructural components are able to provide the functions they provided in the building before the earthquake. Nonstructural components in compliance with the acceptance criteria of this standard for Operational Nonstructural Performance (N-A) and the requirements of ASCE 7, Chapter 13, where $I_p = 1.5$, are expected to achieve this post-earthquake state.
Position Retention	N-B	Nonstructural components might be damaged to the extent that they cannot immediately function but are secured in place so that damage caused by falling, toppling, or breaking of utility connections is avoided. Building access and Life Safety systems, including doors, stairways, elevators, emergency lighting, fire alarms, and fire suppression systems, generally remain available and operable, provided that power and utility services are available. Nonstructural components in compliance with the acceptance criteria of this standard for Position Retention Nonstructural Performance (N-B) and the requirements of ASCE 7, Chapter 13, are expected to achieve this post-earthquake state.
Life Safety	N-C	Nonstructural components may be damaged, but the consequential damage does not pose a life-safety threat. Nonstructural components in compliance with the acceptance criteria of this standard for Life Safety Nonstructural Performance (N-C) and the requirements of ASCE 7, Chapter 13, are expected to achieve this post-earthquake state.
Hazards Reduced	N-D	Nonstructural components are damaged and could potentially create falling hazards, but high-hazard nonstructural components identified in ASCE 7, Table 13.1-1, are secured to prevent falling into areas of public assembly or those falling hazards from those components could pose a risk to life safety for many people. Preservation of egress, protection of fire suppression systems, and similar life-safety issues are not addressed in this Nonstructural Performance Level.
Nonstructural Performance Not Considered	N-E	Used where an evaluation or retrofit does not address all nonstructural components to one of the levels in the previous sections.

8.2.2 Seismic Hazard Levels

The second part of the seismic Performance Objective is the Seismic Hazard Level. Loosely speaking, a Seismic Hazard Level is the magnitude of earthquake for which the capability of a building to achieve the target Performance Level is evaluated (or for which the building is retrofitted to do so). Technically speaking, it is the ground acceleration associated with the earthquake, which gives rise to the seismic forces on the building. In most cases, this is based on what is known as a “response spectrum,” which indicates the maximum acceleration the building is expected to undergo based on the dynamic characteristics of the structure; loosely speaking, the stiffer the structure, the greater the acceleration it will experience.

Parameters for developing response spectra based on a specific level of ground shaking are contained in probabilistic seismic hazard maps that are produced by the United States Geological Survey (USGS). These maps are based on a detailed and ongoing assessment of seismic risk throughout the United States. In this probabilistic approach to seismic hazard assessment, the magnitude of an event is inversely proportional to its frequency—that is, the longer the specified return period between events, the larger the event. This methodology is similar to what is used for flood and hurricane hazard assessment. It is important to understand that the level of ground shaking and building response for any one specific event is highly dependent on many factors, including the type of soils at the site and the geophysical aspects of the seismic event.

Any return period or periods could theoretically be used for seismic evaluation or design/retrofit; seismic design of new buildings has long been based on return periods of either roughly 500 years or 2,500 years, depending on the risk that failure of the building poses to human life. While ASCE 41 does not preclude using any seismic hazard level (i.e. return period) as long as it has a rational basis, it specifies four standard levels from which the Seismic Hazard Level for a particular evaluation/retrofit may be selected; one or more of these standard levels are used in most cases. They are designated as: BSE-2N, BSE-1N, BSE-2E, and BSE-1E (BSE stands for Basic Safety Earthquake).

The BSE-2N and BSE-1N hazards are intended for evaluation and/or retrofit of existing buildings where such evaluations/retrofits are required to demonstrate that the building meets the same standard as that for new buildings designed based on the current Building Code (IBC/ASCE 7)—thus the “N” for “new” at the end of each designation. The BSE-2N hazard is equivalent to the Maximum Considered Earthquake (MCE) used for the design of new buildings per the IBC/ASCE 7; it represents a seismic event with a 2% probability of exceedance in 50 years, or an approximate average return period of roughly 2,500 years. Per IBC/ASCE 7, only new buildings that must remain fully operational following a seismic event, such as hospitals or emergency shelters (buildings classified as Risk Category IV), are designed to resist the full MCE. Typical new buildings (those in Risk Category II) are designed to resist two-thirds of the MCE, which effectively reduces the return period from roughly 2,500 years to roughly 500 years; the BSE-1N hazard in ASCE 41 is equivalent to this. (Building in Risk Category III, the category into which this building will likely fall after the future renovation, must resist an intermediate seismic hazard level per the IBC/ASCE 7.)

The approach in the IBC/ASCE 7 is to design new buildings to achieve the target performance level when subjected to a single seismic hazard level, based on the Risk Category—the higher the risk category of the building, the higher the hazard level. However, in the ASCE 41 methodology, buildings are evaluated (or retrofitted) to achieve varying target performance levels at varying seismic hazard levels, with higher performance required for a lower magnitude (more frequently occurring) earthquake, and lower performance acceptable for a higher magnitude (more rarely occurring) earthquake. Thus, for example, a typical (Risk Category II) building would be evaluated for both a Life Safety performance level at two-thirds of the MCE (BSE-1N hazard) and a Collapse Prevention performance level at the full MCE (BSE-2N hazard).

