CROWDER CONSTRUCTION COMPANY | Hazen

Project Manual Volume 1

HRSD

Hampton Roads Sanitation District

Sustainable Water Phase 3 - Demonstration Facility

CIP No. GNO16200 | June, 2017

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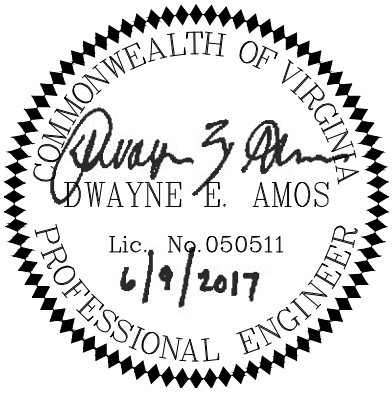
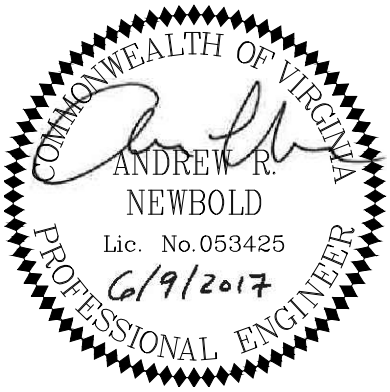
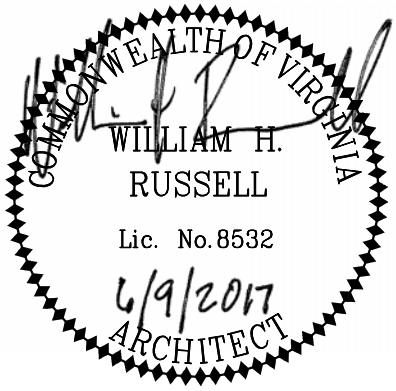
Sustainable Water Phase 3 – Demonstration Facility
Project Manual
June 2017







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Sustainable Water Phase 3 – Demonstration Facility
Project Manual

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SECTION 01070

ABBREVIATIONS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The following is a partial list of typical abbreviations which may be used in the Specifications, and the organizations to which they refer:

AASHTO	-	American Association of State Highway and Transportation Officials
ACI	-	American Concrete Institute
ACIFS	-	American Cast Iron Flange Standards
AFBMA	-	Anti-Friction Bearing Manufacturer's Association
AGA	-	American Gas Association
AGMA	-	American Gear Manufacturers Association
AIA	-	American Institute of Architects
AISC	-	American Institute of Steel Construction
AISI	-	American Iron and Steel Institute
ANSI	-	American National Standard Institute
API	-	American Petroleum Institute
ASCE	-	American Society of Civil Engineers
ASHRAE	-	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing and Materials
AWS	-	American Welding Society
AWWA	-	American Water Works Association
CEMA	-	Conveyor Equipment Manufacturer's Association
CRSI	-	Concrete Reinforcing Steel Institute
DIPRA	-	Ductile Iron Pipe Research Association
Fed Spec	-	Federal Specifications
IEEE	-	Institute of Electrical and Electronic Engineers
IPCEA	-	Insulated Power Cable Engineers Association
ISO	-	Insurance Services Offices
NBS	-	National Bureau of Standards
NEC	-	National Electric Code
NEMA	-	National Electrical Manufacturers Association
NSF	-	National Sanitary Foundation
OSHA	-	Occupational Safety and Health Act
PCI	-	Precast Concrete Institute
UL	-	Underwriters Laboratories, Inc.
USGS	-	United States Geological Survey
VDEQ	-	Virginia Department of Environmental Quality
VDH	-	Virginia Department Health
VDOT	-	Virginia Department of Transportation

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PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01090

REFERENCE STANDARDS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Wherever reference is made to any published standards, codes, or standard specifications, it shall mean the latest standard code, specification, or tentative specification of the technical society, organization, or body referred to, which is in effect at the date of invitation for Bids.

B. All materials, products, and procedures used or incorporated in the work shall be in strict conformance with applicable codes, regulations, specifications, and standards.

C. A partial listing of codes, regulations, specifications, and standards includes the following:

Air Conditioning and Refrigeration Institute (ARI)

Air Diffusion Council (ADC)

Air Moving and Conditioning Association (AMCA)

The Aluminum Association (AA)

American Architectural Manufacturers Association (AAMA)

American Concrete Institute (ACI)

American Gear Manufacturers Association (AGMA)

American Hot Dip Galvanizers Association (AHDGA)

American Institute of Steel Construction, Inc. (AISC)

American Iron and Steel Institute (AISI)

American National Standards Institute (ANSI)

American Society of Civil Engineers (ASCE)

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)

American Society of Mechanical Engineers (ASME)

American Society for Testing and Materials (ASTM)

American Standards Association (ASA)

American Water Works Association (AWWA)

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American Welding Society (AWS)

American Wood-Preserver's Association (AWPA)

Anti-Friction Bearing Manufacturers Association (AFBMA)

Building Officials and Code Administrators (BOCA)

Conveyor Equipment Manufacturers Association (CEMA)

Consumer Product Safety Commission (CPSC)

Factory Mutual (FM)

Federal Specifications

Instrument Society of America (ISA)

Institute of Electrical and Electronics Engineers (IEEE)

National and Local Fire Codes

Lightning Protection Institute (LPI)

National Electrical Code (NEC)

National Electrical Manufacturer's Association (NEMA)

National Electrical Safety Code (NESC)

National Electrical Testing Association (NETA)

National Fire Protection Association (NFiPA)

Regulations and Standards of the Occupational Safety and Health Act (OSHA)

Southern Building Code Congress International, Inc. (SBCCI)

Sheet Metal & Air Conditioning Contractors National Association (SMACCNA)

Standard Building Code

Standard Mechanical Code

Standard Plumbing Code

Uniform Building Code (UBC)

Underwriters Laboratories Inc. (UL)

D. Contractor shall, when required, furnish evidence satisfactory to the Engineer that materials and methods are in accordance with such standards where so specified.

E. In the event any questions arise as to the application of these standards or codes, copies shall be supplied on-site by the Contractor.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

- END OF SECTION -

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SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

A. The completed Work will provide OWNER with a Sustainable Water Demonstration Facility and includes the following elements:

1. Design, construction, and commissioning a demonstration facility that will treat 1 million gallons per day (mgd) of water as described in the Conceptual Documents. Work includes procurement, installation, and commissioning of the advanced water treatment process equipment and instrumentation as described in the Conceptual Documents and procurement, installation, and commissioning of all pumps, piping, equipment, and instrumentation required to operate, control, and monitor a complete treatment train.
2. Design and construction of a complete facility to house the demonstration treatment process and to include space for public outreach and education, laboratory space, office space, electrical services, HVAC and building services, and other features identified.
3. Design and construction of site improvements required for the proposed facility, including stormwater facilities, facility access, and parking spaces to accommodate anticipated needs.
4. Design, excavation, and installation of all required connections to existing Nansemond Treatment Plant infrastructure including but not limited to secondary clarifier effluent piping, sanitary piping, potable and non-potable water piping, natural gas piping, electrical, and I&C systems.
5. Design, excavation, and installation of required piping, equipment, instrumentation, and controls to connect to injection well facilities (wells constructed by others).
6. Design, excavation, and installation of fire protection services as required by Code.

1.02 PERMIT DIVISION OF RESPONSIBILITY

A. The anticipated permits required for construction of the Project and division of responsibility for obtaining the permits are provided in the table below:

Anticipated Permits	Responsible Party	Supporting Role
City of Suffolk Site Plan Approval	D/B	HRSD/CH2M

Anticipated Permits	Responsible Party	Supporting Role
City of Suffolk Land Disturbance Permit	D/B	HRSD/CH2M
City of Suffolk Building Permit	D/B	HRSD/CH2M
City of Suffolk/Virginia DCR Stormwater Permit	D/B	HRSD/CH2M
Virginia Department of Environmental Quality (VDEQ) Certificate to Construct (CTC)	D/B	HRSD/CH2M
VDEQ Certificate to Operate (CTO)	D/B	HRSD/CH2M
Environmental Protection Agency (EPA) Underground Injection Control (UIC)	HRSD/CH2M	D/B
City of Suffolk Conditional Use Permit – Minor Amendment {Amendment 1}	HRSD/CH2M	D/B

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 15 20
MAINTENANCE OF FACILITY OPERATIONS

PART 1 GENERAL

1.01 SUMMARY

A. The intent of this Specification is to have the DESIGN/BUILDER schedule and perform the tie- in work and process shutdowns/bypasses in a manner such that the OWNER can maintain service in continuous dependable operation and meet all regulatory requirements. The DESIGN/BUILDER shall adhere to the constraints listed in this section.

1.02 GENERAL CONSTRAINTS

A. All shutdown operations shall be approved by the OWNER. All shutdown operations shall be coordinated with and scheduled at times suitable to the OWNER.

B. OWNER does not guarantee complete system valve closures. The DESIGN/BUILDER's Plan of Operation shall account for this situation in the developed plan.

C. Shutdowns shall not begin until all required materials are on-hand and ready for installation and a written Plan of Operation has been submitted and approved by the OWNER.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 29 00
PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Schedule of Values: Submit on OWNER's standard schedule of values form.
2. Application for Payment.
3. Final Application for Payment.

1.02 SCHEDULE OF VALUES

A. Prepare a separate Schedule of Values for each item of the Work under the Agreement. The schedule of values shall be subdivided into the following work categories:

1. Engineering design services.
2. Builder support during engineering design services.
3. Construction-related field engineering design services.
4. General requirements, bonds, insurance, mobilization/de-mobilization, and overhead and profit.
5. Procurement of water treatment process equipment.
6. Construction services.

B. Upon request of Owner, provide documentation to support the accuracy of the Schedule of Values.

C. An unbalanced or front-end loaded schedule will not be acceptable.

D. Summation of the complete Schedule of Values representing all the Work shall equal the Contract Cost Limit.

1.03 APPLICATION FOR PAYMENT

A. Transmittal Summary Form: Attach one Summary Form with each detailed Application for Payment for each schedule and include Request for Payment of Materials and Equipment on Hand as applicable. Execute certification by authorized officer of DESIGN/BUILDER.

B. Use detailed Application for Payment Form provided by OWNER.

C. Submit Application for Payment via OWNER's online Oracle ERP system using the ERP iSupplier logon link. {Addendum No. 1}

D. Provide separate form for each schedule as applicable.

E. Include accepted Schedule of Values for each portion of Work.

F. Include separate line item for each Change Order and Work Change Directive executed prior to date of submission. Provide further breakdown of such as requested by OWNER.

G. Preparation:

1. Round values to nearest dollar.
2. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form(s) for each schedule as applicable, a listing of materials on hand for each schedule as applicable, and such supporting data as may be requested by OWNER.

1.04 PAYMENT

A. Payment for all Work shown or specified in Contract Documents is included in the Contract Price. Payment will be based on a percentage complete basis for each line item of the accepted Schedule of Values.

1.05 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

A. Payment will not be made for following:

1. Loading, hauling, and disposing of rejected material.
2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.
3. Rejected loads of material, including material rejected after it has been placed by reason of failure of DESIGN/BUILDER to conform to provisions of Contract Documents.
4. Material not unloaded from transporting vehicle.
5. Defective Work not accepted by OWNER.
6. Material remaining on hand after completion of Work.

1.06 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

A. Partial Payment: No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings and preliminary operation and maintenance data is acceptable to OWNER.

B. Final Payment: Will be made only for products incorporated in Work; remaining products, for which partial payments have been made, shall revert to DESIGN/BUILDER unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

1.07 PARTIAL PAYMENT FOR UNDELIVERED, PROJECT-SPECIFIC MANUFACTURED OR FABRICATED EQUIPMENT

A. Notwithstanding above provisions, partial payments for undelivered (not yet delivered to Site or not stored in the vicinity of Site) products specifically manufactured for this Project, excluding off the shelf or catalog items, will be made for products listed below when all following conditions exist:

1. Partial payment request is supported by written acknowledgment from Suppliers that invoice requirements have been met.
2. Equipment is adequately insured, maintained, stored, and protected by appropriate security measures.
3. Each equipment item is clearly marked and segregated from other items to permit inventory and accountability.
4. Authorization has been provided for access to storage Site for OWNER.
5. Equipment meets applicable requirements of these Contract Documents. {Addendum No. 1}

B. Failure of DESIGN/BUILDER to continue compliance with above requirements shall give cause for OWNER to withhold payments made for such equipment from future partial payments.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 31 13
PROJECT COORDINATION

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational:

1. Photographs:
   a. Digital Images: Submit one copy of DVD disc containing images within 5 days of being taken. Each image is to have a minimum file size of 1.4 Mb (1,400 Kb) so viewed resolution is high quality. The production of larger file sizes with higher resolution is encouraged.
2. Video Recordings: Submit one copy within 5 days of being taken.

1.02 RELATED WORK AT SITE

A. General:

1. Other work that is either directly or indirectly related to scheduled performance of the Work under these Contract Documents, listed henceforth, is anticipated to be performed at Site by others.
2. Coordinate the Work of these Contract Documents with work of others as specified in General Conditions.
3. Include sequencing constraints specified herein as a part of progress schedule.

1.03 UTILITY NOTIFICATION AND COORDINATION

A. Coordinate the Work with various utilities within Project limits. Notify applicable utilities prior to commencing Work, if damage occurs, or if conflicts or emergencies arise during the Work.

B. {Addendum No. 1}

1.04 FACILITY OPERATIONS

A. Continuous operation of OWNER's facilities is of critical importance. Schedule and conduct activities to enable existing facilities to operate continuously, unless otherwise specified.

B. Perform Work continuously during critical connections and changeovers, and as required to prevent interruption of OWNER's operations.

C. When necessary, plan, design, and provide various temporary services, utilities, connections, temporary piping and heating, access, and similar items to maintain continuous operations of OWNER's facility.

D. Do not close lines, open or close valves, or take other action which would affect the operation of existing systems. Operation of all existing valves, pumps, and appurtenances that will affect OWNER's operation will be performed by the OWNER, except as specifically required by the Contract Documents, and will be considered within 48 hours after receipt of DESIGN/BUILDER's written request.

E. Process or Facility Shutdown: Refer to Section 01 15 20, Maintenance of Facility Operations.

F. Install and maintain bypass facilities and temporary connections required to keep OWNER's operations on line. Sequences other than those specified will be considered upon written request to OWNER, provided they afford equivalent continuity of operations.

G. Do not proceed with Work affecting a facility's operation without obtaining OWNER's advance approval of the need for and duration of such Work.

H. Relocation of Existing Facilities:

1. During construction, it is expected that minor relocations of Work will be necessary.
2. Provide complete relocation of existing structures and Underground Facilities, including piping, utilities, equipment, structures, electrical conduit wiring, electrical duct bank, and other necessary items.
3. Use only new materials for relocated facility. Match materials of existing facility, unless otherwise shown or specified.
4. Perform relocations to minimize downtime of existing facilities.
5. Install new portions of existing facilities in their relocated position prior to removal of existing facilities, unless otherwise accepted by OWNER.

1.05 ADJACENT FACILITIES AND PROPERTIES

A. Examination:

1. After Effective Date of the Agreement and before Work at Site is started, DESIGN/BUILDER and OWNER shall make a thorough examination of pre-existing conditions including existing buildings, structures, and other improvements in vicinity of Work, as applicable, which could be damaged by construction operations. {Addendum No. 1}

2. Periodic reexamination shall be jointly performed to include, but not limited to, cracks in structures, settlement, leakage, and similar conditions.

B. Documentation:

1. Record and submit documentation of observations made on examination inspections in accordance with this section. {Addendum No. 1}
2. Such documentation shall be used as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of DESIGN/BUILDER's operations. {Addendum No. 1}

1.06 CONSTRUCTION PHOTOGRAPHS

A. General:

1. Photographically document all phases of the Project including preconstruction, construction progress, and post-construction.
2. OWNER shall have right to select subject matter and vantage point from which photographs are to be taken.
3. Digital Images: No post-session electronic editing of images is allowed. Stored image shall be actual image as captured without cropping or other edits.

B. Preconstruction and Post-Construction:

1. After Effective Date of the Agreement and before Work at Site is started, and again upon issuance of Substantial Completion, take a minimum of 48 photographs of Site. {Addendum No. 1}
2. {Addendum No. 1}Format: Digital, minimum resolution of 1832 by 3264 pixels and 24-bit, millions of color.

C. Construction Progress Photos:

1. Photographically demonstrate progress of construction, showing every aspect of Site as well as interior and exterior of new or impacted structures. {Addendum No. 1}
2. Monthly: Take 48 photographs using digital, minimum resolution of 1832 by 3264 pixels and 24-bit, millions of color. {Addendum No. 1}

D. Documentation:

1. Digital Images:
   a. Electronic image shall have date taken embedded into image.
   b. Archive using a commercially available photo management system that provides listing of photographs including date, keyword description, and direction of photograph.

c. Label file folders or database records with Project and OWNER's name, and month and year images were produced.

1.07 {ADDENDUM NO. 1}REFERENCE POINTS AND SURVEYS

A. OWNER's Responsibilities: Establish bench marks convenient to Work.

B. {Addendum No. 1}DESIGN/BUILDER's Responsibilities:

1. Provide survey and layout required to layout the Work.
2. Check and establish exact location of existing facilities prior to construction of new facilities and any connections thereto.
3. In event of discrepancy in data or staking provided by OWNER, request clarification before proceeding with Work.
4. Retain professional land surveyor or civil engineer registered in state of Project who shall perform or supervise engineering surveying necessary for additional construction staking and layout.
5. Maintain complete accurate log of survey work as it progresses as a Record Document.
6. On request of OWNER, submit documentation.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CUTTING, FITTING, AND PATCHING

A. Cut, fit, adjust, or patch Work, including excavation and backfill as required, to make Work complete. {Addendum No. 1}

B. Refinish surfaces to provide an even finish.

1. {Addendum No. 1}Finish restored surfaces to such planes, shapes, and textures that no transition between existing work and the Work is evident in finished surfaces.

C. Restore existing work, underground facilities, and surfaces that are to remain in completed Work including concrete-embedded piping, conduit, and other utilities. {Addendum No. 1}

D. Make restorations with new materials and appropriate methods as specified for new Work of similar nature; if not specified, use recommended practice of manufacturer or appropriate trade association.

E. Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces and fill voids.

F. Remove specimens of installed Work for testing when requested by OWNER.

END OF SECTION

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SECTION 01 31 19
PROJECT MEETINGS

PART 1 GENERAL

1.01 GENERAL

A. OWNER will provide physical arrangements for meetings throughout progress of the Work. DESIGN/BUILDER shall prepare meeting agenda with regular participant input and distribute with written notice of each meeting, preside at meetings, record minutes to include significant proceedings and decisions, and reproduce and distribute copies of minutes within 5 days after each meeting to participants and parties affected by meeting decisions.

1.02 PRE-DESIGN CONFERENCE

A. DESIGN/BUILDER shall schedule and prepare an agenda for a pre-design conference. The purpose of pre-design conference is to designate responsible personnel, establish working relationships, discuss preliminary schedules submitted by the DESIGN/BUILDER and review administrative and procedural requirements for the Project.

B. The pre-design conference shall be held after execution of the Contract. The DESIGN/BUILDER shall coordinate with the OWNER to establish the date, time, and location of the conference and notify the interested and involved parties.

C. DESIGN/BUILDER shall prepare a detailed agenda and materials for the meeting and provide to OWNER for OWNER's input a minimum of 5 working days in advance of the meeting. At a minimum, the agenda shall include the following:

1. Procedural and Administrative:
    a. Personnel and Teams:
        1) Designation and roles of personnel.
        2) Authorities having jurisdiction.
        3) Procedures for communications and correspondence.
2. Conceptual Design Documents
    a. Major design elements associated with the Work.
    b. Scheduling:
        1) Scope of the Work
        2) Contract Times, including milestones (if any).
        3) Phasing and sequencing.
        4) Preliminary progress schedule.
        5) Critical path activities.

c. Permits.
d. Coordination:
    1) Project coordination, and coordination among consultants and contractors.
    2) Coordination with OWNER's operations.
    3) Progress meetings.

1.03 PRECONSTRUCTION CONFERENCE

A. DESIGN/BUILDER shall schedule and prepare an agenda for a preconstruction conference. The pre-design conference shall be held prior to construction activities at the Project Site. The DESIGN/BUILDER shall coordinate with the OWNER to establish the date, time, and location of the conference and notify the interested and involved parties.