The BSE-2E and BSE-1E hazards are intended for evaluation and/or retrofit of existing buildings where such evaluations/retrofits are permitted to meet a lesser standard than that applied to new buildings—thus the “E” for “existing buildings” at the end of these designations. These hazards have lower spectral accelerations, resulting in lower seismic loads. The BSE-2E hazard represents a more extreme seismic event with a less frequent recurrence (5% probability of

exceedance in 50 years, or an approximate average return period of roughly 1,000 years); the BSE-1E hazard represents a lesser ground shaking with a more frequent recurrence (20% probability of exceedance in 50 years, or an approximate average return period of roughly 225 years). Again, for a Risk Category II building, ASCE 41 would require that a building be shown to meet a Life Safety performance level under the BSE-1E seismic loads and a Collapse Prevention performance level under the BSE-2E seismic loads. However, for a Tier 1 or Tier 2 ASCE 41 evaluation only (i.e. not a retrofit), the Life Safety performance level at the BSE-1E hazard level is not evaluated explicitly; only Collapse Prevention at the BSE-2E level is checked. If the building meets a Collapse Prevention performance level at the BSE-2E hazard level, then it is deemed to meet a Life Safety performance level at the BSE-1E level as well.

9.0 ASCE 41 SEISMIC EVALUATION OF HANGARS 3 AND 4 BUILDING

9.1 Performance Objective

Per RP 10 Section 2.1, for a voluntary seismic evaluation like this one, which is not triggered by a change of occupancy or use of the building resulting in a higher Risk Category, the minimum Performance Objective for use in an ASCE 41 evaluation is what is known as the Basic Performance Objective for Existing Buildings (BPOE), which is a lower standard than that for new buildings. For the current Risk Category II (i.e. before any future renovation may increase it to Risk Category III), the BPOE is a Life Safety structural performance level when subjected to the BSE-1E seismic hazard and a Collapse Prevention structural performance level when subjected to the BSE-2E hazard. For nonstructural components, the target performance level is Life Safety for BSE-1E and Hazards Reduced for BSE-2E for the BPOE.

9.2 Seismic Hazard Level and Level of Seismicity

Appendix A is the output from the online ASCE Hazard Tool, which allows one to look up the spectral acceleration parameters for the required ASCE 41 seismic hazards directly from the USGS database, based on a site's exact location (latitude and longitude). The Level of Seismicity for the site, which establishes which Tier 1 checklist items must be evaluated, is Low Seismicity per ASCE 41 Section 2.5, based on the parameters of S_{XS} = 0.17 g and S_{X1} = 0.064 g for the BSE-1N hazard. It is noted that S_{XS} is right on the cusp of the limit of 0.167 g for the site to be classified as Very Low Seismicity; however, if the current standard were ASCE 41-17, S_{XS} would be 0.425 g, and the Level of Seismicity would jump all the way to Moderate, resulting in much more stringent seismic requirements.

9.3 Evaluation Procedure

ASCE 41 Section 3.5.1 permits Tier 1 screening and/or Tier 2 deficiency-based procedures to be used to demonstrate compliance with a Performance Objective, provided that the objective involves a Seismic Hazard Level less than or equal to BSE-2E and a target Performance Level for both structural and nonstructural components less than or equal to Life Safety. ASCE 41 Section 3.5.1 also requires that a building not exceed certain limits on the number of stories and combinations of structural systems in order to use Tier 1 and/or Tier 2 procedures to demonstrate compliance. As this building satisfies all of these limitations, MFSE performed a Tier 1 evaluation.

As indicated in Section 4.0 of this report, this building does not fit neatly into one of the common types of construction for which the ASCE 41 checklists were developed, as it has three different

types of seismic load-resisting systems. The applicable ASCE 41 building types are: Type S1A – Steel Moment Frames with Flexible Diaphragms; Type S5A – Steel Frames with Infill Masonry Shear Walls and Flexible Diaphragms; and Type URM – Unreinforced Masonry Bearing Walls with Flexible Diaphragms. Therefore, MFSE completed the ASCE 41 checklists for all three types, as well as the required Basic Configuration Checklist—a general checklist applicable to all building types, and the required Nonstructural Checklist. Appendix B contains the completed checklists.

The extent of openings in the masonry infill at the steel frames between the hangars and the lean-tos is such that the infill would be non-compliant with the evaluation criteria for Steel Frames with Infill Masonry Shear Walls (Type S5A). Therefore, those frames were evaluated using the checklist for Steel Moment Frames (Type S1A). The masonry infill at the steel frames between the hangars and the WPA infill structure were evaluated using the Type S5A checklist. It is possible that these frames would have non-compliances with evaluation criteria if they were considered as steel moment frames (Type S1A) instead, as might be necessary if some or all of the masonry infill were to be removed in a future renovation; conversely, it is possible that non-compliances with evaluation criteria for steel moment frames found for the frames at the lean-tos could be addressed by closing existing openings in the masonry infill and making upgrades to the infill construction.

The evaluation resulting from the completion of these Tier 1 checklists is something of a brief snapshot in time of the seismic risk associated with this building; it applies only to the building in its current, unoccupied state, and to some extent after the currently proposed repairs are completed (which are not intended explicitly as a seismic retrofit, although they will include some seismic upgrades that are prudent to implement during this phase of construction). However, as noted previously in this report, we understand that the intent is to renovate the building in the near future to accommodate an occupancy/use which will change it to a Risk Category III structure. At that point, the criteria for an ASCE 41 evaluation—and the requirements for a renovation—would change significantly.

10.0 SEISMIC EVALUATION BEYOND THE SCOPE OF ASCE 41

Again, the Tier 1 screening checklists in ASCE 41 are each for a specific type of common construction, but unfortunately, a building does not always fit neatly into one of these common types. Furthermore, by their nature, the checklists must be general and cannot capture unique features of every building that might represent a seismic vulnerability. Finally, although it is not required by ASCE 41 to evaluate all checklist items for a building at a site categorized as Low Seismicity like this one, it may still be prudent to consider some of the items required to be evaluated for higher levels of seismicity if there are features of the building that are vulnerabilities that would be identified by those items.

An appropriate evaluation of this building is complicated by the fact that there is an intended renovation in the near future that we understand is likely to result in a change of occupancy. So although there are some deficiencies that might not be captured in an ASCE 41 evaluation, it is important to try to consider potential seismic upgrade needs that may be triggered by the future renovation.

One feature of this building in particular deserves attention, as it is a seismic vulnerability that is not captured by the use of the ASCE 41 Tier 1 checklists for a Low Seismicity site—the discontinuities in the roof diaphragm, and the high aspect ratio of the portions of the roof

diaphragm over the lean-to structures. The diaphragm over the lean-tos is relatively long and narrow; it has an aspect ratio (the ratio of the long dimension to the short dimension) of roughly 4.67. The maximum aspect ratio permitted by current code for a wood diaphragm of the existing construction—straight lumber decking—is only 2. Even after installing the plywood overlay on the decking that we recommend (discussed further below), the maximum aspect ratio is only 4, which is the highest that current code allows for a wood diaphragm of any construction, so the overlay does not bring it into full compliance with current code.

In and of itself, exceeding a prescriptive code limit like this is not the significant concern (once the overlay is installed and the limit is only exceeded by about 17%, rather than over two times in the existing condition). The more important consideration is how the flexibility of such a long and narrow diaphragm impacts the behavior of the building and the seismic (or wind) demand on various elements of the structure. In the existing condition, the diaphragm is so flexible that rather than spanning fully between the URM walls at either end—the behavior that would typically be assumed—it likely bears laterally against the steel frame of the shared wall with the hangar to some extent, loading the frame out of its own plane. It is likely that the frame was not ever explicitly designed to resist such out-of-plane loading. This would occur to a greater extent at the middle of the 140 ft length of the lean-to, and to a lesser extent towards each end, directly adjacent to the URM walls. Without a complete, rigorous, quantitative structural analysis of the building, it is unknown exactly how much load the diaphragm may impart to the steel frame in a current code-level design seismic (or wind) event, and whether the frame elements have sufficient capacity to resist it. The analysis would involve a comparison of the stiffness of the diaphragm in its own plane, spanning laterally between the URM walls, relative to the out-of-plane stiffness of the steel frame, spanning vertically between the foundation and the hangar roof diaphragm. The addition of the plywood overlay will impact this analysis, as it will increase the stiffness of the lean-to roof diaphragms significantly.

If the lean-to roof diaphragms would in fact load the steel frames out-of-plane, then in addition to verifying that the steel frame elements have the capacity to take that load, it would have to be verified that there is a complete and adequate load path to ultimately transfer that lateral load to elements that are capable of safely delivering it to the foundation; currently, the most likely elements that would do so are the URM front and rear exterior walls of the WPA infill. Alternatively, it is also possible that the future renovation of the building could address this issue by adding one or more new interior shear walls (or other lateral load-resisting elements) in the transverse direction of the lean-tos, thus reducing the span of the roof diaphragm such that it would not impart out-of-plane load to the steel frame.

11.0 SUMMARY OF FINDINGS

In general, there are not many non-compliant checklist items per the ASCE 41 evaluation. However, the reality is that—due on the classification of the site as Low Seismicity per ASCE 41—the extent of the evaluation required by ASCE 41 (i.e. the number of checklist items that must be considered) is quite limited. The aspects of MFSE's evaluation that are outside the scope of ASCE 41—and our proposed upgrades to address them—are perhaps more important than the ASCE 41 evaluation itself.

Except for one item, the building either complied with all of the evaluation criteria in the Basic Configuration Checklist applicable to all building types, or the checklist items did not apply to this building. However, compliance with the general requirement for a "complete, well-defined" load path that serves to transfer all seismic forces on the building to its foundations was deemed

to be unknown at this time. There is a lateral load path that has functioned to a certain extent to resist wind loads throughout the life of the building, which might also resist some or all seismic loads, yet damage is evident, so that load path appears to have deficiencies. The load path is also not straightforward; as noted previously, the discontinuities in the roof diaphragm and the fact that the hangars are completely open (other than doors that do not provide structural load-resistance) on two sides means that the load path is quite complicated. It relies on certain structural elements to act as collectors or drag struts, and may require connections between elements to resist seismic forces for which they were never designed. Based on limited field observations of accessible and visible items, it is not possible to determine whether all of these elements and their connections are capable of resisting these forces; a more detailed investigation of the building—likely including destructive probes—would be required to reach a definitive conclusion.

The steel frames between the hangars and the lean-tos were found to be non-compliant with the ASCE 41 moment frame checklist evaluation criterion for axial stress in the columns. It may be possible to demonstrate compliance with the Quick Check procedure of ASCE 41 Section 4.4.3.6 in the future. They were also non-compliant for load transfer from the roof diaphragm to the frame, as the hangar roof diaphragm does not connect directly to the steel beam of the frame, but rather to a band of unreinforced brick masonry that sits atop the beam. As there does not appear to be any positive mechanical connection between the brick and the steel, diaphragm loads would have to be transferred by friction and/or bond between mortar and steel, which is difficult to quantify and may not be an acceptable means of load transfer per modern design standards.

The masonry infill in the steel frames between the hangars and the WPA infill was found to be compliant with all checklist items. The URM exterior walls of the lean-tos and the WPA infill were also found to be compliant with checklist items for the walls themselves, but the connections needed to transfer in- and out-of-plane seismic (or wind) load between the roof diaphragm and the walls were either found to be noncompliant or could not be evaluated because the connection is not visible without destructive investigation. However, MFSE's current repair designs for the URM walls of the lean-tos already largely address any deficiency in this load path.