B. DESIGN/BUILDER shall be prepared to discuss the following subjects, as a minimum:

1. Required schedules.
2. Status of bonds and insurance.
3. Sequencing of critical path work items.
4. Progress payment procedures.
5. Project changes and clarification procedures.
6. Use of Site, access, office and storage areas, security and temporary facilities.
7. Major product delivery and priorities.
8. DESIGN/BUILDER's safety plan and representative.

C. Attendees will include:

1. OWNER's representatives.
2. DESIGN/BUILDER's office representative.
3. DESIGN/BUILDER's resident superintendent.
4. DESIGN/BUILDER's quality control representative.
5. Subcontractors' representatives whom DESIGN/BUILDER may desire or OWNER may request to attend.
6. OWNER's representatives.
7. Others as appropriate.

1.04 PROGRESS MEETINGS

A. DESIGN/BUILDER shall schedule regular progress meetings to review the Work progress, progress schedule, application for payment, and other matters needing discussion and resolution.

B. Progress Meeting Agenda: {Addendum No. 1}

1. DESIGN/BUILDER will prepare agenda and be prepared to discuss in detail the topics listed below. Progress meeting agenda may be modified by the OWNER during the Project as required:
   a. Review, comment, and amendment (if required) of minutes of previous progress meeting.
   b. Review of progress since previous progress meeting.
   c. Planned progress through the next progress meeting.
   d. Review of Progress Schedule:
      1) Contract times, including milestones (if any).
      2) Critical path.
      3) Schedule for fabrication and delivery of equipment.
      4) Corrective measures, if required.
   e. Design: Review status of critical design elements.
   f. Problems, conflicts, and observations.
   g. Quality standards, testing, and inspections.
   h. Coordination between parties.
   i. Permits.
   j. Other business as appropriate.

C. Attendees will include:

1. OWNER.
2. OWNER's consultant.
3. DESIGN/BUILDER, subcontractors, and suppliers, as appropriate.
4. Others as appropriate.

1.05 OTHER MEETINGS

A. In accordance with Contract Documents and as may be required by OWNER.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Preliminary Progress Schedule: Submit within 10 days after Effective Date of the Agreement.
2. Detailed Progress Schedule:
   a. Submit initial detailed progress schedule within 60 days after Effective Date of the Agreement.
   b. Submit an updated progress schedule at each update, in accordance with Section 1.03, Detailed Progress Schedule.
3. Submit with Each Progress Schedule Submission:
   a. DESIGN/BUILDER's certification that progress schedule submission is actual schedule being used for execution of the Work.
   b. Progress Schedule: Electronic
   c. Narrative Progress Report: Electronic.
4. Prior to final payment, submit a final updated progress schedule. {Addendum No. 1}

1.02 PRELIMINARY PROGRESS SCHEDULE

A. In addition to basic requirements outlined in General Conditions, show a detailed schedule, beginning with Notice to Proceed, for minimum duration of 90 days, and a summary of balance of Project through Final Completion.

B. Show activities including, but not limited to the following:

1. Notice to Proceed.
2. Design activities, including design submittal, and design review periods.
3. Permits.
4. DESIGN/BUILDER early procurement activities for long lead equipment and materials.
5. Initial Site work.
6. Specified Work sequences and construction constraints.
7. Contract milestone and completion dates.
8. Major structural, mechanical, equipment, electrical, architectural, and instrumentation and control Work.
9. System startup summary.
10. Project close-out summary.
11. Demobilization summary.

C. Update preliminary progress schedule monthly as part of progress payment process. Failure to do so may result in the OWNER withholding all or part of the monthly progress payment until the preliminary progress schedule is updated in a manner acceptable to OWNER.

D. Format: In accordance with Article Progress Schedule—Critical Path Network.

1.03 DETAILED PROGRESS SCHEDULE

A. In addition to requirements of General Conditions, submit detailed progress schedule beginning with Notice to Proceed and continuing through Final Completion.

B. Show the duration and sequences of activities required for complete performance of the Work reflecting means and methods chosen by DESIGN/BUILDER.

C. When accepted by OWNER, detailed progress schedule will replace preliminary progress schedule and become baseline schedule. Subsequent revisions will be considered as updated progress schedules.

D. Format: In accordance with Article Progress Schedule—Critical Path Network.

E. Update monthly to reflect actual progress and occurrences to date, including weather delays.

1.04 DESIGN/BUILDER PROGRESS SCHEDULE—CRITICAL PATH NETWORK

A. General: Comprehensive computer-generated schedule using CPM, generally as outlined in Associated General Contractors of America (AGC) 580, "Construction Project Planning and Scheduling Guidelines." If a conflict occurs between the AGC publication and this specification, this specification shall govern.

B. Contents:

1. Schedule shall begin with the date of Notice to Proceed and conclude with the date of Final Completion.
2. Identify Work calendar basis using days as a unit of measure.
3. Show complete interdependence and sequence of design, construction and Project-related activities reasonably required to complete the Work.
4. Identify the Work of separate stages and other logically grouped activities, and clearly identify critical path of activities.

5. Reflect sequences of the Work, restraints, delivery windows, review times, Contract Times and Project milestones set forth in the Agreement. {Addendum No. 1}
6. Include as applicable, at a minimum:
    a. Design activities, design submittals, and review time.
    b. Obtaining permits, submittals for early product procurement, and long lead time items.
    c. Mobilization and other preliminary activities.
    d. Initial Site work.
    e. Specified Work sequences, constraints, and milestones, including Substantial Completion date(s).
    f. Subcontract Work.
    g. Major equipment design, fabrication, factory testing, and delivery dates.
    h. Sitework.
    i. Concrete Work.
    j. Structural steel Work.
    k. Architectural features Work.
    l. Conveying systems Work.
    m. Equipment Work.
    n. Mechanical Work.
    o. Electrical Work.
    p. Instrumentation and control Work.
    q. Interfaces with OWNER-furnished equipment.
    r. Other important Work for each major facility.
    s. Equipment and system startup and test activities.
    t. Project closeout and cleanup.
    u. Demobilization.
7. No activity duration, exclusive of those for submittals review and product fabrication/delivery, shall be less than 1 day, unless otherwise approved.
8. Activity duration for submittal review shall not be less than review time specified unless clearly identified and prior written acceptance has been obtained from OWNER.

C. Network Graphical Display:

1. Plot or print on paper not greater than 30 inches by 42 inches or smaller than 11 inches by 17 inches, unless otherwise approved.
2. Title Block: Show name of Project, OWNER, date submitted, revision or update number, and the name of the scheduler. Updated schedules shall indicate data date.
3. Identify horizontally across top of schedule the time frame by year, month, and day.
4. Identify each activity with a unique number and a brief description of the Work associated with that activity.

5. Indicate the critical path.
6. Show, at a minimum, the controlling relationships between activities.
7. Plot activities on a time-scaled basis, with the length of each activity proportional to the current estimate of the duration.
8. Plot activities on an early start basis unless otherwise requested by OWNER.
9. Provide a legend to describe standard and special symbols used.

D. Schedule Report:

1. On 8-1/2-inch by 11-inch white paper, unless otherwise approved.
2. List information for each activity in tabular format, including at a minimum:
   a. Activity identification number.
   b. Activity description.
   c. Original duration.
   d. Remaining duration.
   e. Early start date (actual start on updated progress schedules).
   f. Early finish date (actual finish on updated progress schedules).
   g. Late start date.
   h. Late finish date.
   i. Total float.
3. Sort reports, in ascending order, as listed below:
   a. Activity number sequence with predecessor and successor activity.
   b. Activity number sequence.
   c. Early-start.
   d. Total float.

1.05 PROGRESS OF THE WORK

A. Updated Progress Schedule shall reflect:

1. Progress of Work to within 5 working days prior to submission.
2. Approved changes in Work scope and activities modified since submission.
3. Delays in submittals or resubmittals, deliveries, or Work.
4. Adjusted or modified sequences of Work.
5. Other identifiable changes.
6. Revised projections of progress and completion.
7. Report of changed logic.

B. Produce detailed subschedules during Project, upon request of OWNER to further define critical portions of the Work such as facility shutdowns.

C. If an activity is not completed by its latest scheduled completion date and this failure is anticipated to extend Contract Times (or milestones), submit, within

7 days of such failure, a written statement as to how nonperformance will be corrected to return Project to acceptable current progress schedule. Actions by DESIGN/BUILDER to complete the Work within Contract Times (or milestones) will not be justification for adjustment to Contract Price or Contract Times.

D. OWNER may order DESIGN/BUILDER to increase plant, equipment, labor force, or working hours if DESIGN/BUILDER fails to:

1. Complete a milestone activity by its completion date.
2. Satisfactorily execute Work as necessary to prevent delay to overall completion of Project, at no additional cost to OWNER.

1.06 SCHEDULE ACCEPTANCE

A. OWNER's acceptance will demonstrate agreement that:

1. Proposed schedule is accepted with respect to:
   a. Contract Times, including Final Completion and all intermediate milestones, are within the specified times.
   b. Specified Work sequences and constraints are shown as specified.
   c. Specified OWNER-furnished equipment or material arrival dates, or range of dates, are included.
   d. Access restrictions are accurately reflected.
   e. Startup and testing times are as specified.
   f. Submittal review times are as specified.
   g. Equipment testing and facility startup duration is as specified and timing is acceptable. {Addendum No. 1}
2. In all other respects, OWNER's acceptance of DESIGN/BUILDER's schedule indicates that, in OWNER's judgment, schedule represents reasonable plan for constructing Project in accordance with the Contract Documents. OWNER's review will not make any change in Contract requirements. Lack of comment on any aspect of schedule that is not in accordance with the Contract Documents will not thereby indicate acceptance of that change, unless DESIGN/BUILDER has explicitly called the nonconformance to OWNER's attention in submittal. Schedule remains DESIGN/BUILDER's responsibility and DESIGN/BUILDER retains responsibility for performing all activities, for activity durations, and for activity sequences required to construct Project in accordance with the Contract Documents.

B. Unacceptable Preliminary Progress Schedule:

1. Make requested corrections; resubmit within 10 days.
2. Until acceptable to OWNER as baseline progress schedule, continue review and revision process, including updating schedule on a monthly basis to reflect actual progress and occurrences to date.

C. Unacceptable Detailed Progress Schedule:

1. Make requested corrections; resubmit within 10 days.
2. Until acceptable to OWNER as baseline progress schedule, continue review and revision process.

D. Narrative Report: All changes to activity duration and sequences, including addition or deletion of activities subsequent to OWNER's acceptance of baseline progress schedule, shall be delineated in narrative report current with proposed updated progress schedule.

1.07 ADJUSTMENT OF CONTRACT TIMES

A. Reference General Conditions.

B. Evaluation and reconciliation of Adjustments of Contract Times shall be based on the updated progress schedule at the time of proposed adjustment or claimed delay.

C. Float:

1. Float time is a Project resource available to both parties to meet contract milestones and Contract Times.
2. Use of float suppression techniques such as preferential sequencing or logic, special lead/lag logic restraints, and extended activity times are prohibited, and use of float time disclosed or implied by use of alternate float-suppression techniques shall be shared to proportionate benefit of OWNER and DESIGN/BUILDER.
3. Pursuant to above float-sharing requirement, no time extensions will be granted nor delay damages paid until a delay occurs which (i) impacts Project's critical path, (ii) consumes available float or contingency time, and (iii) extends Work beyond contract completion date.

D. Claims Based on Contract Times:

1. Where OWNER has not yet rendered formal decision on DESIGN/BUILDER's claim for adjustment of Contract Times, and parties are unable to agree as to amount of adjustment to be reflected in progress schedule, reflect an interim adjustment in the progress schedule as acceptable to OWNER.
2. It is understood and agreed that such interim acceptance will not be binding on either DESIGN/BUILDER or OWNER, and will be made only for the purpose of continuing to schedule Work until such time as formal decision has been rendered as to an adjustment, if any, of the Contract Times.
3. Revise progress schedule prepared thereafter in accordance with OWNER's formal decision.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 DESCRIPTION

A. The OWNER has adopted a paperless documents policy. Where reference is made to the submittals throughout the Division 1 requirements, the intent is to save paper and submit documents using electronic media.

B. DESIGN/BUILDER shall follow the requirements of the General Conditions 6.17, Submittals. OWNER's review is to determine conformance to the Contract Documents. {Addendum No. 1}

C. Scope:

1. DESIGN/BUILDER shall provide design submittals in accordance with the requirements of the Contract Documents.
2. Provide construction submittals well in advance of need for the material or equipment, or procedure (as applicable) in the Work and with ample time required for delivery of material or equipment and to implement procedures following OWNER's review of the associated submittal. Only "Construction Action Submittals" will be reviewed by the OWNER. {Addendum No. 1}
3. DESIGN/BUILDER is responsible for all dimensions associated with the Work. All dimensions must be confirmed by DESIGN/BUILDER, and if required, corrected prior to installation of the Work at the Site. DESIGN/BUILDER is responsible for information pertaining to the fabrication process, for the techniques used for construction, and for coordinating the work of all trades. DESIGN/BUILDER's signature of submittal's stamp and letter of transmittal shall be DESIGN/ BUILDER's representation that DESIGN/BUILDER has met the obligations under the Contract Documents relative to that submittal.

1.02 DEFINITIONS

A. Design Submittals: Include drawings, technical specifications, design calculations, technical data sheets and catalog cuts from equipment manufacturers, permit applications, and supporting documents.

B. Construction Action Submittals: Written and graphic information submitted by DESIGN/BUILDER that requires OWNER's approval, including the following: {Addendum No. 1}

1. Schedule of Values submittals required under Section 01 29 00, Payment Procedures.
2. Progress Schedule submittals required under Section 01 32 00, Construction Progress Documentation.
3. Process and treatment equipment.
4. Process instrumentation and controls.
5. Functional descriptions.
6. Electrical equipment, short-circuit, and arc flash studies.

C. Informational Submittal: Information submitted by DESIGN/BUILDER that requires OWNER's review and determination that submitted information is in accordance with the Conditions of the Contract. {Addendum No. 1}

1.03 PROCEDURES

A. Direct submittals to OWNER electronically. {Addendum No. 1}

B. Electronic Submittals: Submittals shall, unless specifically accepted, be made in electronic format.

1. Each submittal shall be an electronic file in Adobe Acrobat portable document format (PDF). Use the latest version available at time of execution of the Agreement.
2. Electronic files that contain more than 10 pages in PDF format shall contain internal bookmarking from an index page to major sections of the document.
3. Add general information to each PDF file, including title, subject, author, and keywords.
4. PDF files shall be set up to print legibly at 8.5-inch by 11-inch, 11-inch by 17-inch, or 22-inch by 34-inch. No other paper sizes will be accepted.
5. Submit new electronic files for each resubmittal.
6. Include a copy of the Transmittal of Contractor's Submittal form, located at end of section, with each electronic file.
7. OWNER will reject submittal that is not electronically submitted, unless specifically accepted.
8. Provide OWNER with authorization to reproduce and distribute each file as many times as necessary for Project documentation. {Addendum No. 1}
9. Detailed procedures for handling electronic submittals will be discussed at the preconstruction conference.

C. Transmittal of Submittal:

1. DESIGN/BUILDER shall:
   a. Review each submittal and check for compliance with Contract Documents.
   b. Stamp each submittal with uniform approval stamp before submitting to OWNER.
      1) Stamp to include Project name, submittal number, Specification number, DESIGN/BUILDER's reviewer name, date of reviewer approval, and statement certifying submittal has been reviewed, checked, and approved for compliance with Contract Documents.
      2) OWNER will not review submittals that do not bear DESIGN/BUILDER's approval stamp and will return them without action. {Addendum No. 1}
2. Complete, sign, and transmit with each submittal package, one Transmittal of Contractor's Submittal form in format approved by OWNER. {Addendum No. 1}
3. Identify each submittal with the following:
   a. Numbering and Tracking System:
      1) Sequentially number each submittal.
      2) Resubmission of submittal shall have original number with sequential alphabetic suffix.
   b. Specification section and paragraph to which submittal applies.
   c. Project title. {Addendum No. 1}
   d. Date of transmittal.
   e. Names of DESIGN/BUILDER, subcontractor or supplier, and manufacturer as appropriate.
4. Identify and describe each deviation or variation from Contract Documents.

D. Format:

1. Do not base Shop Drawings on reproductions of Contract Documents.
2. Package submittal information by individual specification section. Do not combine different specification sections together in submittal package, unless otherwise directed in specification.
3. Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract Documents.
4. Index with labeled tab dividers in orderly manner.

E. Timeliness: Schedule and submit in accordance with Schedule of Submittals, and requirements of individual specification sections.

F. Processing Time:

1. Time for review shall commence on OWNER's receipt of submittal.
2. OWNER will act upon DESIGN/BUILDER's submittal and transmit response to DESIGN/BUILDER not later than 14 days after receipt, unless otherwise specified.
3. Resubmittals will be subject to same review time.
4. No adjustment of Contract Times or Price will be allowed as a result of delays in progress of Work caused by rejection and subsequent resubmittals. {Addendum No. 1}

G. Resubmittals: Clearly identify each correction or change made.

H. Incomplete Submittals:

1. OWNER will return entire submittal for DESIGN/BUILDER's revision if preliminary review deems it incomplete.
2. When any of the following are missing, submittal will be deemed incomplete:
   a. DESIGN/BUILDER's review stamp; completed and signed.
   b. Transmittal of Contractor's Submittal; completed and signed.

I. {Addendum No. 1}Submittals not required by Contract Documents:

1. Will not be reviewed and will be returned stamped "Not Subject to Review."
2. OWNER will keep one copy and return submittal to DESIGN/BUILDER. {Addendum No. 1}

1.04 CONSTRUCTION ACTION SUBMITTALS {Addendum No. 1}

A. Prepare and submit Action Submittals required by the Contract Documents.

B. Shop Drawings:

1. Copies: One electronic submitted to OWNER.
2. Identify and Indicate:
   a. Applicable Contract Drawing and Detail number, products, units and assemblies, and system or equipment identification or tag numbers.
   b. Equipment and component title. {Addendum No. 1}
   c. Critical field dimensions and relationships to other critical features of Work. Note dimensions established by field measurement.
   d. Project-specific information drawn accurately to scale.

3. Manufacturer's standard schematic drawings and diagrams as follows:
   a. Modify to delete information that is not applicable to the Work.
   b. Supplement standard information to provide information specifically applicable to the Work.
4. Product Data: Provide as specified in individual specifications.
5. {Addendum No. 1}Foreign Manufacturers: When proposed, include names and addresses of at least two companies that maintain technical service representatives close to Project.

C. Samples: Not used.

D. Construction Action Submittal Dispositions: OWNER will review, comment, stamp, and distribute as noted: {Addendum No. 1}

1. Approved:
   a. DESIGN/BUILDER may incorporate product(s) or implement Work covered by submittal.
   b. Distribution: Electronic.
2. Approved as Noted:
   a. DESIGN/BUILDER may incorporate product(s) or implement Work covered by submittal, in accordance with OWNER's notations. {Addendum No. 1}
   b. Distribution: Electronic.
3. Partial Approval, Resubmit as Noted:
   a. Make corrections or obtain missing portions, and resubmit.
   b. Except for portions indicated, DESIGN/BUILDER may begin to incorporate product(s) or implement Work covered by submittal, in accordance with OWNER's notations. {Addendum No. 1}
   c. Distribution: Electronic.
4. Revise and Resubmit:
   a. DESIGN/BUILDER may not incorporate product(s) or implement Work covered by submittal.
   b. Distribution: Electronic.

1.05 INFORMATIONAL SUBMITTALS

A. General:

1. Copies: One electronic submitted to OWNER, unless otherwise indicated in individual specification section.
2. Refer to individual specification sections for specific submittal requirements.
3. OWNER will review each submittal. If submittal meets conditions of the Contract, OWNER will forward copy to appropriate parties. If OWNER determines submittal does not meet conditions of the Contract and is therefore considered unacceptable, OWNER will retain one copy and

return remaining copy with review comments to DESIGN/BUILDER, and require that submittal be corrected and resubmitted. {Addendum No. 1}

B. Certificates:

1. General:
   a. Provide notarized statement that includes signature of entity responsible for preparing certification.
   b. Signed by officer or other individual authorized to sign documents on behalf of that entity.
2. Welding: In accordance with individual specification sections.
3. Installer: Prepare written statements on manufacturer's letterhead certifying installer complies with requirements as specified in individual specification section.
4. Material Test: Prepared by qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
5. Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency or specified in individual specification sections.
6. Manufacturer's Certificate of Compliance: In accordance with Section 01 61 00, Common Product Requirements.

C. {Addendum No. 1}Construction Photographs: In accordance with Section 01 31 13, Project Coordination, and as may otherwise be required in Contract Documents. {Addendum No. 1}

D. Closeout Submittals: In accordance with Section 01 77 00, Closeout Procedures.

E. DESIGN/BUILDER-design Data (related to temporary construction):

1. Written and graphic information.
2. List of assumptions.
3. List of performance and design criteria.
4. Summary of loads or load diagram, if applicable.
5. Calculations.
6. List of applicable codes and regulations.
7. Name and version of software.
8. Information requested in individual specification section.

F. Manufacturer's Instructions: Written or published information that documents manufacturer's recommendations, guidelines, and procedures in accordance with individual specification section.

G. Operation and Maintenance Data: As required in Section 01 78 23, Operation and Maintenance Data.

H. Payment:

1. Application for Payment: In accordance with Section 01 29 00, Payment Procedures.
2. Schedule of Values: In accordance with Section 01 29 00, Payment Procedures.

I. {Addendum No. 1}Schedules:

1. Schedule of Submittals: Prepare separately or in combination with Progress Schedule as specified in Section 01 32 00, Construction Progress Documentation.
   a. Show for each, at a minimum, the following:
      1) Specification section number.
      2) Identification by numbering and tracking system as specified under Paragraph Transmittal of Submittal.
      3) Estimated date of submission to OWNER, including reviewing and processing time.
   b. On a monthly basis, submit updated Schedule of Submittals to OWNER if changes have occurred or resubmittals are required. {Addendum No. 1}
2. Progress Schedules: In accordance with Section 01 32 00, Construction Progress Documentation.

J. Special Guarantee: Supplier's written guarantee as required in individual specification sections.

K. Statement of Qualification: Evidence of qualification, certification, or registration as required in Contract Documents to verify qualifications of professional land surveyor, engineer, materials testing laboratory, specialty Subcontractor, trade, Specialist, consultant, installer, and other professionals. Reference Paragraph 1.01.A.53 of Supplementary Conditions for definition of Specialist.

L. Submittals Required by Laws, Regulations, and Governing Agencies:

1. Promptly submit promptly notifications, reports, certifications, payrolls, and otherwise as may be required, directly to the applicable federal, state, or local governing agency or their representative.
2. Transmit for OWNER's records one copy of correspondence and transmittals (to include enclosures and attachments) between DESIGN/BUILDER and governing agency. {Addendum No. 1}

M. Test, Evaluation, and Inspection Reports:

1. General: Shall contain signature of person responsible for test or report.
2. Factory:
    a. Identification of product and specification section, type of inspection or test with referenced standard or code.
    b. Date of test, Project title and number, and name and signature of authorized person.
    c. Test results.
    d. If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
    e. Provide interpretation of test results, when requested by Engineer.
    f. Other items as identified in individual specification sections.
3. Field:
    a. As a minimum, include the following:
        1) Project title and number.
        2) Date and time.
        3) Record of temperature and weather conditions.
        4) Identification of product and specification section.
        5) Type and location of test, Sample, or inspection, including referenced standard or code.
        6) Date issued, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector.
        7) If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
        8) Provide interpretation of test results, when requested by Engineer.
        9) Other items as identified in individual specification sections.

N. Testing and Startup Data: In accordance with Section 01 91 14, Equipment Testing and Facility Startup.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 45 33
SPECIAL INSPECTION AND TESTING

PART 1 GENERAL

1.01 SUMMARY

A. This section covers requirements for special inspection and testing required in accordance with International Building Code (latest edition) and is in addition to and supplements requirements.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Civil Engineers (ASCE): 7-05, Minimum Design Loads for Buildings and Other Structures.
2. International Code Council (ICC):
   a. International Building Code (IBC), latest edition.
   b. Evaluation Service (ICC-ES) Reports and Legacy Reports.
3. Virginia Uniform Statewide Building Code (USBC).

1.03 DEFINITIONS

A. Agencies and Personnel:

1. Approved Agency: An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved.
2. Registered Design Professional in Responsible Charge: An individual who is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws of the state or jurisdiction in which the Project is to be constructed.
3. Special Inspector: Qualified person employed by DESIGN/BUILDER who will demonstrate competence to the satisfaction of the building official for inspection of a particular type of construction or operation requiring special inspection.

B. Special Inspection:

1. Special Inspection: Inspection required of materials, installation, fabrication, erection, or placement of components and connections requiring special expertise to ensure compliance with approved Contract Documents and referenced standards.

2. Special Inspection, Continuous: Full-time observation of Work requiring special inspection by an approved special inspector who is present in the area where the Work is being performed.
3. Special Inspection, Periodic: Part-time or intermittent observation of Work requiring special inspection by an approved special inspector who is present in the area where the Work has been or is being performed, and at the completion of the Work.

C. Structural Systems and Components:

1. Diaphragm: Component of structural lateral load resisting system consisting of roof, floor, or other membrane or bracing system acting to transfer lateral forces to vertical resisting elements of structure.
2. Drag Strut or Collector: Component of structural lateral load resisting system consisting of a diaphragm or shear wall element that collects and transfers diaphragm shear forces to vertical force-resisting elements or distributes forces within diaphragm or shear wall.
3. Seismic-Force-Resisting System: That part of structural lateral load resisting system that has been considered in the design to provide required resistance to seismic forces identified on Drawings.
4. Shear Wall: Component of structural lateral load resisting system consisting of a wall designed to resist lateral forces parallel to the plane of the wall. Unless noted otherwise on Drawings, load-bearing walls with direct in-plane connections to roof and floors shall be considered to be shear walls.
5. Wind Force Resisting System: That part of the structural system that has been considered in the design to provide required resistance to wind forces identified on Drawings.

D. Nonstructural Components:

1. Architectural Component Supports: Structural members or assemblies of members which transmit loads and forces from architectural systems or components to the structure, including braces, frames, struts, and attachments.
2. Electrical Component Supports: Structural members or assemblies which transmit loads and forces from electrical equipment to the structure, including braces, frames, legs, pedestals, and tethers, as well as elements forged or cast as part of component for anchorage.
3. Mechanical Component Supports: Structural members or assemblies which transmit loads and forces from mechanical equipment to the structure, including braces, frames, skirts, legs, saddles, pedestals, snubbers, and tethers, as well as elements forged or cast as part of component for anchorage.

1.04 SUBMITTALS

A. Informational Submittals:

1. DESIGN/BUILDER shall provide the following:
   a. Completed copies of supplements in accordance with Hampton Roads Regional Special Inspection Guidelines and Procedures, 2006 USBC Edition, latest revision.
   b. Names and qualifications of each testing agency employed, and qualifications of testing agency's personnel that will perform testing as required in accordance with Hampton Roads Regional Special Inspection Guidelines and Procedures, 2006 USBC Edition, latest revision.
   c. List of control procedures within DESIGN/BUILDER's organization for testing, including methods, frequency of reporting, and distribution of testing reports.
   d. Copies of product test reports.

1.05 STATEMENT OF SPECIAL INSPECTIONS (PLAN) REQUIREMENTS

A. Designated Systems for Inspection: As required in support of the building permit application and code requirements listed above.

B. Statement of Special Inspections (Plan): As required in support of the building permit application and code requirements listed above.

C. Special inspection and associated testing of shop fabrication and field construction will be performed by an approved accredited independent agency. DESIGN/BUILDER shall secure and pay for the services of the agency to perform special inspection and associated testing.

D. DESIGN/BUILDER is responsible for associated costs for additional special inspection and testing by special inspectors required due to rejection of materials of in-place Work that cannot be made compliant to Contract Document without additional Site visits or testing.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. DESIGN/BUILDER shall coordinate and provide access to shop or Site for special inspection and testing.

B. Materials and systems, inclusive, shall be inspected during placement where continuous special inspection is required.

C. Materials and systems shall be inspected during or at completion of their placement where periodic special inspection is allowed.

1. Periodic special inspection shall be performed so that Work inspected after, but not during, its placement can be corrected prior to other related Work proceeding and covering inspected Work.
2. Periodic special inspection does not allow sampling of a portion of the Work. All Work shall be inspected.

END OF SECTION

SECTION 01470

WATERTIGHTNESS TESTING OF CONCRETE STRUCTURES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. It is the intent of these Specifications that all concrete work and sealing work around built-in items and penetrations be performed as required to insure that groundwater, surface water, and water or liquids in tanks, channels and containers will not intrude into any equipment rooms, pipe galleries, habitable areas or other generally dry areas.

B. The required watertightness shall be achieved by quality concrete construction and proper sealing of all joints and penetrations.

C. Each unit shall be tested separately and the leakage tests shall be made prior to backfilling and before equipment is installed. Testing water shall be from any potable, non-potable, or natural moving source such as a river or stream, but not from any still water source such as a lake or pond, and not from any wastewater source.

D. All water holding structures shall be tested for leakage by the Design/Builder. The Design/Builder shall provide at his own expense all labor, material, temporary bulkheads, pumps, water measuring devices, etc., necessary to perform the required tests.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03300 – Cast-in-Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. ACI 350.1-10 - Specification for Tightness Testing of Environmental Engineering Concrete Structures

1.04 SUBMITTALS

A. Testing procedures shall be submitted for approval prior to the test.

B. Testing Report: Prior to placing the structure in service, submit for review and approval a detailed bound report summarizing the watertightness test data, describing the testing procedure and showing the calculations on which the test data is based.

PART 2 – PRODUCTS (NOT USED)

32414-000

PART 3 – EXECUTION

3.01 TEST PREPARATION

A. The design capability of the structure to withstand testing shall be verified for the pressures to be applied. Another type of test shall not be substituted for hydrostatic tightness testing without approval of the Engineer.

B. The structure shall not be tested before all elements of the structure which resist any portion of the retained liquid pressure are in place and the concrete has attained its specified compressive strength.

C. Unless otherwise specified, coatings shall not be applied until after the hydrostatic tightness testing is complete. Liners that are mechanically locked to the surface during the placement of the concrete shall be installed before the hydrostatic tightness testing. Interior liners shall be visually examined for deficiencies (pinholes, tears and partially fused splices) and must pass integrity testing. Deficiencies shall be prepared.

D. Clean the exposed concrete surfaces of the structure, including the floor, of all foreign material and debris. Prior to testing, standing water in or outside of the structure that would interfere with the inspection of the exposed concrete surfaces of the structure shall be removed.

E. The concrete surfaces and concrete joints shall be thoroughly inspected for potential leakage points. Areas of potential leakage shall be repaired before filling the containment structure with water.

F. All openings, fittings, and pipe penetrations in the structure shell shall be inspected at both faces of the concrete, if practical. Defective or cracked concrete shall be repaired prior to testing. All structural penetrations and inlet/outlets shall be securely sealed to prevent the loss of water from the structure during the test. All structural penetrations shall be monitored before and during the test to determine the watertightness of these appurtenances. If the structure is to be filled using the inlet/outlet pipe, positive means shall be provided to check that water is not entering or leaving through this pipe once the structure is filled to the test level. Leakage at these inlet/outlets shall be repaired prior to testing. No allowance shall be made in test measurements for uncorrected known points of leakage

G. The flow from any underdrain system, if a system is provided, shall be monitored during this same period, and any increase in flow shall be recorded and considered for information as a part of the hydrostatic tightness testing.

H. The ground water level shall be brought to a level below the top of the base slab and kept at that elevation or at a lower elevation during the test.

I. No backfill shall be placed against the walls or on the wall footings of the structure to be tested unless otherwise specified.

3.02 PROCEDURE

A. The initial filling of a new structure should not exceed a rate of 4 ft/h. Filling shall be continued until the water surface is at the design maximum liquid level, or either 1 in. below any fixed overflow level in covered containment structure or 4 in. in open structure, whichever is lower.

B. The exterior surfaces of the structure shall be inspected during the period of filling the structure. If any flow of water is observed from the structure exterior surfaces, including joints or cracks, the defect causing the leakage shall be repaired prior to testing.

C. Watertightness Test - Part 1: Qualitative Criteria

1. The water shall be kept at the test level for at least 3 days prior to Part 2 of the testing.

2. The exterior surfaces of the structure shall be observed in both the early mornings and later afternoons during the 3-day period before Part 2 of the test. If any water is observed on the structure exterior surfaces, including joints, repaired honeycombed areas and cracks, where moisture can be picked up on a dry hand, the containment structure shall be considered to have failed Part 1 of the test.

3. Wet areas on top of wall footing shall not be cause to fail Part 1 of the test unless the water can be observed to be flowing.

4. Part 2 of the test may begin prior to completion of repairs for Part 1. However, all defects causing the failure of Part 1 shall be repaired before the structure is accepted.

D. Watertightness Test - Part 2: Quantitative Criteria

1. The test measurements shall not be scheduled for a period when the forecast is for a difference of more than 35°F between the ambient temperature readings at the times of the initial and final level measurements of the water surface. The test shall also not be scheduled when the weather forecast indicates the water surface would be frozen before the test is completed.

2. The vertical distance to the water surface shall be measured to within 1/16 in. from a fixed point on the structure above the water surface. Measurements shall be recorded at 24-hour intervals. Measurements taken at the same time of day will reduce the probability of temperature difference.

3. Measurements shall be taken at two locations, 180° apart, which will minimize the effect of differential settlement. Measurements shall be taken at the same locations to reduce the probability of measurement differences.

4. The test period shall be at least the theoretical time required to lower the water surface 3/8 in. assuming a loss of water at 0.050% of the water volume per 24-hour period. The test period shall not be longer than five days.

5. The water temperature shall be recorded at a depth of 18 in. below the water surface at the start and end of the test.

6. A floating, restrained, partially filled, calibrated, open container for evaporation and precipitation measurement should be positioned in open structures and the water level in the container recorded at 24-hour intervals. Determination of evaporation by a shallow pan-type measuring device is not acceptable due to possible heating of the bottom of the shallow pan resulting in accelerated evaporation.

3.03 EVALUATION

A. The containment structure shall continue to be observed in both the early mornings and late afternoons to verify compliance with Part 1 of the test during Part 2.

B. At the end of the test period, the water surface shall be recorded to within 1/16-in at the location of original measurements. The water temperature and the evaporation and precipitation measurements shall be recorded.

C. The allowable loss of water for tightness tests shall not exceed 0.050% of the test water volume in 24 hours.

D. The change in water volume in the structure shall be calculated and corrected, if necessary, for evaporation, precipitation, and temperature based on the change recorded in the water level from the open container. If the loss exceeds the allowable loss, the structure shall be considered to have failed the test.

E. During Part 2 of the test, observed flow or seepage of water from the exterior surface, including that from cracks and joints, should be considered as a failed test. The structure shall also be considered to have failed the test if moisture can be transferred from the exterior surface to a dry hand. Dampness or wetness on top of a footing shall not be considered as a failure test.

3.04 RETESTING

A. A restart of the test shall be required when test measurements become unreliable due to unusual precipitation or other external factors.

B. The Design/Builder shall be permitted to immediately retest when no visible leakage is exhibited. If the structure fails the second test or if the Design/Builder does not exercise the option of immediately retesting after the first test failure, the interior of the structure shall be inspected by a diver or by other means to determine probable areas of leakage. The structure shall only be retested after the most probable areas of leakage are repaired.

C. If the leakage exceeds the allowable limit, the work shall be corrected by methods approved by the Engineer.

D. Upon completion of the necessary remedial work, the leakage test shall be repeated until it is successfully passed.

3.05 NOTIFICATION BY ENGINEER

A. If any leaks, in excess of the specified amount, are not remedied by the Design/Builder within four (4) weeks of notification by the Engineer, regardless of whether the cause of these leaks is or is not determined, the Engineer shall have the authority to have these leaks repaired by others. The cost of repairs, by others, shall be deducted from monies due or to become due to the Design/Builder.

- END OF SECTION -

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SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Nursery and Landscape Association (ANLA): American Standards for Nursery Stock.
2. Federal Emergency Management Agency (FEMA).
3. National Fire Prevention Association (NFPA): 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations.
4. Telecommunications Industry Association (TIA): 568-C, Commercial Building Telecommunications Cabling Standard.
5. U.S. Department of Agriculture (USDA): Urban Hydrology for Small Watersheds.
6. U.S. Weather Bureau: Rainfall-Frequency Atlas of the U.S. for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years.

1.02 SUBMITTALS

A. Informational Submittals:

1. Copies of permits and approvals for construction as required by Laws and Regulations and governing agencies.
2. Temporary Utility Submittals:
   a. Electric power supply and distribution plans.
   b. Water supply and distribution plans.
   c. Dewatering well locations.
   d. Sanitary.
3. Temporary Construction Submittals:
   a. Access Roads: Routes, cross-sections, and drainage facilities.
   b. Parking area plans.
   c. DESIGN/BUILDER’s field office, storage yard, and storage building plans, including gravel surfaced area.
   d. Fencing and protective barrier locations and details.
   e. Staging area location plan.
   f. Plan for maintenance of existing plant operations.

1.03 MOBILIZATION

A. Mobilization shall include, but not be limited to, these principal items:

1. Obtaining required permits.
2. Moving DESIGN/BUILDER's field office and equipment required for first month operations onto Site.
3. Installing temporary construction power, wiring, and lighting facilities.
4. Providing onsite communication facilities, including telephones.
5. Providing onsite sanitary facilities and potable water facilities as specified and as required by Laws and Regulations, and governing agencies.
6. Arranging for and erection of DESIGN/BUILDER's work and storage yard.
7. Posting OSHA required notices and establishing safety programs and procedures.
8. Having DESIGN/BUILDER's superintendent at Site full time.

1.04 PROTECTION OF WORK AND PROPERTY

A. Comply with OWNER's safety rules while on OWNER's property.

B. Keep OWNER informed of serious onsite accidents and related claims.

C. Use of Explosives: No blasting or use of explosives will be allowed onsite.

1.05 CONFINED SPACE, HOT WORK PERMIT AND EXPLOSION PROOF AREAS, LOCKOUT/TAGOUT

A. Confined Space:

1. Certain portions of the Site constitute confined spaces as defined in 29 CFR 1926 or permit-required confined spaces as defined in 29 CFR 1910. The confined spaces at Site might include the following existing facilities:
   a. All chambers and vaults.
   b. Aeration effluent channels.
   c. Aeration influent chambers.
   d. Aeration tanks.
   e. Manholes.
   f. Preaeration tanks (all).
   g. Primary clarifiers.
   h. Primary solids valve vaults.
   i. Wet wells.
   j. Any other spaces with potential for engulfment or hazardous atmosphere.
2. Determination on what areas are classified as confined space shall be made by DESIGN/BUILDER, following DESIGN/BUILDER survey of

the Site. Existing procedures of OWNER related to confined space, inclusive of the "HRSD Confined Space Entry Program," shall be available to DESIGN/BUILDER to assist in identification of confined spaces.

3. DESIGN/BUILDER shall incorporate into Work all appropriate measures required to protect the health and safety of personnel at the Site, including employees of DESIGN/BUILDER, Subcontractors, suppliers, OWNER, Owner's Consultant, and other personnel, while performing Work in and around confined spaces. DESIGN/BUILDER shall comply with all applicable federal, state, and local rules and regulations, including OWNER's internal rules and regulations pertinent to confined space, including the "HRSD Confined Space Entry Program."
4. Submittals: Provide Site-specific confined space entry plan in accordance with Section 01 33 00, Submittal Procedures to include the following elements.
    a. Site-specific hazard assessment to identify confined spaces at Site.
    b. Measures to safeguard entry to permit-requiring confined spaces.
    c. Training plan, use of personal protection, safety equipment, and instrumentation.
    d. Procedures for confined space entry, including forms to be used.
    e. Recordkeeping procedures.
5. OWNER's employees cannot act as "qualified person" for the DESIGN/BUILDER. OWNER's gas detection monitors and other equipment or supplies shall not be available to DESIGN/BUILDER.

B. Hot Work Permit and Explosion Proof Areas: According to an existing "HRSD Hot Work Permit Program," the OWNER requires that a hot work permit is issued prior to any Work involving electric or gas welding, cutting, brazing, or similar flame-producing or spark-producing operations or in close proximity to (within 25 feet or where posted) hazardous chemical process systems/equipment. The DESIGN/BUILDER shall comply with this requirement and obtain a hot work permit from the OWNER before engaging in any hot work or work in close proximity to hazardous chemical process system/equipment.