The two deficiencies identified in the nonstructural checklist were lack of bracing of unreinforced masonry partition walls—the infill in the steel frames between the hangars and the lean-tos—and unreinforced masonry parapets that exceed a prescriptive maximum height-to-thickness ratio. Again, MFSE's current repair designs already address bracing of the URM infill. There are also unreinforced masonry partition walls within the lean-tos that are not braced to the roof diaphragm, but we understand that those walls will be removed anyway in the current rehabilitation, so they will no longer be non-compliant.

It must be kept in mind that many—if not all—potential deficiencies in the seismic load-resistance of a structure would also be deficiencies in the resistance to wind load. Simply because ASCE 41 only requires a limited evaluation for seismic performance does not imply that the expected performance of the building in a current code-level design wind event (700-year mean recurrence interval) would be acceptable. The proposed future renovation of the building for a new use/occupancy should therefore include a thorough evaluation of the expected lateral performance of the building in the design wind event as well as the design seismic event; any upgrades found to be necessary for wind resistance would also improve the seismic resistance.

12.0 RISK ASSESSMENT

Per RP 10, the federal agency responsible for a property shall use the results of the seismic evaluation of a building to perform a risk assessment to determine if the building poses an Unacceptable Risk Exposure (URE) to the agency. In the absence of some other methodology established by the agency, RP 10 states that the building shall be designated as posing an URE if any one of the following six conditions are true:

Structural components

1) Over 15% of the structural components in the entire building resisting seismic demand in one direction do not meet the performance objective.
2) Over 50% of the structural components in one story of the building resisting seismic demand in one direction do not meet the performance objective.
3) The performance of one or more structural components indicates a “significant potential” (as defined by the agency) for total or partial collapse of the building.

Nonstructural components

4) Over 15% of the nonstructural components in the entire building do not meet the performance objective.
5) Over 30% of the nonstructural components in one story of the building do not meet the performance objective.
6) The performance of one or more nonstructural components indicates a “significant potential” (as defined by the agency) for: life-threatening injuries or loss of life; excessive time to restore functionality of the affected nonstructural system, adversely impacting agency mission; or excessive direct or indirect economic loss.

However, for a building that is listed—or certified as eligible for listing—in the National Register of Historic Places that is found to pose an URE based on a seismic evaluation, RP 10 Section 1.7 provides some flexibility to the agency in establishing an appropriate alternative performance objective and evaluation procedure if all feasible seismic risk mitigation strategies would threaten or destroy the historical or cultural significance of the building, subject to: limitations to ensure the safety of building occupants and the public at large; applicable federal, state, and local laws, regulations, and standards; and record requirements.

An ASCE 41 Tier 1 evaluation does not involve a full quantitative seismic analysis of a structure. Therefore, it is not straightforward to apply the results to the criteria above for an URE—one cannot use the results to say that a specific percentage of components in the building do not meet the performance objective. If a building were found to be non-compliant with all or nearly all of the Tier 1 checklist items, one might reasonably infer that a complete analysis would show that more than 15% of components do not meet the performance objective, but in this case, the results of the screening are not overwhelmingly non-compliant. However, again, this is a snapshot in time and does not mean that the building poses an acceptable risk without significant retrofit, given the planned future change of occupancy.

13.0 RECOMMENDATIONS FOR SEISMIC REHABILITATION

13.1 Current Upgrade Recommendations

MFSE is currently the structural Engineer of Record for a project to repair existing damage to the Hangars 3 and 4 building. This project is not a seismic retrofit; however, where MFSE is designing repairs to damaged structure, our repair design also includes measures to bring the repaired element (only) up to current code seismic design requirements to the greatest extent possible. Thus, we have effectively already implemented many recommendations that we would have made for seismic rehabilitation.

However, it is important to understand that the current project is only to repair the building to its original state and as if its occupancy/use—and thus Risk Category per the IBC/ASCE 7—will remain unchanged (although the building is technically currently unoccupied, we have treated it as if it is currently the typical Risk Category II). The planned future renovation may trigger more stringent seismic design requirements due to the new occupancy/use, which may increase it to Risk Category III. Furthermore, changes that either increase the seismic demand on, or decrease the seismic load-resisting capacity of, existing elements may result in other necessary upgrades and even re-work of upgrades included in the current repairs. Examples of such changes would be: cutting new penetrations in roofs or walls, adding mezzanine levels, or adding nonstructural items like heavy finishes or partition walls that increase the weight of the building—and thus inertial seismic forces on the structure—significantly.

One recommendation we have already implemented in our repair design for the URM exterior walls of the lean-to buildings is to provide a load path for the walls of the hangar door pockets to be laterally supported by the seismic load-resisting system of the building. Currently, there is significant cracking of these pocket walls, which appears to be the result of the lack of such lateral bracing. Unlike the other hangars on the site, the lean-tos at Hangars 3 and 4 are only one story; as a result, the door pocket walls cantilever vertically roughly 12 ft above the lean-to roof diaphragm. Furthermore, the wall of the pocket that forms the front façade of the lean-to currently has no positive connection at all to the lean-to roof diaphragm, and it is lacking an adequate load path to be laterally braced by the steel frame at the wall shared with the hangar. Our repairs introduce a steel “strongback” at the front wall of the pocket and a new wood diaphragm within the cavity above the door tracks—with a connection to the steel frame—as well as new anchorage of the rear wall to the lean-to roof diaphragm, thus establishing a complete load path for laterally bracing the pocket walls to the primary seismic load-resisting system of the building. We have also included new steel reinforcement in many of the joints of the rebuilt front wall of the hangar door pockets, as the 8” thick existing URM wall was insufficient to span out-of-plane to locations of lateral bracing.