C. Lockout/Tagout: According to an existing "HRSD Lockout/Tagout Program," the OWNER requires that DESIGN/BUILDER's key employees are briefed by OWNER on the program. All Work performed by DESIGN/BUILDER shall be in accordance with OWNER's lockout/tagout program.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 TEMPORARY UTILITIES

A. Power:

1. Electric power will be available at or near Site. Determine type and amount available and make arrangements for obtaining temporary electric power service, metering equipment, and pay costs for electric power used during Contract period, except for portions of the Work designated in writing by OWNER as substantially complete.
2. Cost of electric power will be borne by DESIGN/BUILDER.

B. Lighting: Provide temporary lighting to meet applicable safety requirements to allow erection, application, or installation of materials and equipment, and observation or inspection of the Work.

C. Heating, Cooling, and Ventilating:

1. Provide as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for installation of materials, and to protect materials, equipment, and finishes from damage because of temperature or humidity. Costs for temporary heat shall be borne by DESIGN/BUILDER.
2. Provide adequate forced air ventilation of enclosed areas to cure installed materials, to dispense humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.
3. Pay costs of installation, maintenance, operation, removal, and fuel consumed.
4. Provide portable unit heaters, complete with controls, oil- or gas-fired, and suitably vented to outside as required for protection of health and property.
5. If permanent natural gas piping is used for temporary heating units, do not modify or reroute gas piping without approval of utility company. Provide separate gas metering as required by utility.

D. Water:

1. Hydrant water is available from nearby hydrants. Secure written permission for connection and use from OWNER and meet requirements for use.
2. OWNER will furnish construction and drinking water required at no cost to DESIGN/BUILDER on Site. Furnish and install temporary piping and facilities to transport water to the Work.

E. Sanitary and Personnel Facilities:

1. Provide and maintain facilities for DESIGN/BUILDER's employees, subcontractors, and other onsite employers' employees. Service, clean, and maintain facilities and enclosures.
2. Use of OWNER's existing sanitary facilities by construction personnel will not be allowed.

F. Telephone Service:

1. DESIGN/BUILDER: Arrange and provide onsite telephone service for use during construction. Pay costs of installation and monthly bills.
2. No incoming calls allowed to OWNER's plant telephone system.

G. Fire Protection: Furnish and maintain on Site adequate firefighting equipment capable of extinguishing incipient fires. Comply with applicable parts of NFPA 241.

3.02 PROTECTION OF WORK AND PROPERTY

A. General:

1. Perform Work within right-of-way and easements in a systematic manner that minimizes inconvenience to property owners and the public.
2. No residence or business shall be cut off from vehicular traffic, unless special arrangements have been made.
3. Maintain in continuous service existing oil and gas pipelines, underground power, telephone or communication cable, water mains, irrigation lines, sewers, poles and overhead power, and other utilities encountered along line of the Work, unless other arrangements satisfactory to owners of said utilities have been made.
4. Where completion of the Work requires temporary or permanent removal or relocation of existing utility, coordinate activities with owner of said utility and perform work to their satisfaction.
5. Protect, shore, brace, support, and maintain underground pipes, conduits, drains, and other underground utility construction uncovered or otherwise affected by construction operations.
6. Keep fire hydrants and water control valves free from obstruction and available for use at all times.
7. In areas where DESIGN/BUILDER's operations are adjacent to or near a utility, such as gas, telephone, television, electric power, water, sewer, or irrigation system, and such operations may cause damage or inconvenience, suspend operations until arrangements necessary for protection have been made by DESIGN/BUILDER.
8. Notify property owners and utility offices that may be affected by construction operation at least 2 days in advance: Before exposing a

utility, obtain utility owner's permission. Should service of utility be interrupted due to DESIGN/BUILDER's operation, notify proper authority immediately. Cooperate with said authority in restoring service as promptly as possible and bear costs incurred.

9. Do not impair operation of existing sewer system. Prevent construction material, pavement, concrete, earth, volatile and corrosive wastes, and other debris from entering sewers, pump stations, or other sewer structures.
10. Maintain original Site drainage wherever possible.

B. Site Security: Provide and maintain additional temporary security fences as necessary to protect the Work and DESIGN/BUILDER-furnished products not yet installed.

C. Trees and Plantings:

1. Protect from damage and preserve trees, shrubs, and other plants outside limits of the Work and within limits of the Work, which are designated on Drawings to remain undisturbed.
    a. Where practical, tunnel beneath trees when on or near line of trench.
    b. Employ hand excavation as necessary to prevent tree injury.
    c. Do not stockpile materials or permit traffic within drip lines of trees.
    d. Provide and maintain temporary barricades around trees.
    e. Water vegetation as necessary to maintain health.
    f. Cover temporarily exposed roots with wet burlap, and keep burlap moist until soil is replaced around roots.
    g. No trees, except those specifically shown on Drawings to be removed, shall be removed without written approval of Engineer.
    h. Dispose of removed trees in a legal manner off the Site.
2. Balling and burlapping of trees indicated for replacement shall conform to recommended specifications set forth in the American Standards for Nursery Stock, published by American Nursery and Landscape Association. Balls shall be firm and intact and made-balls will not be accepted. Handle ball and burlap trees by ball and not by top.
3. In event of damage to bark, trunks, limbs, or roots of plants that are not designated for removal, treat damage by corrective pruning, bark tracing, application of a heavy coating of tree paint, and other accepted horticultural and tree surgery practices.
4. Replace each plant that dies as a result of construction activities.

D. Existing Structures:

1. Where DESIGN/BUILDER contemplates removal of small structures such as mailboxes, signposts, and culverts that interfere with

DESIGN/BUILDER's operations, obtain approval of property owner and Engineer.
2. Move mailboxes to temporary locations accessible to postal service.
3. Replace items removed in their original location and a condition equal to or better than original.

E. Finished Construction: Protect finished floors and concrete floors exposed as well as those covered with composition tile or other applied surfacing.

F. Waterways: Keep ditches, culverts, and natural drainages continuously free of construction materials and debris.

G. Dewatering: Construct, maintain, and operate cofferdams, channels, flume drains, sumps, pumps, or other temporary diversion and protection works. Furnish materials required, install, maintain, and operate necessary pumping and other equipment for the environmentally safe removal and disposal of water from the various parts of the Work. Maintain foundations and parts of the Work free from water.

H. Endangered and Threatened Species:

1. Take precautions necessary and prudent to protect native endangered and threatened flora and fauna.
2. Notify Engineer of construction activities that might threaten endangered and threatened species or their habitats.
3. Engineer will mark areas known as habitats of endangered and threatened species prior to commencement of onsite activities.
4. Additional areas will be marked by Engineer as other habitats of endangered and threatened species become known during construction.

3.03 TEMPORARY CONTROLS

A. Air Pollution Control:

1. Minimize air pollution from construction operations.
2. Burning of waste materials, rubbish, or other debris will not be permitted on or adjacent to Site.
3. Conduct operations of dumping rock and of carrying rock away in trucks to cause a minimum of dust. Give unpaved streets, roads, detours, or haul roads used in construction area a dust-preventive treatment or periodically water to prevent dust. Strictly adhere to applicable environmental regulations for dust prevention.
4. Provide and maintain temporary dust-tight partitions, bulkheads, or other protective devices during construction to permit normal operation of existing facilities. Construct partitions of plywood, insulating board, plastic sheets, or similar material. Construct partitions in such a manner that dust and dirt from demolition and cutting will not enter other parts

of existing building or facilities. Remove temporary partitions as soon as need no longer exists.

B. Noise Control:

1. Provide acoustical barriers so noise emanating from tools or equipment will not exceed legal noise levels.
2. Noise Control Ordinance: refer to City of Suffolk requirements.
3. Noise Control Plan: Propose plan to mitigate construction noise and to comply with noise control ordinances, including method of construction, equipment to be used, and acoustical treatments.

C. Water Pollution Control:

1. Divert sanitary sewage and nonstorm waste flow interfering with construction and requiring diversion to sanitary sewers. Do not cause or permit action to occur which would cause an overflow to existing waterway.
2. Prior to commencing excavation and construction, obtain OWNER's agreement with detailed plans showing procedures intended to handle and dispose of sewage, groundwater, and dewatering pump discharges.
3. Comply with Section 01 57 13, Temporary Erosion and Sedimentation Control, for stormwater flow and surface runoff.
4. Do not dispose of volatile wastes such as mineral spirits, oil, chemicals, or paint thinner in storm or sanitary drains. Disposal of wastes into streams or waterways is prohibited. Provide acceptable containers for collection and disposal of waste materials, debris, and rubbish.

D. Erosion, Sediment, and Flood Control: Provide, maintain, and operate temporary facilities as specified in Section 01 57 13, Temporary Erosion and Sedimentation Control, to control erosion and sediment releases, and to protect the Work and existing facilities from flooding during construction period.

3.04 STORAGE YARDS AND BUILDINGS

A. Coordinate requirements with Section 01 61 00, Common Product Requirements.

B. Temporary Storage Yards: Construct temporary storage yards for storage of products that are not subject to damage by weather conditions.

C. Temporary Storage Buildings:

1. Provide environmental control systems that meet recommendations of manufacturers of equipment and materials stored.

2. Arrange or partition to provide security of contents and ready access for inspection and inventory.
3. Store combustible materials (paints, solvents, fuels) in a well-ventilated and remote building meeting safety standards.

3.05 ACCESS ROADS

A. Construct access roads as shown and within easements, rights-of-way, or Project limits.

B. Maintain drainage ways. Install and maintain culverts to allow water to flow beneath access roads. Provide corrosion-resistant culvert pipe of adequate strength to resist construction loads.

C. Provide gravel, crushed rock, or other stabilization material to permit access by all motor vehicles at all times.

D. Maintain road grade and crown to eliminate potholes, rutting, and other irregularities that restrict access.

E. Coordinate with Engineer detours and other operations affecting traffic and access. Provide at least 72 hours' notice to Engineer of operations that will alter access to Site.

3.06 PARKING AREAS

A. Control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, OWNER's operations, or construction operations.

B. Provide parking facilities for personnel working on Project. No employee or equipment parking will be permitted on OWNER's existing paved areas.

3.07 VEHICULAR TRAFFIC

A. Comply with Laws and Regulations regarding closing or restricting use of public streets or highways. No public or private road shall be closed, except by written permission of proper authority. Ensure the least possible obstruction to traffic and normal commercial pursuits.

B. Conduct the Work to interfere as little as possible with public travel, whether vehicular or pedestrian.

C. Maintain top of backfilled trenches before they are paved, to allow normal vehicular traffic to pass over. Provide temporary access driveways where required. Cleanup operations shall follow immediately behind backfilling.

D. When flaggers and guards are required by regulation or when deemed necessary for safety, furnish them with approved orange wearing apparel and other regulation traffic control devices.

E. Notify fire department and police department before closing street or portion thereof. Notify said departments when streets are again passable for emergency vehicles. Do not block off emergency vehicle access to consecutive arterial crossings or dead-end streets, in excess of 300 linear feet, without written permission from fire department. Conduct operations with the least interference to fire equipment access, and at no time prevent such access. Furnish DESIGN/BUILDER's night emergency telephone numbers to police department.

F. Coordinate traffic routing with that of others working in same or adjacent areas.

3.08 CLEANING DURING CONSTRUCTION

A. In accordance with General Conditions, as may be specified in other Specification sections, and as required herein.

B. Wet down exterior surfaces prior to sweeping to prevent blowing of dust and debris. At least weekly, sweep floors (basins, tunnels, platforms, walkways, roof surfaces), and pick up and dispose of debris.

C. Provide approved containers for collection and disposal of waste materials, debris, and rubbish. At least weekly, dispose of such waste materials, debris, and rubbish offsite.

D. At least weekly, brush sweep entry drive, roadways, and other streets and walkways affected by the Work and where adjacent to the Work.

END OF SECTION

SECTION 01 57 13
TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. The DESIGN/BUILDER shall be responsible for providing necessary materials and taking appropriate measures to comply with requirements of the stormwater permit and minimize pollutants in stormwater runoff from the Project.

B. National Pollutant Discharge Elimination System: Comply with federal, state, and local laws, rules and regulations, and the National Pollutant Discharge Elimination System (NPDES) Construction Stormwater Discharge Permit or Permits applicable to the project. A copy of the Project's General Construction Permit, if applicable to the Project, is available from OWNER. NPDES General Construction permits are required on projects that involve disturbance of 1 acre or more with potential to discharge stormwater to surface waters.

C. The following documents are part of the Work included under this section:

1. Storm Water Pollution Prevention Plan (SWPP): Prepared by DESIGN/BUILDER and filed with authority having jurisdiction over storm water discharges during construction.
2. Virginia Stormwater Management Program (VSMP) Permit: Prepared by DESIGN/BUILDER and submitted to the Virginia Department of Environmental Quality together with the required permit fee.
3. Stormwater Inspection Reports: Prepared by DESIGN/BUILDER's site superintendent or project manager using the form provided by the authority having jurisdiction. Number, frequency, and content of reports to be prepared in accordance with requirements of the authority having jurisdiction.
4. Notice of Termination (NOT): prepared by DESIGN/BUILDER to be submitted upon completion of all work that may result in pollution in the stormwater discharges.

D. DESIGN/BUILDER shall not perform excavation work at the Site until the VSMP Permit, Erosion and Sediment Control Permit, and the City of Suffolk Land Disturbance Permit have been issued.

E. DESIGN/BUILDER shall pay civil penalties and other costs incurred by OWNER, including additional engineering, administration, and inspection services associated with noncompliance to applicable permits related to stormwater discharges associated with construction activity and sediment and erosion controls associated with the Work.

F. Contract price shall include all material, labor, and other permits and incidental costs related to:

1. Preparing required permits
2. Submission and application fees associated with permits.
3. Installing and maintaining structural and non-structural items used in complying with permits.
4. Clean-up, disposal, and repairs following we weather events or spills caused by DESIGN/BUILDER.
5. Implementing and maintaining “best management practices,” as defined in applicable permits.
6. Inspections of storm water, sediment, and erosion controls as required to complete Work.

1.02 SUBMITTALS

A. Informational Submittals:

1. Virginia Stormwater Management Program (VSMP) permit application.
2. VSMP permit.
3. Stormwater inspection reports.
4. Notice of termination.
5. Modified plans shall meet all requirements of the applicable jurisdictions.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 INSPECTIONS AND REPAIRS

A. Perform site inspections and assessments as required by all permit requirements.

B. Cooperate with representatives of authorities having jurisdiction during periodic visits to the Site, and promptly provide information requested by authorities having jurisdiction.

C. Complete required repairs in accordance with permit requirements.

D. Prepare SWPPP revisions and obtain approvals as required when changes in design, construction, operation, or maintenance during construction activities necessitate a modification.

END OF SECTION

SECTION 01 61 00
COMMON PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 DEFINITIONS

A. Products:

1. New items for incorporation in the Work, whether purchased by DESIGN/BUILDER or OWNER for the Project, or taken from previously purchased stock, and may also include existing materials or components required for reuse.
2. Includes the terms material, equipment, machinery, components, subsystem, system, hardware, software, and terms of similar intent and is not intended to change meaning of such other terms used in Contract Documents, as those terms are self-explanatory and have well recognized meanings in construction industry.
3. Items identified by manufacturer's product name, including make or model designation, indicated in manufacturer's published product literature, that is current as of the date of the Contract Documents.

1.02 PREPARATION FOR SHIPMENT

A. When practical, factory assemble products. Mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable protective coating.

B. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate its purchase order number, bill of lading number, contents by name, name of Project and DESIGN/BUILDER, equipment number, and approximate weight. Include complete packing list and bill of materials with each shipment.

C. Extra Materials, Special Tools, Test Equipment, and Expendables:

1. Furnish in accordance with manufacturers' recommendations.
2. Schedule:
   a. Ensure that shipment and delivery occurs concurrent with shipment of associated equipment.
   b. Transfer to OWNER shall occur immediately subsequent to DESIGN/BUILDER's acceptance of equipment from supplier.
3. Packaging and Shipment:
   a. Package and ship extra materials and special tools to avoid damage during long term storage in original cartons insofar as

possible, or in appropriately sized, hinged-cover, wood, plastic, or metal box.

b. Prominently displayed on each package, the following:
   1) Manufacturer's part nomenclature and number, consistent with operation and maintenance manual identification system.
   2) Applicable equipment description.
   3) Quantity of parts in package.
   4) Equipment manufacturer.

4. Replace extra materials and special tools found to be damaged or otherwise inoperable at time of transfer to OWNER.

D. Request a minimum 7-day advance notice of shipment from manufacturer.

E. Factory Test Results: Reviewed and accepted by OWNER's consultant before product shipment as required in individual Specification sections.

1.03 DELIVERY AND INSPECTION

A. Deliver products in accordance with accepted current progress schedule and coordinate to avoid conflict with the Work and conditions at Site. Deliver anchor bolts and templates sufficiently early to permit setting prior to placement of structural concrete.

B. Deliver products in undamaged condition, in manufacturer's original container or packaging, with identifying labels intact and legible. Include on label, date of manufacture and shelf life, where applicable.

C. Unload products in accordance with manufacturer's instructions for unloading or as specified. Record receipt of products at Site. Promptly inspect for completeness and evidence of damage during shipment.

D. Remove damaged products from Site and expedite delivery of identical new undamaged products, and remedy incomplete or lost products to provide that specified, so as not to delay progress of the Work.

1.04 HANDLING, STORAGE, AND PROTECTION

A. Handle and store products in accordance with manufacturer's written instructions and in a manner to prevent damage. Store in approved storage yards or sheds provided in accordance with Section 01 50 00, Temporary Facilities and Controls. Provide manufacturer's recommended maintenance during storage, installation, and until products are accepted for use by OWNER.

B. Manufacturer's instructions for material requiring special handling, storage, or protection shall be provided prior to delivery of material.

C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to ensure that products are maintained under specified conditions, and free from damage or deterioration. Keep running account of products in storage to facilitate inspection and to estimate progress payments for products delivered, but not installed in the Work.

D. Store electrical, instrumentation, and control products, and equipment with bearings in weather-tight structures maintained above 60 degrees F. Protect electrical, instrumentation, and control products, and insulate against moisture, water, and dust damage. Connect and operate continuously space heaters furnished in electrical equipment.

E. Store fabricated products above ground on blocking or skids, and prevent soiling or staining. Store loose granular materials in well-drained area on solid surface to prevent mixing with foreign matter. Cover products that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.

F. Store finished products that are ready for installation in dry and well-ventilated areas. Do not subject to extreme changes in temperature or humidity.

G. After installation, provide coverings to protect products from damage due to traffic and construction operations. Remove coverings when no longer needed.

H. Hazardous Materials: Prevent contamination of personnel, storage area, and Site. Meet requirements of product specification, codes, and manufacturer's instructions.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide manufacturer's standard materials suitable for service conditions, unless otherwise specified in the individual Specifications.

B. Where product specifications include a named manufacturer, with or without model number, and also include performance requirements, named manufacturer's products must meet the performance specifications.

C. Like items of products furnished and installed in the Work shall be end products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, manufacturer's services, and implement same or similar process instrumentation and control functions in same or similar manner.

D. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.

E. Provide interchangeable components of the same manufacturer, for similar components, unless otherwise specified.

F. Equipment, Components, Systems, and Subsystems: Design and manufacture with due regard for health and safety of operation, maintenance, and accessibility, durability of parts, and shall comply with applicable OSHA, state, and local health and safety regulations.

G. Regulatory Requirement: Coating materials shall meet federal, state, and local requirements limiting the emission of volatile organic compounds and for worker exposure.

H. Safety Guards: Provide for all belt or chain drives, fan blades, couplings, or other moving or rotary parts. Cover rotating part on all sides. Design for easy installation and removal. Use 16-gauge or heavier; galvanized steel, aluminum coated steel, or galvanized or aluminum coated 1/2-inch mesh expanded steel. Provide galvanized steel accessories and supports, including bolts. For outdoors application, prevent entrance of rain and dripping water.

I. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

J. Special Tools and Accessories: Furnish to OWNER, upon acceptance of equipment, all accessories required to place each item of equipment in full operation. These accessory items include, but are not limited to, adequate oil and grease (as required for first lubrication of equipment after field testing), light bulbs, fuses, hydrant wrenches, valve keys, handwheels, chain operators, special tools, and other spare parts as required for maintenance.

K. Lubricant: Provide initial lubricant recommended by equipment manufacturer in sufficient quantity to fill lubricant reservoirs and to replace consumption during testing, startup, and operation until final acceptance by OWNER.

L. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by

manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 FABRICATION AND MANUFACTURE

A. General:

1. Manufacture parts to U.S.A. standard sizes and gauges.
2. Two or more items of the same type shall be identical, by the same manufacturer, and interchangeable.
3. Design structural members for anticipated shock and vibratory loads.
4. Use 1/4-inch minimum thickness for steel that will be submerged, wholly or partially, during normal operation.
5. Modify standard products as necessary to meet performance Specifications.

B. Lubrication System:

1. Require no more than weekly attention during continuous operation.
2. Convenient and accessible; oil drains with bronze or stainless steel valves and fill-plugs easily accessible from the normal operating area or platform. Locate drains to allow convenient collection of oil during oil changes without removing equipment from its installed position.
3. Provide constant-level oilers or oil level indicators for oil lubrication systems.
4. For grease type bearings, which are not easily accessible, provide and install stainless steel tubing; protect and extend tubing to convenient location with suitable grease fitting.

2.03 SOURCE QUALITY CONTROL

A. Calibration Instruments: Bear the seal of a reputable laboratory certifying instrument has been calibrated within the previous 12 months to a standard endorsed by the National Institute of Standards and Technology (NIST).

B. Factory Tests: Perform in accordance with accepted test procedures and document successful completion.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspect materials and equipment for signs of pitting, rust decay, or other deleterious effects of storage. Do not install material or equipment showing such effects. Remove damaged material or equipment from the Site and expedite delivery of identical new material or equipment. Delays to the Work resulting from material or equipment damage that necessitates procurement of new products will be considered delays within DESIGN/BUILDER's control.

3.02 INSTALLATION

A. No shimming between machined surfaces is allowed.

B. Install the Work in accordance with NECA Standard of Installation, unless otherwise specified.

C. Repaint painted surfaces that are damaged prior to equipment acceptance.

D. Handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's instructions, and as may be specified. Retain a copy of manufacturers' instruction at Site, available for review at all times.

3.03 FIELD FINISHING

A. In accordance with HRSD Coatings Manual, latest edition.

3.04 ADJUSTMENT AND CLEANING

A. Perform required adjustments, tests, operation checks, and other startup activities.

3.05 LUBRICANTS

A. Fill lubricant reservoirs and replace consumption during testing, startup, and operation prior to acceptance of equipment by OWNER.

END OF SECTION

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Submit prior to application for final payment.
   a. Record Documents: As required in General Conditions.
   b. Approved Shop Drawings and Samples: As required in the General Conditions.
   c. Special bonds, special guarantees, and service agreements.
   d. Consent of Surety to Final Payment: As required in General Conditions.
   e. Releases or Waivers of Liens and Claims: As required in General Conditions.
   f. Releases from agreements.
   g. Final Application for Payment: Submit in accordance with procedures and requirements stated in Section 01 29 00, Payment Procedures.
   h. Extra Materials: As required by individual Specification sections.

1.02 RECORD DOCUMENTS

A. Quality Assurance:

1. Furnish qualified and experienced person, whose duty and responsibility shall be to maintain record documents.
2. Accuracy of Records:
   a. Coordinate changes within record documents, making legible and accurate entries on each sheet of Drawings and other documents where such entry is required to show change.
   b. Purpose of Project record documents is to document factual information regarding aspects of the Work, both concealed and visible, to enable future modification of the Work to proceed without lengthy and expensive Site measurement, investigation, and examination.
3. Make entries within 24 hours after receipt of information that a change in the Work has occurred.
4. Prior to submitting each request for progress payment, request OWNER's consultant's review and approval of current status of record documents. Failure to properly maintain, update, and submit record documents may result in a deferral by OWNER's consultant to

recommend whole or any part of DESIGN/BUILDER's Application for Payment, either partial or final.

1.03 RELEASES FROM AGREEMENTS

A. Furnish OWNER written releases from property owners or public agencies where side agreements or special easements have been made, or where DESIGN/BUILDER's operations have not been kept within the OWNER's construction right-of-way.

B. In the event DESIGN/BUILDER is unable to secure written releases:

1. Inform OWNER of the reasons.
2. OWNER or its representatives will examine the Site, and OWNER will direct DESIGN/BUILDER to complete the Work that may be necessary to satisfy terms of the side agreement or special easement.
3. Should DESIGN/BUILDER refuse to perform this Work, OWNER reserves right to have it done by separate contract and deduct cost of same from Contract Price, or require DESIGN/BUILDER to furnish a satisfactory bond in a sum to cover legal Claims for damages.
4. When OWNER is satisfied that the Work has been completed in agreement with Contract Documents and terms of side agreement or special easement, right is reserved to waive requirement for written release if: (i) DESIGN/BUILDER's failure to obtain such statement is due to grantor's refusal to sign, and this refusal is not based upon any legitimate Claims that DESIGN/BUILDER has failed to fulfill terms of side agreement or special easement, or (ii) DESIGN/BUILDER is unable to contact or has had undue hardship in contacting grantor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 MAINTENANCE OF RECORD DOCUMENTS

A. General:

1. DESIGN/BUILDER shall maintain a complete set of design documents on Site and prepare updates during the course of the construction period.
2. Label or stamp each record document with title, "RECORD DOCUMENTS," in neat large printed letters.
3. Record information concurrently with construction progress and within 24 hours after receipt of information that change has occurred. Do not cover or conceal Work until required information is recorded.
4. DESIGN/BUILDER shall prepare and submit interim Record Drawings in accordance with HRSD Standards and Preferences, latest edition immediately prior to submitting request for Substantial Completion.

5. DESIGN/BUILDER shall prepare and submit final Record Drawings in accordance with HRSD Standards and Preferences, latest edition prior to request for final payment.

B. Preservation:

1. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
2. Make documents and samples available at all times for observation by OWNER's consultant.

C. Making Entries on Drawings:

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required.
   a. Color Coding:
      1) Green when showing information deleted from Drawings.
      2) Red when showing information added to Drawings.
      3) Blue and circled in blue to show notes.
2. Date entries.
3. Call attention to entry by "cloud" drawn around area or areas affected.
4. Legibly mark to record actual changes made during construction, including, but not limited to:
   a. Depths of various elements of foundation in relation to finished first floor data if not shown or where depth differs from that shown.
   b. Horizontal and vertical locations of existing and new underground facilities and appurtenances, and other underground structures, equipment, or Work. Reference to at least two measurements to permanent surface improvements.
   c. Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.
   d. Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.
   e. Changes made by Addenda and Field Orders, Work Change Directive, Change Order, and OWNER's consultant's written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number.
5. Dimensions on Schematic Layouts: Show on record drawings, by dimension, the centerline of each run of items such as are described in previous subparagraph above.
   a. Clearly identify the item by accurate note such as "cast iron drain," "galv. water," and the like.

b. Show, by symbol or note, vertical location of item ("under slab," "in ceiling plenum," "exposed," and the like).
c. Make identification so descriptive that it may be related reliably to Specifications.

3.02 FINAL CLEANING

A. At completion of the Work or of a part thereof and immediately prior to DESIGN/BUILDER's request for certificate of Substantial Completion; or if no certificate is issued, immediately prior to DESIGN/BUILDER's notice of completion, clean entire Site or parts thereof, as applicable.

1. Leave the Work and adjacent areas affected in a cleaned condition satisfactory to OWNER.
2. Remove grease, dirt, dust, paint or plaster splatter, stains, labels, fingerprints, and other foreign materials from exposed surfaces.
3. Repair, patch, and touch up marred surfaces to specified finish and match adjacent surfaces.
4. Clean all windows.
5. Clean and wax wood, vinyl, or painted floors.
6. Broom clean exterior paved driveways and parking areas.
7. Hose clean sidewalks, loading areas, and others contiguous with principal structures.
8. Rake clean all other surfaces.
9. Remove snow and ice from access to buildings.
10. Replace air-handling filters and clean ducts, blowers, and coils of ventilation units operated during construction.
11. Leave water courses, gutters, and ditches open and clean.

B. Use only cleaning materials recommended by manufacturer of surfaces to be cleaned.

END OF SECTION

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Detailed information for the preparation, submission, and Engineer's review of operation and maintenance (O&M) data, as required by individual Specification sections.

1.02 DEFINITIONS

A. Preliminary Data: Initial and subsequent submissions for OWNER's review.

B. Final Data: OWNER-accepted data, submitted as specified herein.

1.03 SEQUENCING AND SCHEDULING

A. Equipment and System Data:

1. Preliminary Data:
   a. Do not submit until Shop Drawing for equipment or system has been reviewed and approved by OWNER or OWNER's consultant.
   b. Submit prior to shipment date.
2. Final Data: Submit instructional manual formatted data not less than 30 days prior to equipment or system field functional testing.

B. Materials and Finishes Data:

1. Preliminary Data: Submit at least 15 days prior to request for final inspection.
2. Final Data: Submit within 10 days after final inspection.

1.04 DATA FORMAT

A. Prepare preliminary and final data in the form of electronic media.

B. Electronic Media Format:

1. Portable Document Format (PDF):
   a. After all preliminary data has been found to be acceptable to OWNER, submit O&M data in PDF format on CD.
   b. Files to be exact duplicates of accepted preliminary data. Arrange by specification number and name.

c. Files to be fully functional and viewable in most recent version of Adobe Acrobat.

1.05 SUBMITTALS

A. Informational:

1. Data Outline: Submit electronic copy of a detailed outline of proposed organization and contents of final data prior to preparation of preliminary data.
2. Preliminary Data: Submit electronically.
3. Final Data: Submit one electronic copy in the format specified herein.

1.06 DATA FOR EQUIPMENT AND SYSTEMS

A. Content for Each Unit (or Common Units) and System:

1. Product Data:
   a. Include only those sheets that are pertinent to specific product.
   b. Clearly annotate each sheet to:
      1) Identify specific product or part installed.
      2) Identify data applicable to installation.
      3) Delete references to inapplicable information.
   c. Function, normal operating characteristics, and limiting conditions.
   d. Performance curves, engineering data, nameplate data, and tests.
   e. Complete nomenclature and commercial number of replaceable parts.
   f. Original manufacturer’s parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.
   g. Spare parts ordering instructions.
   h. Where applicable, identify installed spares and other provisions for future work (e.g., reserved panel space, unused components, wiring, terminals).
2. As-installed, color-coded piping diagrams.
3. Charts of valve tag numbers, with the location and function of each valve.
4. Drawings: Supplement product data with Drawings as necessary to clearly illustrate:
   a. Format:
      1) Provide reinforced, punched, binder tab; bind in with text.
      2) Reduced to 8-1/2 inches by 11 inches, or 11 inches by 17 inches folded to 8-1/2 inches by 11 inches.
      3) Where reduction is impractical, fold and place in 8-1/2-inch by 11-inch envelopes bound in text.

4) Identify Specification section and product on Drawings and envelopes.

b. Relations of component parts of equipment and systems.

c. Control and flow diagrams.

d. Coordinate drawings with Project record documents to assure correct illustration of completed installation.

5. Instructions and Procedures: Within text, as required to supplement product data.

a. Format:

1) Organize in consistent format under separate heading for each different procedure.

2) Provide logical sequence of instructions for each procedure.

3) Provide information sheet for OWNER's personnel, including:

a) Proper procedures in event of failure.

b) Instances that might affect validity of guarantee or bond.

b. Installation Instructions: Including alignment, adjusting, calibrating, and checking.

c. Operating Procedures:

1) Startup, break-in, routine, and normal operating instructions.

2) Test procedures and results of factory tests where required.

3) Regulation, control, stopping, and emergency instructions.

4) Description of operation sequence by control manufacturer.

5) Shutdown instructions for both short and extended duration.

6) Summer and winter operating instructions, as applicable.

7) Safety precautions.

8) Special operating instructions.

d. Maintenance and Overhaul Procedures:

1) Routine maintenance.

2) Guide to troubleshooting.

3) Disassembly, removal, repair, reinstallation, and re-assembly.

6. Guarantee, Bond, and Service Agreement: In accordance with Section 01 77 00, Closeout Procedures.

B. Content for Each Electric or Electronic Item or System:

1. Description of Unit and Component Parts:

a. Function, normal operating characteristics, and limiting conditions.

b. Performance curves, engineering data, nameplate data, and tests.

c. Complete nomenclature and commercial number of replaceable parts.

d. Interconnection wiring diagrams, including control and lighting systems.

2. Circuit Directories of Panelboards:
    a. Electrical service.
    b. Control requirements and interfaces.
    c. Communication requirements and interfaces.
    d. List of electrical relay settings, and control and alarm contact settings.
3. Electrical interconnection wiring diagram, including as applicable, single-line, three-line, schematic and internal wiring, and external interconnection wiring.
4. As-installed control diagrams by control manufacturer.
5. Operating Procedures:
    a. Routine and normal operating instructions.
    b. Startup and shutdown sequences, normal and emergency.
    c. Safety precautions.
    d. Special operating instructions.
6. Maintenance Procedures:
    a. Routine maintenance.
    b. Guide to troubleshooting.
    c. Adjustment and checking.
    d. List of relay settings, control and alarm contact settings.
7. Manufacturer's printed operating and maintenance instructions.
8. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

C. Maintenance Summary:

1. Compile individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components or sub-units.
2. Format:
    a. Use Maintenance Summary Form bound with this section or electronic facsimile of such.
    b. Each Maintenance Summary may take as many pages as required.
    c. Use only 8-1/2-inch by 11-inch size paper.
    d. Complete using typewriter or electronic printing.
3. Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.
4. Recommended Spare Parts:
    a. Data to be consistent with manufacturer's Bill of Materials/Parts List furnished in O&M manuals.
    b. "Unit" is the unit of measure for ordering the part.
    c. "Quantity" is the number of units recommended.
    d. "Unit Cost" is the current purchase price.

1.07 DATA FOR MATERIALS AND FINISHES

A. Content for Architectural Products, Applied Materials, and Finishes:

1. Manufacturer's data, giving full information on products:
   a. Catalog number, size, and composition.
   b. Color and texture designations.
   c. Information required for reordering special-manufactured products.
2. Instructions for Care and Maintenance:
   a. Manufacturer's recommendation for types of cleaning agents and methods.
   b. Cautions against cleaning agents and methods that are detrimental to product.
   c. Recommended schedule for cleaning and maintenance.

B. Content for Moisture Protection and Weather Exposed Products:

1. Manufacturer's data, giving full information on products:
   a. Applicable standards.
   b. Chemical composition.
   c. Details of installation.
2. Instructions for inspection, maintenance, and repair.

1.08 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are part of this Specification.

1. Equipment Maintenance Data Summary
2. Lubrication Summary

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

Equipment Record

EXHIBIT C1

Equipment Maintenance Data Summary

*Project Name:				Page No.		of	
*Equip. Description		*Date Installed		*Date Started			
*Equip. Location		*Cost		*Estimated Life			
Project Equip. Tag No.		*Shop Dwg Trans No.		*Spec Sec.			
*Equip. Manufacturer							
Manuf. Address				Phone Number			
Local Vendor							
Vendor Address				Phone Number			

*BREAK-IN MAINTENANCE REQUIREMENT (INITIAL OIL CHANGES, ETC.)	D	W	M	Q	S	A	Hours

*PREVENTIVE MAINTENANCE REQUIREMENTS	D	W	M	Q	S	A	Hours

*RECOMMENDED SPARE PARTS			
Part No.	Part Name	Quantity	Cost

*ELECTRICAL NAMEPLATE DATA							
Equip.							
Make							
Serial No.				ID No.			
Model No.				Frame No.			
HP		V.		Amp.		HZ	
PH		RPM		SF		Duty	
Code		Ins. Cl.		Des		Type	
Nema		C. Amb.		Temp Rise		Rating	
Misc.							

*MECHANICAL NAMEPLATE DATA						
Equip.						
Make						
Serial No.			ID No.			
Model No.			Frame No.			
HP		RPM		Cap.		Size	
TDH		IMP. Sz.		Des		CFM	
PSI		Assy. No.		Case No.		
Misc.						
Lubrication information on the following page						

Equipment Record

EXHIBIT C2

Lubrication Summary

Equipment Description		Project Equip. Tag No.		Page		of	

Lubricant Point	

Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point	

Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point	

Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point	

Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point	

Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

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SECTION 01 78 40
POST-FINAL INSPECTION

PART 1 GENERAL

1.01 DESCRIPTION

A. Approximately 1 year after Substantial Completion, OWNER's consultant will schedule with OWNER and DESIGN/BUILDER the post-final inspection and will send a written notice to OWNER and DESIGN/BUILDER advising of date and time for post-final inspection.

B. DESIGN/BUILDER'S project manager shall attend the post-final inspection.

C. After post-final inspection, OWNER's consultant will furnish to DESIGN/BUILDER a list of required correction Work that shall be completed by DESIGN/BUILDER. {Addendum No. 1}

{ADDENDUM NO. 1}PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 91 14
EQUIPMENT TESTING AND FACILITY STARTUP

PART 1 GENERAL

1.01 DEFINITIONS

A. Facility: Entire Project, or an agreed-upon portion, including all of its unit processes.

B. Functional Test: Test or tests in presence of OWNER's consultant and OWNER to demonstrate that installed equipment meets manufacturer's installation, calibration, and adjustment requirements and other requirements as specified.

C. Performance Test: Test or tests performed after any required functional test in presence of OWNER's consultant and OWNER to demonstrate and confirm individual equipment meets performance requirements. {Addendum No. 1}

D. Unit Process: As used in this section, a unit process is a portion of the facility that performs a specific process function.

E. Facility Performance Demonstration:

1. A demonstration, conducted by DESIGN/BUILDER, with assistance of OWNER, to demonstrate and document the performance of the entire operating facility, both manually and automatically (if required), based on criteria developed in conjunction with OWNER.
2. Such demonstration is for the purposes of (i) verifying to OWNER entire facility performs as a whole, (ii) demonstrating that the facility can meet design flow and pressure (hydraulic) requirements, and (iii) documenting performance characteristics of completed facility for OWNER's records.
{Addendum No. 1}

1.02 SUBMITTALS

A. Informational Submittals:

1. Facility startup and performance demonstration plan.
2. Functional and performance test results.
3. Completed Unit Process Startup Form for each unit process.
4. Completed Facility Performance Demonstration/Certification Form.

1.03 FACILITY STARTUP AND PERFORMANCE DEMONSTRATION PLAN

A. Develop a written plan, to include the following: {Addendum No. 1}

1. Step-by-step instructions for startup of each unit process and the complete facility.
2. Unit Process Startup Form (sample attached), to minimally include the following:
   a. Description of the unit process, including equipment numbers/nomenclature of each item of equipment and all included devices.
   b. Detailed procedure for startup of the unit process, including valves to be opened/closed, order of equipment startup, etc.
   c. Startup requirements for each unit process, including water, power, chemicals, etc.
   d. Space for evaluation comments.
3. Facility Performance Demonstration/Certification Form (sample attached), to minimally include the following:
   a. Description of unit processes included in the facility startup.
   b. Sequence of unit process startup to achieve facility startup.
   c. Description of computerized operations, if any, included in the facility.
   d. DESIGN/BUILDER certification facility is capable of performing its intended function(s), including fully automatic operation.
   e. Signature spaces for DESIGN/BUILDER and OWNER's consultant.
4. Coordination with OWNER's sampling efforts. {Addendum No. 1}

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Facility Startup Meetings: Schedule, in accordance with requirements of Section 01 31 19, Project Meetings, to discuss test schedule, test methods, materials, chemicals and liquids required, facilities operations interface, and OWNER involvement.

B. DESIGN/BUILDER's Testing and Startup Representative:

1. Designate and furnish one or more personnel to coordinate and expedite testing and facility startup.
2. Representative(s) shall be present during startup meetings and shall be available at all times during testing and startup.

C. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required for testing and startup.

D. Provide labor and materials required for laboratory analyses.

E. Provide subcontractor and equipment manufacturers' staff adequate to prevent delays. Schedule ongoing work so as not to interfere with or delay testing and startup.

F. OWNER will:

1. Provide water, power, chemicals, and other items as required for startup, unless otherwise indicated.
2. Witness and support activities of DESIGN/BUILDER.