While these measures provided needed upgrades to resist seismic loading, they also address the same deficiencies in resistance to wind load, which is the greater concern in terms of both likely frequency of occurrence and magnitude of loading, as the building is located directly adjacent to open water, an exposure that results in high wind forces. The added reinforcement is not enough to resist new building code-level wind loads, which are based on a 700-year mean recurrence interval. A much more significant intervention—likely unacceptable from a preservation, constructability, and/or cost standpoint—would be required to do so; however, the reinforcement will improve the performance of the building in more frequent wind events.

Another primary recommendation that we have already implemented is providing adequate bracing of the east and west exterior URM walls of the lean-tos to the roof diaphragm for out-of-

plane seismic (and wind) loading. This upgrade was included because the upper portion of the Hangar 4 wall and parapet are already to be rebuilt due to existing deterioration, and the existing T&G roof decking is to be replaced on both lean-tos. Specifying these elements to simply be rebuilt as currently constructed, without an adequate connection between wall and roof, would not have made sense. This repair also establishes a more reliable and quantifiable load path for in-plane lateral load to be transferred to the wall from the roof diaphragm. Currently, the unreinforced masonry infill at the lowest level of the steel frames shared with the lean-tos has no positive connection at its top to the frame beam above it (the infill is also unusually offset from the plane of the frame). This is a significant hazard, because the URM could not resist current code-level out-of-plane inertial seismic forces due to its own weight (and likely could not resist forces due to lesser seismic events either) and could collapse on building occupants in a seismic event. Our repairs therefore include our recommendation of adding connections to laterally brace the top of the infill to the frame beam.

Finally, as the deteriorated wood roof decking is to be replaced throughout the building and a new roof is to be installed for the current rehabilitation, it is prudent to take this opportunity to upgrade the roof diaphragm by adding a plywood overlay. The seismic demand per current code on the roof diaphragm at the hangers is roughly four times the capacity of the existing straight lumber decking diaphragm. At the lean-tos, the demand may be roughly eight times the existing capacity, depending on the exact behavior of the structure. The demand-to-capacity ratio for the diaphragms for a current code design-level wind event is similar. By adding the plywood overlay and fastening specified in our repair design, the existing diaphragm capacity is increased by a factor of roughly nine. Doing so at this time will hopefully ensure that no matter how the building is renovated in the future and how the use/occupancy changes, there would not need to be costly rework to retrofit the roof structure, potentially requiring removal of the roofing after it has just been replaced.

13.2 Future Upgrade/Analysis Recommendations

The following are remaining recommended upgrades, or recommended analysis to determine whether upgrades are in fact warranted. Although it appears that these analyses and upgrades are not strictly required at this time based on the definition of an URE in RP 10 (see Section 12.0 of this report), these items would need to be analyzed and retrofitted as required based on code provisions triggered by the planned future renovation. Such an analysis cannot be performed until the nature and magnitude of the loading on each structural element is established based on the use/occupancy and complete information about the renovation, such as: layout/configuration of the spaces, addition of any internal partition walls, addition of any new mezzanine levels, weights of new materials, size and location of any new openings in walls or diaphragms, etc. Furthermore, the structural design strategy for the renovation (e.g. flexible or rigid diaphragm analysis/design, or potential addition of new lateral load-resisting elements) would change the demands on the various elements of the existing lateral load-resisting system. However, as noted in Section 12.0 this report, RP 10 provides some flexibility to federal agencies in allowing renovations/retrofits of designated historic buildings to be designed to meet a lesser standard than might otherwise be required, if meeting the applicable code provisions would threaten or destroy the historical or cultural significance of the building (subject to certain limitations).

1) Perform more detailed analysis of the steel frames (based on noncompliance of the columns with the ASCE 41 evaluation criterion) to determine whether the frames can be demonstrated to provide adequate resistance to the applicable seismic or wind loads. Retrofit if required.

2) Upgrade connections of diaphragms to steel frames as required to transfer seismic and wind forces.
3) Where steel frames have existing URM masonry infill, address the fact that masonry infill is not an approved system to resist seismic loads in current code (IBC/ASCE 7), and if it is necessary to meet current code, the masonry would theoretically only be considered to be mass that increases the demand on the steel moment frame, rather than contributing to its seismic load-resistance, as the infill would be expected to fail during the design seismic event.
4) Analyze whether the URM infill panels in the steel frames are capable of spanning out-of-plane under seismic loading (or the wind loading they may experience when the hangar doors are open). Based on the classification of this site as “low” seismicity per ASCE 41, there was not requirement to check this for the evaluation. However, the ASCE 41 screening checklist was likely not developed anticipating the condition that occurs in this building, where the steel frame is in a three-story clear height space. In that situation, an out-of-plane failure of URM infill could result in a significant hazard of brick falling from a story above onto occupants. Thus, more detailed consideration and analysis of the out-of-plane behavior of the infill would be warranted, including its connection to the frame (ASCE 41 requires only that it be in contact with the frame), and if determined to be a significant risk, should be addressed.
5) Analyze the complete load path for resisting seismic and wind loads on the building in the east-west direction, parallel to the hangar doors, and retrofit any elements found to be inadequate to resist the applied loads. This includes analyzing the roof diaphragm connection to the steel roof truss at the north and south edges of each hangar, analyzing the truss to function as a collector to deliver the lateral load to the north and south exterior URM walls of the WPA infill and the lean-tos, and analyzing all of the intermediate members and connections. Particular attention must be paid to the steps in the height of the roof between the hangars and the WPA infill and the lean-tos, as this condition can result in seismic and wind demands on members and connections that were likely only designed to resist gravity loads. This analysis would also include a rigorous, quantitative evaluation of the extent to which the slender lean-to roof diaphragms may impart seismic and wind load on the steel frames out of the plane of the frames based on relative stiffness, rather than spanning to the north and south exterior URM walls of the lean-tos, as discussed previously in this report. If load is imparted to the steel frames out of their plane, then the complete load path to transfer that load to the foundations must be analyzed: the steel columns spanning vertically to the hangar roof diaphragm, transfer of their reactions to the diaphragm, the diaphragm spanning to the collector trusses at the north and south edges of the roof, and the transfer of the forces from the collectors to the north and south exterior URM walls of the WPA infill and lean-tos. All intermediate members and connections in this load path must also of course be analyzed.
6) Perform complete analysis of existing URM walls to resist applied seismic and wind loads, both in- and out-of-plane. The in-plane analysis must account for distribution of load to wall piers in a line based on their relative stiffness (both flexural and shear stiffness) and must also account for the maximum shear stress in the piers based on a parabolic shear stress distribution, as required by current code (IBC/TMS 402) for URM; in other words, the shear stress in the wall is not simply the total shear divided by the total net area. Any net flexural tension in the piers must be shown to be within the allowable tensile stress for URM. If the walls could not be shown to have adequate capacity to resist all shear and flexural demands, they would have to be retrofitted.
7) Provide either post-installed internal reinforcement or external bracing (via walers on the inside face of the parapet with diagonal kickers to the roof diaphragm) of any URM

parapets exceeding the prescriptive limit on height-to-thickness ratio in the ASCE 41 nonstructural checklist, unless they can be demonstrated by calculation to be capable of resisting current code out-of-plane seismic and wind loads without retrofit.

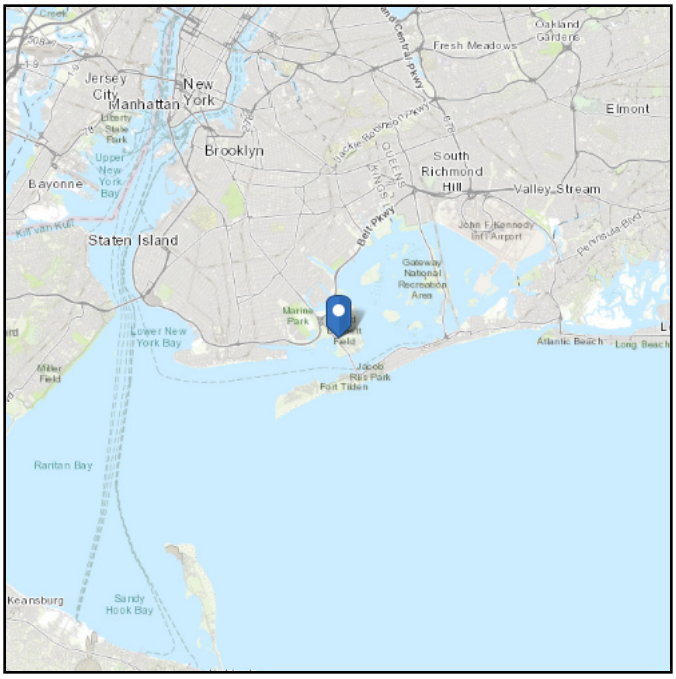
APPENDIX A: ASCE 41 SEISMIC HAZARDS

ASCE Hazards Report

Address:
No Address at This Location

Standard: ASCE/SEI 41-23
Risk Category: II
Soil Class: E - Soft Clay Soil

Latitude: 40.586866
Longitude: -73.895471
Elevation: 13.877981421785679 ft (NAVD 88)



Seismic

Site Soil Class: E - Soft Clay Soil

Hazard Level BSE-2N:

S_{XS} :	0.25	S_{X1} :	0.096

Hazard Level BSE-1N:

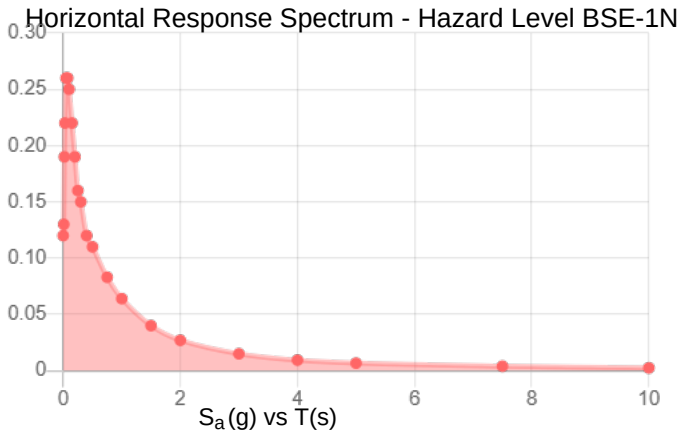
S_{XS} :	0.17	S_{X1} :	0.064

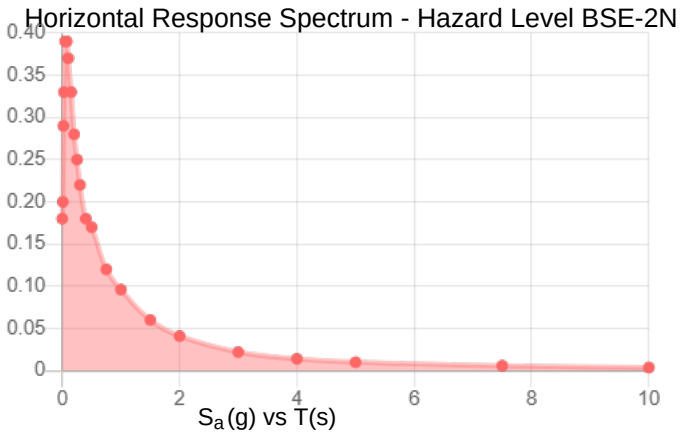
Hazard Level BSE-2E:

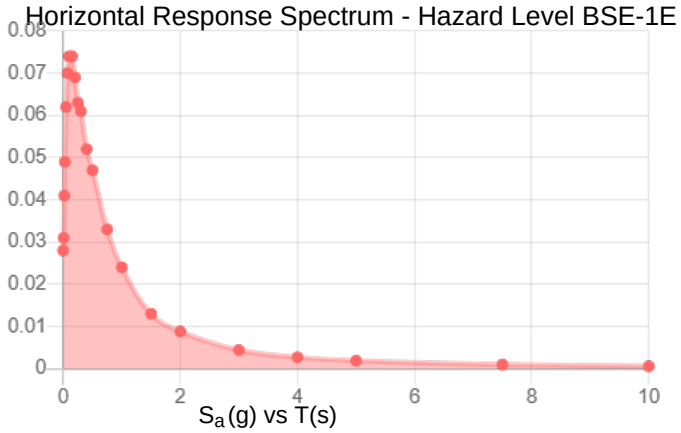
S_{XS} :	0.17	S_{X1} :	0.063

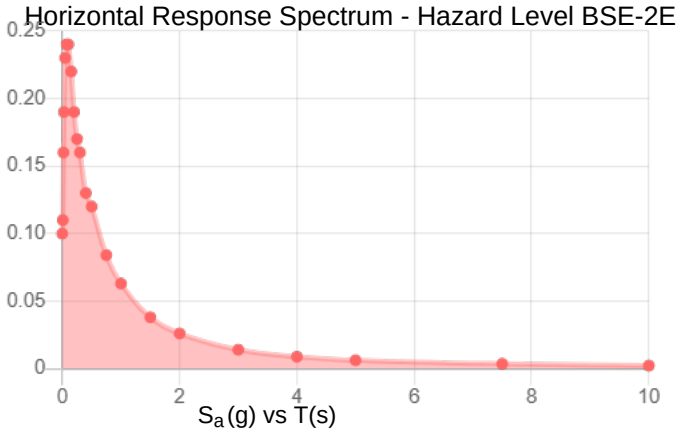
Hazard Level BSE-1E:

S_{XS} :	0.062	S_{X1} :	0.024









Data Accessed: **Wed Feb 26 2025**

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APPENDIX B: ASCE 41 TIER 1 CHECKLISTS

Table 17-2. Collapse Prevention Basic Configuration Checklist.

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Low Seismicity			
Building System—General			
C NC N/A U	LOAD PATH: The structure contains a complete, well-defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of all elements of the building to the foundation.	5.4.1.1	A.2.1.1
C NC N/A U	ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building is greater than 0.25% of the height of the shorter building in low seismicity, 0.5% in moderate seismicity, and 1.5% in high seismicity.	5.4.1.2	A.2.1.2
C NC N/A U	MEZZANINES: Interior mezzanine levels are braced independently from the main structure or are anchored to the seismic-force-resisting elements of the main structure.	5.4.1.3	A.2.1.3
Building System—Building Configuration			
C NC N/A U	WEAK STORY: The sum of the shear strengths of the seismic-force-resisting system in any story in each direction is not less than 80% of the strength in the adjacent story above.	5.4.2.1	A.2.2.2
C NC N/A U	SOFT STORY: The stiffness of the seismic-force-resisting system in any story is not less than 70% of the seismic-force-resisting system stiffness in an adjacent story above or less than 80% of the average seismic-force-resisting system stiffness of the three stories above.	5.4.2.2	A.2.2.3
C NC N/A U	VERTICAL IRREGULARITIES: All vertical elements in the seismic-force-resisting system are continuous to the foundation.	5.4.2.3	A.2.2.4
C NC N/A U	GEOMETRY: There are no changes in the net horizontal dimension of the seismic-force-resisting system of more than 30% in a story relative to adjacent stories, excluding 1-story penthouses and mezzanines.	5.4.2.4	A.2.2.5
C NC N/A U	MASS: There is no change in effective mass of more than 50% from one story to the next. Light roofs, penthouses, and mezzanines need not be considered.	5.4.2.5	A.2.2.6
C NC N/A U	TORSION: The estimated distance between the story center of mass and the story center of rigidity is less than 20% of the building width in either plan dimension. This statement does not apply to buildings with flexible diaphragms.	5.4.2.6	A.2.2.7

Table 17-8. Collapse Prevention Structural Checklist for Building Types S1 and S1a.

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Low Seismicity			
Seismic-Force-Resisting System			
C NC N/A U	REDUNDANCY: The number of lines of moment frames in each principal direction is greater than or equal to 2.	5.5.1.1	A.3.1.1.1
C NC N/A U	DRIFT CHECK: The drift ratio of the steel moment frames, calculated using the Quick Check procedure of Section 4.4.3.1 is less than 0.030.	5.5.2.1.2	A.3.1.3.1
C NC N/A U	COLUMN AXIAL STRESS CHECK: The axial stress caused by gravity loads in columns subjected to overturning forces is less than $0.10F_y$. Alternatively, the axial stress caused by overturning forces alone, calculated using the Quick Check procedure of Section 4.4.3.6 is less than $0.30F_y$.	5.5.2.1.3	A.3.1.3.2
C NC N/A U	FLEXURAL STRESS CHECK: The average flexural stress in the moment-frame columns and beams, calculated using the Quick Check procedure of Section 4.4.3.9, is less than F_y. Columns need not be checked if the strong column–weak beam checklist item is compliant.	5.5.2.2.2	A.3.1.3.3
Connections			
C NC N/A U	TRANSFER TO STEEL FRAMES: Diaphragms are connected for transfer of seismic forces to the steel frames.	5.7.2	A.5.2.2
C NC N/A U	STEEL COLUMNS: The columns in seismic-force-resisting frames are anchored to the building foundation with a minimum of two anchor rods and with the base plates bearing on concrete or a grout pad.	5.7.3.1	A.5.3.1

Table 17-16. Collapse Prevention Structural Checklist for Building Types S5 and S5a.