3.02 {ADDENDUM NO. 1}EQUIPMENT TESTING

A. Preparation:

1. Complete installation before testing.
2. Furnish qualified manufacturers' representatives.
3. Equipment Test Report Form: Provide written test report for each item of equipment to be tested, to include the minimum information:
   a. OWNER/Project name.
   b. Equipment or item tested.
   c. Date and time of test.
   d. Type of test performed (functional or performance).
   e. Test method.
   f. Test conditions.
   g. Test results.
   h. Signature spaces for DESIGN/BUILDER and OWNER's consultant as witness.
4. Cleaning and Checking: Prior to beginning functional testing:
   a. Calibrate testing equipment in accordance with manufacturer's instructions.
   b. Inspect and clean equipment, devices, connected piping, and structures to ensure they are free of foreign material.
   c. Lubricate equipment in accordance with manufacturer's instructions.
   d. Turn rotating equipment by hand when possible to confirm that equipment is not bound.
   e. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
   f. Check power supply to electric-powered equipment for correct voltage.

g. Adjust clearances and torque.
h. Test piping for leaks.

5. Ready-to-test determination will be by OWNER's consultant based at least on the following:
   a. Acceptable operation and maintenance data.
   b. Notification by DESIGN/BUILDER of equipment readiness for testing.
   c. Adequate completion of work adjacent to, or interfacing with, equipment to be tested.
   d. Availability and acceptability of manufacturer's representative, when specified, to assist in testing of respective equipment.
   e. Satisfactory fulfillment of other specified manufacturer's responsibilities.
   f. Equipment and electrical tagging complete.
   g. Delivery of all spare parts and special tools.

B. Functional Testing:

1. Conduct in accordance with manufacturer's recommendations.
2. Notify OWNER and OWNER's consultant in writing at least 10 days prior to scheduled date of testing.
3. Prepare equipment test report summarizing test method and results.
4. When, in OWNER's consultant's opinion, equipment meets functional requirements specified, such equipment will be accepted for purposes of advancing to performance testing phase, if so required by individual Specification sections. Such acceptance will be evidenced by OWNER's consultant/OWNER's signature as witness on equipment test report.

C. Performance Testing:

1. Conduct in accordance with manufacturer's recommendations to demonstrate performance parameters designated.
2. Notify OWNER's consultant and OWNER in writing at least 10 days prior to scheduled date of test.
3. Performance testing shall not commence until equipment has been accepted by OWNER's consultant as having satisfied functional test requirements specified.
4. Type of fluid, gas, or solid for testing shall be as specified.
5. Unless otherwise indicated, furnish labor, materials, and supplies for conducting the test and taking samples and performance measurements.
6. Prepare equipment test report summarizing test method and results.
7. When, in OWNER's consultant's opinion, equipment meets performance requirements specified, such equipment will be accepted as to conforming to Contract requirements. Such acceptance will be

evidenced by OWNER's consultant's signature on equipment test report.

3.03 STARTUP OF UNIT PROCESSES

A. Prior to unit process startup, equipment within unit process shall be accepted by OWNER's consultant as having met functional and performance testing requirements specified.

B. Make adjustments, repairs, and corrections necessary to complete unit process startup.

C. Demonstrate that package equipment is performing as intended and that instrumentation and controls are operating.

3.04 FACILITY PERFORMANCE DEMONSTRATION

A. When, in the opinion of OWNER's consultant, startup of all unit processes has been achieved, sequence each unit process to the point that facility is operational.

B. Demonstrate proper operation of required interfaces within and between individual unit processes.

C. Facility performance demonstration shall be considered complete when, in opinion of OWNER's consultant, the facility has operated in manner intended for 7 continuous days without significant interruption. This period is in addition to functional or performance test periods specified elsewhere.

D. Significant Interruption: May include any of the following events:

1. Failure of DESIGN/BUILDER to provide and maintain qualified onsite startup personnel as scheduled.
2. Failure to meet specified functional operation for more than 2 consecutive hours.
3. Failure of any critical equipment or unit process that is not satisfactorily corrected within 2 hours after failure.
4. Failure of any noncritical equipment or unit process that is not satisfactorily corrected within 8 hours after failure.
5. As determined by OWNER's consultant.

E. A significant interruption will require startup then in progress to be stopped. After corrections are made, startup test period to start from beginning again.

F. After facility is operating, complete performance testing of equipment and systems not previously tested.

G. Document, as defined in Facility Startup and Performance Demonstration Plan, the performance of the facility including its integrated control system, until all unit processes are operable and under control of the integrated control system.

H. Certify, on the Facility Performance Demonstration/Certification Form, that facility is capable of performing its intended function(s), including fully automatic operation.

3.05 SUPPLEMENTS

A. Supplements listed below, following "End of Section," are a part of this Specification:

1. Unit Process Startup Form.
2. Facility Performance Demonstration/Certification Form.

END OF SECTION

UNIT PROCESS STARTUP FORM

OWNER: _____ **PROJECT:** _____

Unit Process Description: (Include description and equipment number of all equipment and devices):

_____

_____

_____

_____

Startup Procedure (Describe procedure for sequential startup and evaluation, including valves to be opened/closed, order of equipment startup, etc.):

_____

_____

_____

_____

_____

Startup Requirements (Water, power, chemicals, etc.): _____

_____

_____

Evaluation Comments: _____

_____

_____

_____

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FACILITY PERFORMANCE DEMONSTRATION/CERTIFICATION FORM

OWNER:_____ **PROJECT:**_____

Unit Processes Description (List unit processes involved in facility startup):

_____

_____

_____

_____

Unit Processes Startup Sequence (Describe sequence for startup, including computerized operations, if any):

_____

_____

_____

_____

_____

DESIGN/BUILDER Certification that Facility is capable of performing its intended function(s), including fully automatic operation:

DESIGN/BUILDER: _____ **Date:** _____**, 20____**

OWNER's Consultant: _____ **Date:** _____**, 20____**
(Authorized Signature)

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SECTION 02050

DEMOLITION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Design/Builder shall furnish all labor, materials and equipment in accordance with the requirements of Section 01 15 20 - Maintenance of Facility Operations.

B. In addition, the Design/Builder shall demolish and remove all concrete and asphaltic paving, curbs, sidewalk, and miscellaneous yard structures as required and shown on the Contract Drawings during the construction work.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 15 20 - Maintenance of Facility Operations

B. Section 01 33 00 – Submittal Procedures

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. References shall be in accordance with reference standards, codes, and specifications as set forth herein and in Section 02100 - Clearing, Grubbing, and Site Preparation.

PART 2 -- EXECUTION

2.01 DEMOLITION

A. Existing concrete and asphaltic paving, curbs, sidewalk and miscellaneous yard structures within the areas designated for new construction work shall be completely demolished and all debris removed from the site.

B. Excavation caused by demolition shall be backfilled with fill free from rubbish and debris.

C. Work shall be performed in such manner as not to endanger the safety of the workmen or the public or cause damage to nearby structures.

D. Provide all barriers and precautionary measures in accordance with Owner's requirements and other authorities having jurisdiction.

E. Where parts of existing structures or pavements are to remain in service, demolish the portions to be removed, repair damage, and leave the structure or pavement in proper condition for the intended use. Remove concrete, asphalt, and masonry to the lines designated by drilling, chipping, or other suitable methods. Leave the resulting surfaces reasonably true and even, with sharp straight corners that will result in neat joints with new construction and be satisfactory for the purpose intended. Where existing reinforcing rods

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are to extend into new construction, remove the concrete so that the reinforcing is clean and undamaged. Cut off other reinforcing 1/2-inch below the surface and fill with epoxy resin binder flush with the surface.

F. Prior to the execution of the work, the Design/Builder, Owner and Engineer shall jointly survey the condition of the adjoining and/or nearby structures and pavements. Photographs and records shall be made of any prior settlement or cracking of structures, pavements, and the like, that may become the subject of possible damage claims.

2.02 DISPOSAL OF MATERIAL

A. All debris resulting from the demolition and removal work shall be disposed of by the Design/Builder as part of the work of this Contract. Material designated by the Owner to be salvaged shall be stored on the construction site as directed. All other material shall be disposed of off site at a properly permitted facility by the Design/Builder at his expense.

B. Burning of any debris resulting from the demolition will not be permitted at the site.

- END OF SECTION -

SECTION 02100

CLEARING, GRUBBING, AND SITE PREPARATION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Includes all labor, material, equipment and appliances required for the complete execution of any additions, modifications, or alterations to existing building(s) and new construction work as shown on the Drawings and specified herein.

B. Principal items of work include:

1. Notifying all authorities owning utility lines running to or on the property. Protecting and maintaining all utility lines to remain and capping those that are not required in accordance with instructions of the Utility Companies, and all other authorities having jurisdiction.

2. Clearing the site within the Limits of Disturbance, including removal of grass, brush, shrubs, trees, loose debris and other encumbrances except for trees marked to remain.

3. Boxing and protecting all trees, shrubs, lawns and the like within areas to be preserved. Relocating trees and shrubs, so indicated on the Drawings, to designated areas.

4. Repairing all injury to trees, shrubs, and other plants caused by site preparation operations shall be repaired immediately. Work shall be done by qualified personnel in accordance with standard horticultural practice and as approved by the Engineer.

5. Removing topsoil to its full depth from designated areas and stockpiling on site where directed by the Owner for future use.

6. Disposing from the site all debris resulting from work under this Section in a properly permitted facility.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02200 - Earthwork

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Virginia Administrative Code, Title 9, Agency 15.

1.04 STREET AND ROAD BLOCKAGE

A. Closing of streets and roads during progress of the work shall be in compliance with the requirements of the Owner and other authorities having jurisdiction. Access shall be provided to all facilities remaining in operation.

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1.05 PROTECTION OF PERSONS AND PROPERTY

A. All work shall be performed in such a manner to protect all personnel, workmen, pedestrians and adjacent property and structures from possible injury and damage.

B. All conduits, wires, cables and appurtenances above or below ground shall be protected from damage.

C. Provide warning and barrier fence where shown on the Drawings and as specified herein.

PART 2 -- EXECUTION

2.01 CLEARING OF SITE

A. Before removal of topsoil, and start of excavation and grading operations, the areas within the clearing limits shall be cleared and grubbed.

B. Clearing shall consist of cutting, removal, and satisfactory disposal of all trees, fallen timber, brush, bushes, rubbish, sanitary landfill material, fencing, and other perishable and objectionable material within the areas to be excavated or other designated areas. Should it become necessary to remove a tree, bush, brush or other plants adjacent to the area to be excavated, the Design/Builder shall do so only after permission has been granted by the Owner.

C. Excavation resulting from the removal of trees, roots and the like shall be filled with suitable material, as approved by the Engineer, and thoroughly compacted per the requirements contained in Section 02200 - Earthwork.

D. Unless otherwise shown or specified, the Design/Builder shall. clear and grub a strip at least 15 ft. wide along all permanent fence lines installed under this Contract.

E. In temporary construction easement locations, only those trees and shrubs shall be removed which are in actual interference with excavation or grading work under this Contract, and removal shall be subject to approval by the Owner.

2.02 STRIPPING AND STOCKPILING EXISTING TOPSOIL

A. Existing topsoil and sod on the site within areas designated on the Drawings shall be stripped to whatever depth it may occur, and stored in locations directed by the Owner.

B. The topsoil shall be free of stones, roots, brush, rubbish, or other unsuitable materials before stockpiling the topsoil.

C. Care shall be taken not to contaminate the stockpiled topsoil with any unsuitable materials.

2.03 GRUBBING

A. Grubbing shall consist of the removal and disposal of all stumps, roots, logs, sticks and other perishable materials to a depth of at least 6-inches below ground surfaces.

B. Large stumps located in areas to be excavated shall be removed during grading operations.

2.04 DISPOSAL OF MATERIAL

A. All debris resulting from the clearing and grubbing work shall be disposed of by the Design/Builder as part of the work of this Contract. Material designated by the Owner to be salvaged shall be stored on the construction site as directed by the Owner for reuse in this Project or removal by others.

B. Burning of any debris resulting from the clearing and grubbing work will not be permitted at the site.

2.05 WARNING AND BARRIER FENCE

A. The fence shall be made of a visible, lightweight, flexible, high strength polyethylene material. The fence shall be Beacon Plus High Visibility Orange Safety Fence as manufactured by TENAX, or equal.

B. Physical Properties

Fence:

Color:	International Orange
Roll Size:	4' x 100'
Roll weight:	12.5 lbs.
Mesh opening:	1-1/2" x 3-1/2"

Posts:

ASTM Designation:	ASTM 702
Length:	5 feet long (T-Type)
Weight:	1.25 #/Foot (min)
Area of Anchor Plate:	14 Sq. In.

C. Drive posts 12 to 18 inches into ground every 10' to 12'. Wrap fence material around first terminal post allowing overlap of one material opening. Use metal tie wire or plastic tie wrap to fasten material to itself at top, middle and bottom. At final post, cut with utility knife or scissors at a point halfway across an opening. Wrap around and tie at final post in the same way as the first post.

D. Use tie wire or tie wrap at intermediate posts and splices as well. Thread ties around a vertical member of the fence material and the post, and bind tightly against the post. For the most secure fastening, tie at top, middle and bottom. Overlap splices a minimum of four fence openings, tie as above, fastening both edges of the fence material splice overlap.

- END OF SECTION -

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SECTION 02200

EARTHWORK

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, equipment and materials required to complete all work associated with excavation, including off-site borrow excavation, dewatering, backfill, drainage layers beneath and around structures, foundation and backfill stone, filter fabric, embankments, stockpiling topsoil and any excess suitable material in designated areas, in place compaction of embankments, backfill and subgrades beneath foundations and roadways, excavation support, disposing from the site all unsuitable materials, providing erosion and sedimentation control grading, site grading and preparation of pavement and structure subgrade, and other related and incidental work as required to complete the work shown on the Drawings and specified herein.

B. All excavations shall be in conformity with the lines, grades, and cross sections shown on the Drawings or established by the Engineer.

C. It is the intent of this Specification that the Design/Builder conduct the construction activities in such a manner that erosion of disturbed areas and off-site sedimentation be absolutely minimized.

D. All work under this Contract shall be done in conformance with and subject to the limitations of the latest editions of the Virginia Department of Transportation 2016 Road and Bridge Specification Book, the Virginia Erosion and Sediment Control Handbook (VESCH), Third Edition, 1999 or latest, and the requirements of the City of Suffolk's Erosion and Sediment Control Program.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements of related work are included in Division 1 and Division 2 of these Specifications.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced Specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Virginia Department of Transportation 2016 Road and Bridge Specification Book.

2. American Society for Testing and Materials (ASTM):

ASTM C 127 Test for Specific Gravity and Absorption of Coarse Aggregate.

ASTM C 136 Test for Sieve Analysis of Fine and Coarse Aggregates.

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ASTM D 422	Particle Size Analysis of Soils.
ASTM D 423	Test for Liquid Limit of Soils.
ASTM D 424	Test for Plastic Limit and Plasticity Index of Soils.
ASTM C 535	Test for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
ASTM D 698	Standard Method of Test for the Moisture - Density Relations of Soils Using a 5.5 lb. (2.5 kg) Rammer and a 12-inch (305 mm) Drop.
ASTM D1556	Test for Density of Soil in Place by the Sand-Cone Method.
ASTM D1557	Test for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10-lbs. (4.5 kg) Rammer and 18-inch (457 mm) Drop.
ASTM D2049	Test Method for Relative Density of Cohesionless Soils.
ASTM D2167	Test for Density of Soil in Place by the Rubber-Balloon Method.
ASTM D2216	Test for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures.
ASTM D2487	Test for Classification of Soils for Engineering Purposes.
ASTM D2922	Test for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

1.04 SUBSURFACE CONDITIONS

A. Information on subsurface conditions is provided in the geotechnical report available to the Design/Builder titled “Report of Subsurface Exploration and Geotechnical Services” and dated March 24, 2017.

B. Attention is directed to the fact that there may be water pipes, storm drains and other utilities located in the area of proposed excavation. Perform all repairs to same in the event that excavation activities disrupt service.

1.05 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, the Design/Builder shall submit the following:

1. Name and location of all material suppliers.

2. Certificate of compliance with the standards specified above for each source of each material.

3. List of disposal sites for waste and unsuitable materials and all required permits for use of those sites.

4. Plans and cross sections of open cut excavations showing side slopes and limits of the excavation at grade.

5. Samples of synthetic filter fabric and reinforced plastic membrane with manufacturer's certificates or catalog cuts stating the mechanical and physical properties. Samples shall be at least one (1) foot wide and four (4) feet long taken across the roll with the warp direction appropriately marked.

6. Construction drawings and structural calculations for any types of excavation support required. Drawings and calculations shall be sealed by a currently registered Professional Engineer in the State of Virginia.

7. Monitoring plan and pre-construction condition inspection and documentation of all adjacent structures, utilities, and roadways near proposed installation of excavation support systems and near areas where dewatering is required to facilitate construction.

8. Dewatering procedures.

1.06 PRODUCT HANDLING

A. Soil and rock material shall be excavated, transported, placed, and stored in a manner so as to prevent contamination, segregation and excessive wetting. Materials which have become contaminated or segregated will not be permitted in the performance of the work and shall be removed from the site.

PART 2 -- PRODUCTS

2.01 SELECT FILL

A. Soils from the excavations meeting requirements stipulated herein with the exceptions of topsoil and organic material may be used as select fill for backfilling, constructing embankments, reconstructing existing embankments, and as structural subgrade support.

B. Select fill used for embankment construction shall be should classified per the Unified Soil Classification System (USCS) as SW, SP, SP-SM, or SM with a maximum of 20 percent fines passing the No. 200 sieve. Soils meeting these criteria may not be available on site.

C. Select fill used for backfilling shall either be material as described in Paragraph B above or a granular soil material with a Maximum Plasticity Index (PI) of 6.

D. Regardless of material used as select fill, materials shall be compacted at a moisture content satisfactory to the Engineer, which shall be approximately that required to produce

the maximum density except that the moisture content shall not be more than 3% below nor more than 3% above the optimum moisture content for the particular material tested in accordance with the ASTM D698.

E. Select fill used as subgrade support shall be a coarse aggregate material meeting the gradation requirements of #57 or #67 aggregates in accordance with ASTM C-33, or Aggregate Base Course (ABC) as defined in Section 02207 – Aggregate Materials.

F. Where excavated material does not meet requirements for select fill, Design/Builder shall furnish off-site borrow material meeting the specified requirements herein.

2.02 TOPSOIL

A. Topsoil shall be considered the surface layer of soil and sod, suitable for use in seeding and planting. It shall contain no mixture of refuse or any material toxic to plant growth.

2.04 GEOTEXTILES

A. The Design/Builder shall provide geotextiles as indicated on the Drawings and specified herein. The materials and placement shall be as indicated under Section 02274 - Geotextiles.

PART 3 -- EXECUTION

3.01 STRIPPING OF TOPSOIL

A. In all areas to be excavated, filled, paved, or graveled the topsoil shall be stripped to its full depth and shall be deposited in storage piles on the site, at locations designated by the Owner, for subsequent reuse. Topsoil shall be kept separated from other excavated materials and shall be piled free of roots and other undesirable materials.

3.02 EXCAVATION

A. All material excavated, regardless of its nature or composition, shall be classified as UNCLASSIFIED EXCAVATION. Excavation shall include the removal of all soil, rock, weathered rock, rocks of all types, boulders, conduits, pipe, and all other obstacles encountered and shown to be removed within the limits of excavation shown on the Drawings or specified herein.

B. All suitable material removed in the excavation shall be used as far as practicable in the formation of embankments, subgrades, and shoulders, and at such other places as may be indicated on the Drawings or indicated by the Owner. No excavation shall be wasted except as may be permitted by the Engineer. Refer to the drawings for specific location and placement of suitable excavated materials in the formation of embankments, backfill, and structural and roadway foundations. THE ENGINEER AND/OR MATERIALS TESTING CONSULTANT WILL DESIGNATE MATERIALS THAT ARE UNSUITABLE. The Design/Builder shall furnish off site disposal areas for the unsuitable material. Where suitable materials containing excessive moisture are encountered above grade in cuts, the Design/Builder shall construct above grade ditch drains prior to the excavation of the cut material when in the opinion of the Engineer and/or materials testing consultant such measures are necessary to provide proper construction.

C. All excavations shall be made in the dry and in such a manner and to such widths as will give ample room for properly constructing and inspecting the structures and/or piping they are to contain and for such excavation support, pumping and drainage as may be required. Excavation shall be made in accordance with the grades and details shown on the Drawings and as specified herein.

D. Excavation slopes shall be flat enough to avoid slides that will cause disturbance of the subgrade or damage of adjacent areas. Excavation requirements and slopes shall be as indicated in the Drawings. The Design/Builder shall intercept and collect surface runoff both at the top and bottom of cut slopes. The intersection of slopes with natural ground surfaces, including the beginning and ending of cut slopes, shall be uniformly rounded as shown on the Drawings or as may be indicated by the Engineer. Concurrent with the excavation of cuts the Design/Builder shall construct intercepting berm ditches or earth berms along and on top of the cut slopes at locations shown on the Drawings or designated by the Engineer. All slopes shall be finished to reasonably uniform surfaces acceptable for seeding and mulching operations. No rock or boulders shall be left in place which protrude more than 1 foot within the typical section cut slope lines, and all rock cuts shall be cleaned of loose and overhanging material. All protruding roots and other objectionable vegetation shall be removed from slopes.

E. It is the intent of these Specifications that all structures shall bear on an aggregate base, crushed stone or screened gravel bedding placed to the thickness shown on the Drawings, specified in these Specifications, or not less than 4-inches. Bedding for process piping shall be as specified in Section 15000 - Basic Mechanical Requirements, or as shown on the Drawings.

F. The bottom of all excavations for structures and pipes shall be examined by the Engineer and/or materials testing consultant for bearing value and the presence of unsuitable material. If, in the opinion of the Engineer and/or materials testing consultant, additional excavation is required due to the low bearing value of the subgrade material, or if the in-place soils are soft, yielding, pumping and wet, the Design/Builder shall remove such material to the required width and depth and replace it with thoroughly compacted select fill, and/or crushed stone or screened gravel as indicated by the Engineer.

G. All cuts shall be brought to the grade and cross section shown on the Drawings, or established by the Engineer, prior to final inspection and acceptance by the Engineer.

H. Slides and overbreaks which occur due to negligence, carelessness or improper construction techniques on the part of the Design/Builder shall be removed and disposed of by the Design/Builder. If grading operations are suspended for any reason whatsoever, partially completed cut and fill slopes shall be brought to the required slope and the work of seeding and mulching or other required erosion and sedimentation control operations shall be performed.

3.03 EXCAVATION SUPPORT

A. The Design/Builder shall furnish, place, and maintain such excavation support which may be required to support sides of excavation or to protect pipes and structures from possible damage and to provide safe working conditions. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he may order additional supports

put in. The Design/Builder shall be responsible for the adequacy of all supports used and for all damage resulting from failure of support system or from placing, maintaining and removing it.

B. Selection of and design of any proposed excavation support systems is exclusively the responsibility of the Design/Builder. Design/Builder shall submit for information only drawings and calculations on proposed systems sealed by a Professional Engineer currently registered in the State of Virginia.

C. The Design/Builder shall exercise caution in the installation and removal of supports to insure that excessive or unusual loadings or vibrations are not transmitted to any new or existing structure. The Design/Builder shall promptly repair at his expense any and all damage that can be reasonably attributed to installation or removal of excavation support system.

D. Design/Builder shall monitor movement and vibration in the excavation support systems as well as movement and vibration at adjacent structures, utilities and roadways near excavation supports. Design/Builder shall submit a monitoring plan developed by the excavation support design engineer. All pre-construction condition assessment and documentation of adjacent structures on-site and off-site shall be performed by the Design/Builder. If any sign of distress such as cracking or movement occurs in any adjacent structure, utility or roadway during installation of supports, subsequent excavation, service period of supports, subsequent backfill and construction, or removal of supports, Owner shall be notified immediately. Design/Builder shall be exclusively responsible for repair of any damage to any roadway, structure, utility, pipes, etc. both on-site and off-site, as a result of his operations.

E. All excavation supports shall be removed upon completion of the work except as indicated herein. The Owner may permit supports to be left in place at the request and expense of the Design/Builder. The Engineer may order certain supports left permanently in place in addition to that required by the Contract. Any excavation supports left in place shall be cut off at least two (2) feet below the finished ground surface or as directed by the Engineer.

3.04 PROTECTION OF SUBGRADE

A. To minimize the disturbance of bearing materials and provide a firm foundation, the Design/Builder shall comply with the following requirements:

1. Use of heavy rubber-tired construction equipment shall not be permitted on the final subgrade unless it can be demonstrated that drawdown of groundwater throughout the entire area of the structure is at least 3 feet below the bottom of the excavation (subgrade). Even then, the use of such equipment shall be prohibited should subgrade disturbance result from concentrated wheel loads.

2. Subgrade soils disturbed through the operations of the Design/Builder shall be excavated and replaced with compacted select fill or crushed stone at the Design/Builder's expense as indicated by the Engineer.

3. The Design/Builder shall provide positive protection against penetration of frost into materials below the bearing level during work in winter months. This protection can consist of a temporary blanket of straw or salt hay covered with a plastic membrane or other acceptable means.

3.05 PROOFROLLING

A. The subgrade of all structures and all areas that will support pavements or select fill shall be proofrolled. After stripping of topsoil, excavation to subgrade and prior to placement of fills, the exposed subgrade shall be carefully inspected by probing and testing as needed. Any topsoil or other organic material still in place, frozen, wet, soft, or loose soil, and other undesirable materials shall be removed. The exposed subgrade shall be proofrolled with a heavily loaded tandem-wheeled dump truck to check for pockets of soft material hidden beneath a thin crust of better soil. Any unsuitable materials thus exposed shall be removed and replaced with an approved compacted material.

3.06 DEWATERING

A. The Design/Builder shall do all dewatering as required for the completion of the work. Procedures for dewatering proposed by the Design/Builder shall be submitted to the Engineer for review. All water removed by dewatering operations shall be disposed of in accordance with the Virginia Erosion and Sediment Control Law.

B. The dewatering system shall be of sufficient size and capacity as required to control groundwater or seepage to permit proper excavation operations, embankment construction and reconstruction, subgrade preparation, and to allow concrete to be placed in a dry condition. The system shall include a sump system or other equipment, appurtenances and other related earthwork necessary for the required control of water. The Design/Builder shall drawdown groundwater to at least 3 feet below the bottom of excavations (subgrade) at all times in order to maintain a dry and undisturbed condition.

C. The Design/Builder shall control, by acceptable means, all water regardless of source. Water shall be controlled and its disposal provided for at each berm, structure, etc. The entire periphery of the excavation areas shall be ditched and diked to prevent water from entering the excavation. The Design/Builder shall be fully responsible for disposal of the water and shall provide all necessary means at no additional expense to the Owner. The Design/Builder shall be solely responsible for proper design, installation, proper operation, maintenance, and any failure of any component of the system.

D. The Design/Builder shall be responsible for and shall repair without cost to the Owner, any damage to work in place and the excavation, including damage to the bottom due to heave and including removal of material and pumping out of the excavated area. The Design/Builder shall be responsible for damages to any other area or structure caused by his failure to maintain and operate the dewatering system proposed and installed by the Design/Builder.

E. The Design/Builder shall take all the steps that he considers necessary to familiarize himself with the surface and subsurface site conditions, and shall obtain the data that is required to analyze the water and soil environment at the site and to assure that the materials used for the dewatering systems will not erode, deteriorate, or clog to the extent that the dewatering systems will not perform properly during the period of dewatering.

F. Prior to the execution of the work, the Design/Builder, Owner and Engineer shall jointly survey the condition of adjoining structures. Photographs and records shall be made of any

prior settlement or cracking of structures, pavements, and the like, that may become the subject of possible damage claims.

3.07 EMBANKMENTS

A. The Design/Builder shall perform the construction of embankments in such a manner that cut and fill slopes will be completed to final slopes and grade in a continuous operation. The operation of removing excavation material from any cut and the placement of embankment in any fill shall be a continuous operation to completion unless otherwise permitted by the Engineer.

B. Surfaces upon which embankments are to be constructed shall be stripped of topsoil, organic material, rubbish and other extraneous materials. After stripping and prior to placing embankment material, the Design/Builder shall compact the top 12-inches of in place soil as specified under Paragraph 3.09, COMPACTION.

C. Any soft or unsuitable materials revealed before or during the in place compaction shall be removed as indicated by the Engineer and/or materials testing consultant and replaced with select fill.

D. Ground surfaces on which embankment is to be placed, shall be scarified or stepped in a manner which will permit bonding of the embankment with the existing surface. The embankment soils shall be as specified under Part 2 - Products, and shall should be placed in horizontal lifts with maximum height of 12 inches loose measure and compacted and shall be kept approximately level by the use of effective spreading equipment. New fill should be adequately keyed into stripped and scarified subgrade soils and should, and where applicable, be benched into the existing slopes. Hauling shall be distributed over the full width of the embankment, and in no case will deep ruts be allowed to form during the construction of the embankment. The embankment shall be properly drained at all times. Each layer of the embankment shall be thoroughly compacted to the density specified under Paragraph 3.09, COMPACTION.

E. The embankment or fill material in the layers shall be of the proper moisture content before rolling to obtain the prescribed compaction. Wetting or drying of the material and manipulation when necessary to secure a uniform moisture content throughout the layer shall be required. Should the material be too wet to permit proper compaction or rolling, all work on all portions of the embankment thus affected shall be delayed until the material has dried to the required moisture content. Samples of all embankment materials for testing, both before and after placement and compaction, will be taken at frequent intervals. From these tests, corrections, adjustments, and modifications of methods, materials, and moisture content will be made to construct the embankment.

F. In confined areas such as utility trenches or behind foundation walls, portable compaction equipment and thin lifts of three inches to four inches may be required to achieve specified degrees of compaction.

F. Where embankments are to be placed and compacted on hillsides, or when new embankment is to be compacted against embankments, or when embankment is built in part widths, the slopes that are steeper than 4:1 shall be loosened or plowed to a minimum depth of 6 inches or, if in the opinion of the Engineer, the nature of the ground is such that greater precautions should be taken to bind the fill to the original ground then benches shall be cut in the existing ground as indicated by Engineer.

G. When rock and other embankment material are excavated at approximately the same time, the rock shall be incorporated into the outer portions of the embankments and the other material which meets the requirements for select fill shall be incorporated into the formation of the embankments. Stones or fragmentary rock larger than 4-inches in their greatest dimension will not be allowed within the top 6-inches of the final grade. Stones, fragmentary rock, or boulders larger than 12-inches in their greatest dimension will not be allowed in any portions of embankments and shall be disposed of by the Design/Builder as indicated by the Engineer. When rock fragments or stone are used in embankments, the material shall be brought up in layers as specified or directed and every effort shall be exerted to fill the voids with finer material to form a dense, compact mass which meets the densities specified for embankment compaction.

3.08 BACKFILLING

A. All structures and pipes shall be backfilled with the type of materials shown on the Drawings and specified herein. Select fill shall be deposited in successive, uniform, approximately horizontal layers not exceeding 8-inches in compacted depth for the full width. Stones or fragmentary rock larger than 4-inches in their greatest dimension will not be allowed within the top 6-inches of the ground nor within 6 inches of pipes. No stone or fragmentary rock larger than 12-inches in their greatest dimension will be allowed for any portion of backfill. Compaction shall be in accordance with the requirements of Paragraph 3.09, COMPACTION.

B. Where excavation support is used, the Design/Builder shall take all reasonable measures to prevent loss of support beneath and adjacent to pipes and existing structures when supports are removed. If significant volumes of soil cannot be prevented from clinging to the extracted supports, the voids shall be continuously backfilled as rapidly as possible. The Design/Builder shall thereafter limit the depth below subgrade that supports will be installed in similar soil conditions or employ other appropriate means to prevent loss of support.

3.09 COMPACTION

A. The Design/Builder shall compact embankments, backfill, crushed stone, aggregate base, and in place subgrade in accordance with the requirements of this Section. The densities specified herein refer to percentages of maximum density as determined by the noted test methods. Compaction of materials on the project shall be in accordance with the following schedule:

	Density % Std. Proctor (D698)	Density % Mod. Proctor (D1557)	Max. Lift Thickness as Compacted Inches
Embankments Beneath Structures*	98	95	8
Other Embankments	95	92	8
Backfill Around Structures	95	92	8
Backfill in Pipe Trenches	95	92	8
Crushed Stone Beneath Structures	**	**	12
Select Sand	--	98	8

	Density % Std. Proctor (D698)	Density % Mod. Proctor (D1557)	Max. Lift Thickness as Compacted Inches
Aggregate Base Material and Select Fill Beneath Pavements and Structures	--	98	8
Crushed Stone Backfill	**	**	12
Crushed Stone Pipe Bedding	**	**	12
In place Subgrade Beneath Structures	98	95	Top 12-inches

* Embankments beneath structures shall be considered to include a zone 10 feet out from the foundation of the structure extending down to the natural ground on a 45° slope.

** The aggregate shall be compacted to a degree acceptable to the Engineer by use of a vibratory compactor and/or crawler tractor.

B. Field density tests will be made by the materials testing consultant to determine if the specified densities have been achieved, and these tests shall be the basis for accepting or rejecting the compaction. In-place density tests will be performed in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. The Engineer in conjunction with the materials testing consultant will be the judge as to which test method will be the most appropriate. Failure to achieve the specified densities shall require the Design/Builder to re-compact the material or remove it as required. The Design/Builder shall, if necessary, increase his compactive effort by increasing the number of passes, using heavier or more suitable compaction equipment, or by reducing the thickness of the layers. The Design/Builder shall adjust the moisture contents of the soils to bring them within the optimum range by drying them or adding water as required.

C. Testing will be performed as frequently as deemed necessary by the Engineer and/or materials testing consultant. As a minimum, one in-place density test shall be performed for each 1000 cubic yards of embankment placed and 500 cubic yards of backfill placed or one test performed each day for either.

3.10 REMOVAL OF EXCESS AND UNSUITABLE MATERIALS

A. The Design/Builder shall remove and dispose of off-site all unsuitable materials.

B. All unsuitable materials shall be disposed of in locations and under conditions that comply with federal, state and local laws and regulations.

C. The Design/Builder shall obtain an off-site disposal area prior to beginning demolition or excavation operations.

D. Any surplus excavated material not used for backfilling or embankment suitable for reuse shall be deposited on-site in the disposal area indicated on the Drawings or as directed by the Owner. Approved disposal areas may also be used by the Design/Builder for spreading and drying any excavated material suitable as select fill that is too wet for use immediately after being excavated. The Design/Builder shall maintain the earth surfaces of the disposal area, both during the work and until the completion of all seeding and mulching or other

erosion control measures specified, in a manner which will effectively control erosion and sedimentation. If necessary, the Design/Builder shall clear and grub the disposal site prior to any excavation work.

1. Earth waste shall be shaped to contours which are comparable to and blend in with the adjacent topography where practical, but in no case will slopes steeper than 3 horizontal to 1 vertical be permitted.

2. Seeding and mulching shall be performed over all the earth waste area. The work of seeding and mulching shall be performed in accordance with Section 02910 - Final Grading and Landscaping.

E. When all excess and unsuitable material disposal operations are completed, the Design/Builder shall leave the disposal sites in a condition acceptable to the Owner and Owner(s) of the disposal site(s).

3.11 BORROW EXCAVATION

A. Description

The work covered by this section consists of the excavation of approved material from borrow sources and the hauling and utilization of such material as required on the Drawings or directed by the Engineer. It shall also include the removing, stockpiling, and replacement of topsoil on the borrow source; the satisfactory disposition of material from the borrow source which is not suitable for use; and the satisfactory restoration of the borrow source and haul roads to an acceptable condition upon completion of the work.

Borrow excavation shall not be used before all available suitable unclassified excavation has been used for backfill and incorporated into the embankments.

B. Coordination with Seeding Operations

The Design/Builder shall coordinate the work covered by this section with the construction of embankments so that the requirements of Section 02200 are met.

C. Materials

All material shall meet the requirements of Division 2 shown below:

Borrow Material .....Section 02200, Subsection 2.01 - Select Fill

D. Construction Methods

1. General

The surface of the borrow area shall be thoroughly cleared and grubbed and cleaned of all unsuitable material including all organics, topsoil, etc., before beginning the excavation. Disposal of material resulting from clearing and grubbing shall be in accordance with Section 02100.

Each borrow operation shall not be allowed to accumulate exposed, erodible slope area in excess of 1 acre at any one given time without the Design/Builder's

beginning permanent seeding and mulching of the borrow source or other erosion control measures as may be approved by the Engineer.

The topsoil shall be removed and stockpiled at locations that will not interfere with the borrow operations and that meet the approval of the Engineer. Temporary erosion control measures shall be installed as may be necessary to prevent the erosion of the stockpile material. Once all borrow has been removed from the source or portion thereof, the stockpiled topsoil shall be spread uniformly over the source.

Where it is necessary to haul borrow material over existing roads, the Design/Builder shall use all necessary precautions to prevent damage to the existing roads. The Design/Builder shall also conduct his hauling operations in such a manner as to not interfere with the normal flow of traffic and shall keep the traffic lanes free from spillage at all times.

2. Owner Furnished Sources

Where borrow sources are furnished by the Owner the location of such sources will be as directed by the Owner.

The Owner will furnish the necessary haul road right-of-way at locations designated by the Owner. All haul roads required shall be built, maintained, and removed when directed by the Owner. Where the haul road is to be reclaimed for cultivation the Design/Builder shall plow or scarify the area to a minimum depth of 8 inches.

The borrow sources shall be left in a neat and presentable condition after use. All slopes shall be smoothed, rounded, and constructed not steeper than 3:1. Where the source is to be reclaimed for cultivation the source shall be plowed or scarified to a minimum depth of 8 inches, disc harrowed, and terraces constructed. The source shall be graded to drain such that no water will collect or stand and a functioning drainage system shall be provided.

All sources shall be seeded and mulched in accordance with Section 02910.

3. Design/Builder Furnished Sources

The approval of borrow sources furnished by the Design/Builder shall be subject to the following conditions:

a. The Design/Builder shall be responsible for acquiring the right to take the material and any rights of access that may be necessary; for locating and developing the source; and any clearing and grubbing and drainage ditches necessary.

Such right shall be in writing and shall include an agreement with the Owner that the borrow source may be dressed, shaped, seeded, mulched, and drained as required by these Specifications after all borrow has been removed.

b. Except where borrow is to be obtained from a commercial source, the Design/Builder and the property owner shall jointly establish a borrow source

development, use, and reclamation plan prior to engaging in any land disturbing activity on the proposed source other than material sampling that may be necessary. The Design/Builder's plan shall address the following:

(1) Drainage

The source shall be graded to drain such that no water will collect or stand and a functioning drainage system shall be provided. If drainage is not practical, and the source is to serve as a pond, the minimum average depth below the water table shall be 4 feet or the source graded so as to create wetlands as appropriate.

(2) Slopes

The source shall be dressed and shaped in a continuous manner to contours which are comparable to and blend in with the adjacent topography, but in no case will slopes steeper than 3:1 be permitted.

(3) Erosion Control

The plan shall address the temporary and permanent measures that the Design/Builder intends to employ during use of the source and as a part of the reclamation. The Design/Builder's plan shall provide for the use of staged permanent seeding and mulching on a continual basis while the source is in use and the immediate total reclamation of the source when no longer needed.

4. Maintenance

During construction and until final acceptance the Design/Builder shall use any methods approved by the Engineer which are necessary to maintain the work covered by this section so that the work will not contribute to excessive soil erosion.

- END OF SECTION -

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SECTION 02207

AGGREGATE MATERIALS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Design/Builder shall furnish all labor, equipment and materials required to complete all work associated with the installation of aggregate material beneath foundations, as backfill and as roadway subgrades and other related and incidental work as required to complete the work shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02050 - Erosion and Sediment Control

B. Section 02200 – Earthwork

C. Section 02515 – Pervious Concrete Pavement

D. Section 02910 - Final Grading and Landscaping

E. Section 02920 – Bioretention Cell

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Virginia Department of Transportation Road and Bridge Specifications, and applicable special provisions and copied notes.

2. ASTM C 127 Test for Specific Gravity and Absorption of Coarse Aggregate.

3. ASTM C 136 Test for Sieve Analysis of Fine and Coarse Aggregates.

4. ASTM C 535 Test for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

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1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures.