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Low Seismicity			
Seismic-Force-Resisting System			
C NC N/A U	REDUNDANCY: The number of lines of shear walls in each principal direction is greater than or equal to 2.	5.5.1.1	A.3.2.1.1
C NC N/A U	SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check procedure of Section 4.4.3.3 is less than 70 lb/in.^{2} (0.48 MPa)	5.5.3.1.1	A.3.2.4.1
C NC N/A U	SHEAR STRESS CHECK: The shear stress in the unreinforced masonry shear walls, calculated using the Quick Check procedure of Section 4.4.3.3 is less than 30 lb/in.^{2} (0.21 MPa) for clay units and 70 lb/in.^{2} (0.48 MPa) for concrete units. Bays with openings greater than 25% of the wall area shall not be included in A_w of Equation (4-8).	5.5.3.1.1	A.3.2.5.1
C NC N/A U	INFILL WALL CONNECTIONS: Masonry is in full contact with frame.	5.5.3.5.1 5.5.3.5.3	A.3.2.6.1
Is compliant at WPA Infill Building. Infill Walls at Lean-tos not considered as part of lateral system.			
Connections			
C NC N/A U	STEEL COLUMNS: The columns in seismic-force-resisting frames are anchored to the building foundation with a minimum of two anchor rods and with the base plates bearing on concrete or a grout pad.	5.7.3.1	A.5.3.1

Table 17-36. Collapse Prevention Structural Checklist for Building Types URM and URMa.

Status	Evaluation Statement	Tier 2 Reference	Commentary Reference
Low and Moderate Seismicity			
Seismic-Force-Resisting System			
C NC N/A U	REDUNDANCY: The number of lines of shear walls in each principal direction is greater than or equal to 2.	5.5.1.1	A.3.2.1.1
C NC N/A U	SHEAR STRESS CHECK: The shear stress in the unreinforced masonry shear walls, calculated using the Quick Check procedure of Section 4.4.3.3, is less than 30 lb/in.^{2} (0.21 MPa) for clay units and 70 lb/in.^{2} (0.48 MPa) for concrete units.	5.5.3.1.1	A.3.2.5.1
Connections			
C NC N/A U Currently NC; will comply once retrofits per Construction Documents are implemented.	WALL ANCHORAGE: Exterior concrete or masonry walls that are dependent on the diaphragm for lateral support are anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections have strength to resist the connection force calculated in the Quick Check procedure of Section 4.4.3.7.	5.7.1.1	A.5.1.1
C NC N/A U	WOOD LEDGERS: The connection between the wall panels and the diaphragm does not induce cross-grain bending or tension in the wood ledgers or top plates fastened to the walls.	5.7.1.3	A.5.1.2
C NC N/A U	TRANSFER TO SHEAR WALLS: Diaphragms are connected for transfer of seismic forces to the shear walls.	5.7.2	A.5.2.1
C NC N/A U	GIRDER–COLUMN CONNECTION: There is a positive connection using plates, connection hardware, or straps between the girder and the column support.	5.7.4.1	A.5.4.1

Table 17-38. Nonstructural Checklist.

Status	Evaluation Statement[a,b]	Tier 2 Reference	Commentary Reference
Partitions			
C NC N/A U	**HR—LMH; LS—LMH; PR—LMH.** UNREINFORCED MASONRY: Unreinforced masonry or hollow-clay tile partitions are braced at a spacing of at most 10 ft (3 m) in Low or Moderate Seismicity, or at most 6 ft (1.8 m) in High Seismicity.	13.6.2	A.7.1.1
Currently NC at Lean-To Infill Wall but will comply once retrofit per construction documents is implemented.			
C NC N/A U	**HR—LMH; LS—LMH; PR—LMH.** HEAVY PARTITIONS SUPPORTED BY CEILINGS: The tops of masonry or hollow-clay tile partitions are not laterally supported by an integrated ceiling system.	13.6.2	A.7.2.1
Parapets, Cornices, Penthouses, and Appendages			
C NC N/A U	**HR—LMH; LS—LMH; PR—LMH.** URM PARAPETS OR CORNICES: Laterally unsupported unreinforced masonry parapets or cornices have height-to-thickness ratios no greater than the following: for Life Safety in Low or Moderate Seismicity, 2.5; for Life Safety in High Seismicity and for Position Retention in any seismicity, 1.5.	13.6.5	A.7.8.1
Masonry Chimneys			
C NC N/A U	**HR—LMH; LS—LMH; PR—LMH.** URM CHIMNEYS: Unreinforced masonry chimneys extend above the roof surface no more than the following: for Life Safety in Low or Moderate Seismicity, three times the least dimension of the chimney; for Life Safety in High Seismicity and for Position Retention in any seismicity, two times the least dimension of the chimney.	13.6.9	A.7.9.1
C NC N/A U	**HR—LMH; LS—LMH; PR—LMH.** ANCHORAGE: Masonry chimneys are anchored at each floor level, at the topmost ceiling level, and at the roof.	13.6.9	A.7.9.2