1. Materials gradation and certification.

2. ASTM C127, ASTM C136, and ASTM C535 test results

PART 2 -- PRODUCTS

2.01 CRUSHER RUN, SELECT FILL, AND SCREENED GRAVEL

A. Select fill or screened gravel shall meet the requirements of Aggregate Standard Size No. 57 or No. 67 as defined by Section 203 of the VDOT Standard Specifications.

B. Crusher Run shall be as defined by Section 205 of the VDOT Standard Specifications.

2.02 SELECT SAND

A. Select sand shall meet the requirements of Section 202 of the VDOT Road and Bridge Specifications for materials and gradation. The size used shall be Standard Size No. 2A or 2B as listed and defined in Table 11-1, "Fine Aggregate", of the VDOT Road and Bridge Specifications.

2.03 CHOKER STONE

A. Choker stone shall be clean, washed No. 8 stone meeting the requirements of ASTM D448.

2.04 GRAVEL DRAINAGE LAYER

A. Stone for the gravel drainage layer stone shall be clean, washed No. 2 stone (3 inch to ¾ in size) meeting the requirements of ASTM D448.

PART 3 -- EXECUTION

3.01 CRUSHER RUN AND SCREENED GRAVEL

A. Design/Builder shall install crusher run and screened gravel in accordance with the VDOT Road and Bridge Specifications and as shown on the Drawings and indicated in the Contract Documents.

1. Unless otherwise stated herein or shown on the Drawings, all mat foundations (bottom slabs) for the proposed structures shall have a blanket of screened gravel or crusher run 4-inches thick minimum placed directly beneath the proposed mat. The blanket shall extend a minimum of 12 inches beyond the extremities of the mat.

2. For subgrade preparation at structures and structural fill, the foundation material shall be select fillwhere specifically specified on Drawings, otherwise, screened gravel shall be used.

3. For ground under drains, pipe bedding, and drainage layers beneath structures the coarse aggregate shall meet the requirements of aggregate standard Size No. 57 or No. 67, as defined by VDOT Road and Bridge Specifications.

3.02 SELECT SAND

A. Design/Builder shall install select sand in accordance with the VDOT Road and Bridge Specifications and as shown on the Drawings and indicated in the Contract Documents.

- END OF SECTION -

SECTION 02274

GEOTEXTILES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Design/Builder shall furnish and install all Geotextiles, including all necessary and incidental items, as detailed or required for the Design/Builder to complete the installation in accordance with the Drawings and these Specifications.

B. For the location of each type of Geotextile see the Drawings and Details.

1.02 REFERENCES

A. AASHTO Standards

1. AASHTO M 288-06 (2011) Geotextile Specification for Highway Applications

1.03 SUBMITTALS

A. Prior to shipping to the site, the Design/Builder shall submit to the Engineer two copies of a mill certificate or affidavit signed by a legally authorized official of the Manufacturer for each type of Geotextile. The Supplier shall also submit three Geotextile samples of each product, 1 yard square each, seamed and unseamed as appropriate, with the mill certificate for each Geotextile type supplied. The mill certificate or affidavit shall attest that the Geotextile meets the chemical, physical and manufacturing requirements stated in the specifications. The samples shall be labeled with the manufacturer's lot number, machine direction, date of sampling, project number, specifications, manufacturer and product name.

B. The Engineer shall be furnished copies of the delivery tickets or other acceptable receipts as evidence for materials received that will be incorporated into construction.

PART 2 -- MATERIALS

2.01 MATERIALS

A. Filter Geotextile shall be a minimum 6-ounce per square yard (nominal) nonwoven needle punched synthetic fabric consisting of staple or continuous filament polyester or polypropylene manufactured in a manner accepted by the Engineer and the Owner. The Geotextiles shall be inert and unaffected by long-term exposure to chemicals or liquids with a pH range from 3 to 10. The Geotextiles shall have a minimum threshold water head of 0.25-inches in the "as received" condition.

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1. Filter Geotextile shall have a Survivability Class of Class 1, 2 or 3 in accordance with AASHTO M288, unless otherwise specified herein.

B. Cushion Geotextile shall be a minimum 16-ounce per square yard nonwoven needle punched synthetic fabric consisting of continuous filament or staple polyester or polypropylene manufactured in a manner accepted by the Engineer and the Owner. The Geotextiles shall be inert and unaffected by long-term exposure to chemicals or liquids with a pH range from 3 to 10.

1. Cushion Geotextile shall have a Survivability Class of Class 1 in accordance with AASHTO M288.

C. Type I Separator Geotextile shall be a minimum 8-ounce per square yard (nominal) nonwoven neddlepunched synthetic fabric consisting of staple or continuous filament polyester or polypropylene manufactured in a manner accepted by the Engineer and the Owner. The Geotextiles shall be inert and unaffected by long term exposure to chemicals or liquids with a pH range from 3 to 10.

1. Type I Separator Geotextile shall have a Survivability Class of Class 1 or 2 in accordance with AASHTO M288, unless otherwise specified herein.

D. Type II Separator Geotextile shall be a woven slit film or monofilament synthetic fabric consisting of polyester or polypropylene in a manner approved by the Engineer. Geotextile shall be treated to resist degradation due to exposure to ultraviolet light.

1. Type II Separator Geotextile shall have a Survivability Class of Class 1 in accordance with AASHTO M288, unless otherwise specified herein.

E. All Geotextiles shall conform to the properties listed using the test methods listed in Table 1. The Design/Builder shall be responsible for timely submittals of all confirmation test data for Geotextiles.

PART 3 -- EXECUTION

3.01 SHIPPING, HANDLING AND STORAGE

A. During all periods of shipment and storage, all Geotextiles shall be protected from direct sunlight, temperature greater than 140°F water, mud, dirt, dust, and debris.

B. To the extent possible, the Geotextile shall be maintained wrapped in heavy-duty protective covering until use. Geotextile delivered to the project site without protective covering shall be rejected. After the protective covering has been removed, the Geotextile shall not be left uncovered for longer than fourteen (14) days, under any circumstances.

C. Unloading and storage of Geotextiles shall be the responsibility of the Design/Builder.

D. Geotextiles that are damaged during shipping or storage shall be rejected and replaced at Design/Builder expense.

3.02 QUALITY ASSURANCE CONFORMANCE TESTING

A. At the option of the Engineer representative samples of Geotextiles shall be obtained and tested by the Engineer to assure that the material properties conform to these Specifications. Conformance testing shall be conducted by the Engineer and paid for by the Design/Builder.

B. Conformance testing shall be completed at a minimum frequency of one sample per 100,000 square feet of Geotextile delivered to the project site. Sampling and testing shall be as directed by the Engineer.

C. Conformance testing of the Geotextiles shall include but not be limited to the following properties:

1. Mass Per Unit Area (ASTM D5261)
2. Grab Tensile Strength (ASTM D4632)
3. Trapezoidal Tear (ASTM D4533)
4. Puncture Resistance (ASTM D6241)

D. The Engineer may add to, remove or revise the test methods used for determination of conformance properties to allow for use of improved methods.

E. All Geotextile conformance test data shall meet or exceed requirements outlined in Table 1 of these Specifications for the particular category of Geotextile prior to installation. Any materials that do not conform to these requirements shall be retested or rejected at the direction of the Engineer.

F. Each roll of Geotextile will be visually inspected by the Engineer or his representative. The Engineer reserves the right to sample and test at any time and reject, if necessary, any material based on visual inspection or verification tests.

G. A Geotextile that is rejected shall be removed from the project site and replaced at the Design/Builder's expense. Sampling and conformance testing of the Geotextile supplied as replacement for rejected material shall be performed by the Engineer at Design/Builder's expense.

3.03 INSTALLATION

A. Geotextiles shall be placed to the lines and grades shown on the Drawings. At the time of installation, the Geotextile shall be rejected by the Engineer if it has defects, rips, holes, flaws, evidence of deterioration, or other damage.

B. It is the intent of these Specifications that Geotextiles used to protect natural drainage media be placed the same day as the drainage media to prevent soil, sediment or windblown soils to make contact with the drainage media.

C. The Geotextiles shall be placed smooth and free of excessive wrinkles. Geotextiles shall conform to and be in contact with the approved subgrade.

D. When the Geotextiles are placed on slopes, the upslope fabric portion shall be lapped such that it is the upper or exposed Geotextile.

E. Geotextiles shall be temporarily secured in a manner accepted by the Engineer prior to placement of overlying materials.

F. In the absence of specific requirements shown on the Drawings, the following shall be used for overlaps of adjacent rolls of Geotextile:

GEOTEXTILE TYPE/ APPLICATION	OVERLAP OF ADJACENT ROLLS[(1)] (INCHES)	TRANSVERSE END OVERLAP (INCHES)
Filter Geotextile	6 min	12 min
Cushion Geotextile	12 min	12 min
Separator-Roadway Applications	12 min	24 min
Separator-Slope Protection	18 min	24 min
Separator Geotextile	12 min	18 min

(1) Overlaps may be reduced if adjacent panels are sewn or heat bonded where approved by the Engineer.

G. Any Geotextile that is torn or punctured shall be repaired or replaced as directed by the Engineer by the Design/Builder at no additional cost to the Owner. The repair shall consist of a patch of the same type of Geotextile placed over the failed areas and shall overlap the existing Geotextile a minimum of 12-inches from any point of the rupture.

H. Any Geotextile that is subjected to excessive sediment buildup on its surface during construction shall be replaced by the Design/Builder prior to placement of overlying material.

TABLE 1 - MINIMUM REQUIRED GEOTEXTILE PROPERTIES*

GEOTEXTILE PROPERTY	FILTER GEOTEXTILE	CUSHION GEOTEXTILE	TYPE I SEPARATOR GEOTEXTILE	TYPE II SEPARATOR GEOTEXTILE
Geotextile Construction	Nonwoven Needlepunched	Nonwoven Needlepunched	Nonwoven Neddlepunched	Woven
Mass per Unit Area (Unit Weight), ASTM D5261 (oz/yd^2)	5.6	15.7	7.8	N/A
Ultraviolet Resistance, (500 hrs.) ASTM D4355, Average % Strength Retention	70	70	70	70
Grab Tensile Strength (lbs.), ASTM D4632	150	340	200	$390^{(1)}X250^{(2)}$
Grab Tensile elongation (%) ASTM D4632	50	50	50	20 MAX
Wide Width Tensile Strength, (lbs./in.) ASTM D4595	N/A	N/A	N/A	N/A
Trapezoid Tear Strength (lbs) ASTM D4533	65	155	90	100
Apparent Opening Size (AOS), (mm), ASTM D4751	0.25	N/A	0.25	0.4
Permittivity at 50 mm constant head (sec^{-1}), ASTM D4491	1.6	N/A	1.2	0.1
Puncture Resistance, ASTM D6241 (lb)	430	1100	575	950

*** MINIMUM AVERAGE ROLL VALUE (MARV)**

(1) Warp Direction

(2) Fill Direction

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SECTION 02276

EROSION AND SEDIMENTATION CONTROL

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

A. The Design/Builder shall employ a Responsible Land Disturber certified in the Commonwealth of Virginia who is responsible for implementing Best Management Practices (BMP's) to prevent and minimize erosion and resultant sedimentation in all cleared and grubbed areas during and after construction. This item covers the Work necessary for the installation of structure and measures for the prevention and control of soil erosion. The Design/Builder shall furnish all material, labor and equipment necessary for the proper installation, maintenance, inspection, monitoring, reporting, and removal (where applicable) of erosion prevention and control measures and to cause compliance with the General Virginia Pollutant Discharge Elimination System (VPDES) Permit Regulation for Discharges of Storm Water From Construction Activities (9 VAC 25-180) and VPDES General Permit No. VAR10 under this Section.

B. All excavations shall be in conformity with the lines, grades, and cross sections shown on the Drawings or established by the Engineer.

C. It is the intent of this Specification that the Design/Builder conduct the construction activities in such a manner that erosion of disturbed areas and off site sedimentation be absolutely minimized.

D. All Work under this Contract shall be done in conformance with and subject to the limitations of the Virginia Erosion and Sediment Control Handbook (VESCH) and the Virginia Erosion and Sediment Control Law, Regulations and Certification Regulations, as adopted in the Code of Virginia Title 10-1, Chapter 5, Article 4 and Sections 4VAC30-50 and 4VAC50-50 of the Virginia Administration Code.

E. The Design/Builder shall comply with all applicable minimum standards set in the Virginia Erosion and Sediment Control Handbook. The following excerpts from the VESCH Minimum Standards are particularly important:

1. Permanent or temporary soil stabilization shall be applied to denuded areas within seven days after final grade is reached on any portion of the site. Temporary soil stabilization shall be applied within seven days to denuded areas that may not be at final grade but will remain dormant (undisturbed) for longer than 30 days. Permanent stabilization shall be applied to areas that are to be left dormant for more than one year.

2. A permanent vegetative cover shall be established on denuded areas not otherwise permanently stabilized. Permanent vegetation shall not be considered established until a ground cover is achieved that, in the opinion of the local program administrator or his designated agent, is uniform, mature enough to survive and will inhibit erosion.

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3. Stabilization measures shall be applied to earthen structures such as dams, dikes and diversions immediately after installation.

4. All temporary erosion and sediment control measures shall be removed within 30 days after final site stabilization or after the temporary measures are no longer needed, unless otherwise authorized by the local program administrator. Trapped sediment and the disturbed soil areas resulting from the deposition of temporary measures shall be permanently stabilized to prevent further erosion and sedimentation.

F. Due to the nature of the Work required by this Contract, it is anticipated that the location and nature of the erosion and sedimentation control devices will be adjusted on several occasions to reflect the current phase of construction. The construction schedule adopted by the Design/Builder will impact the placement and need for specific devices required for the control of erosion. The Design/Builder shall develop and implement such additional techniques as may be required to minimize erosion and off-site sedimentation. The location and extent of erosion and sedimentation control devices shall be revised at each phase of construction that results in a change in either the quantity or direction of surface runoff from constructed areas. All deviations from the erosion and sedimentation control provisions shown on the Drawings shall have the prior acceptance of the Engineer.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02100 – Clearing, Grubbing, and Site Preparation

B. Section 02200 – Earthwork

C. Section 02910 – Final Grading and Landscaping

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of these specifications, all Work hereunder shall conform to the applicable requirements of the referenced portions of the following documents, to the extent that the requirements therein are not in conflict with the provisions of this Section.

1. Code of Virginia, Title 10.1, Chapter 5, Article 4

2. Virginia Erosion and Sediment Control Handbook (VESCH), latest edition.

3. General Virginia Pollutant Discharge Elimination System (VPDES) Permit Regulation for Discharges of Storm Water From Construction Activities (9 VAC 25-180) and VPDES General Permit No. VAR10.

4. Erosion and Sediment Control Plan as required by the VPDES Permit.

5. Maintenance and Inspection Procedures as required by the VPDES Permit

B. See Specification Section 01090 - Reference Standards.

1.04 REGULATORY COMPLIANCE

A. Land disturbance activities are not authorized to begin until after all required erosion and sediment control permits are obtained from the United States, Commonwealth of Virginia, and the City of Suffolk. Design/Builder is the Co-Primary Permittee and Operator under the provisions of the VPDES Permit. As such, Design/Builder will be required to sign certain certifications as described in the VPDES Permit. Design/Builder shall comply with requirements specified in the Contract Documents or by the Engineer. Design/Builder shall also comply with all other laws, rules, regulations, ordinances and requirements concerning soil erosion and sediment control established in the United States, the Commonwealth of Virginia, and the City of Suffolk. The following documents and the documents referenced therein define the regulatory requirements for this Section 02276.

1. VPDES PERMIT: The Virginia Pollution Discharge Elimination System (VPDES) General Permit (VAR 10) for Discharges of Storm Water from Construction Activity governs land disturbance or construction activities of one (1) acre or more. On applicable sites, Design/Builder is responsible for complying with terms and conditions of this permit.

2. Manual for Erosion and Sediment Control: Design/Builder shall follow Practices and Standards of the Virginia Erosion and Sediment Control Handbook (VESCH), Third Edition, or latest.

3. SWP3: The Design/Builder shall prepare a Storm Water Pollution Prevention Plan (SWP3), and shall follow the practices described in the SWP3.

1.05 SUBMITTALS

A. Prior to the start of the Work, the Design/Builder shall prepare and submit a plan for applying the temporary and permanent erosion and siltation control measures as shown on the Owner's approved Erosion and Sediment Control Plan. Construction Work shall not commence until the schedule of Work and the methods of operations have been reviewed and approved.

B. In accordance with the procedures and requirements set forth in the General Conditions Division 1 and Section 01 33 00, the Design/Builder shall submit the following:

1. Name and location of all material suppliers.

2. Certificate of compliance with the standards specified above for each source of each material.

3. List of disposal sites for waste and unsuitable materials and all required permits for use of those sites.

1.06 EROSION AND SEDIMENTATION CONTROL DEVICES

A. The following erosion and sedimentation control devices shall be incorporated into the Work. Other devices, as necessary and acceptable to the Engineer shall be installed as required.

1. Temporary Sediment Traps shall be constructed at the locations shown on the Drawings, at the termination of all Temporary Diversions diverting sediment laden runoff, and at other locations indicated by the Engineer. Temporary Sediment Traps shall be constructed by excavating the appropriate size rectangular basin and constructing a rock-fill dam on the discharge end to form a sediment trap. Temporary Sediment Traps shall be spaced to limit the maximum tributary drainage area to less than or equal to 3 acres. Temporary Sediment Traps shall be designed, installed and maintained in accordance with the requirements of Section 3.13 of the VESCH.

2. Temporary Diversions shall be constructed at the locations shown on the Drawings, and at other locations indicated by the Engineer. Dimensions shall be as shown on the Drawings. All diversion ditches transporting sediment-laden runoff shall terminate in Temporary Sediment Traps. Temporary Diversions shall be designed, installed and maintained in accordance with the requirements of Section 3.12 of the VESCH.

3. Silt Fence shall be constructed at the locations shown on the Drawings, and at other locations indicated by the Engineer. Silt fence shall not be installed across streams, ditches or waterways. Silt Fence shall be designed, installed and maintained in accordance with requirements of Section 3.05 of the VESCH.

4. Rock Check Dams shall be constructed at the locations shown on the Drawings, and at other locations indicated by the Engineer. Dimensions shall be as shown on the Drawings. Rock Check Dams shall be designed, installed and maintained in accordance with the requirements of Section 3.20 of the VESCH.

5. Block and Gravel Drop Inlet Sediment Filters shall be constructed at the locations shown on the Drawings, and at other locations indicated by the Engineer. Dimensions shall be as shown on the Drawings. Block and Gravel Drop Inlet Sediment Filters shall be designed, installed and maintained in accordance with the requirements of Section 3.07 of the VESCH.

6. Block and Gravel Curb Inlet Sediment Filters shall be constructed at the locations shown on the Drawings, and at other locations indicated by the Engineer. Gravel Curb Inlet Sediment Filters shall be designed, installed and maintained in accordance with the requirements of Section 3.07 of the VESCH.

7. Culvert Inlet Protection shall be constructed at the locations shown on the Drawings, and at other locations indicated by the Engineer. Culvert Inlet Protection shall be designed, installed and maintained in accordance with the requirements of Section 3.08 of the VESCH.

8. Temporary and Permanent Stormwater Conveyance Channels shall be installed at the locations shown on the Drawings, and at other locations indicated by the Engineer. Channels and Channel Linings shall be designed, installed and maintained in accordance with the requirements of Sections 3.17 and 3.36 of the VESCH.

9. Riprap Outlet Protection shall be constructed at the locations shown on the Drawings and at other locations indicated by the Engineer. All Riprap Outlet Protection shall be designed, installed and maintained in accordance with the requirements of Sections 3.18 and 3.19 of the VESCH.

10. Temporary Construction Entrances shall be located at points where vehicles enter and leave a construction site and at other locations indicated by the Engineer. Temporary Construction Entrances shall be designed, installed and maintained in accordance with the requirements of Section 3.02 of the VESCH.

1.07 GUARANTEE

A. All restoration and revegetation Work shall be subject to the correction period specified in the Contract Documents.

PART 2 -- MATERIALS

2.01 MATERIALS

A. Materials for use in erosion and sedimentation control devices shall be in accordance with the Virginia Erosion and Sediment Control Handbook.

2.02 TEMPORARY SEDIMENT TRAPS

A. Temporary Sediment Traps shall be constructed as shown on the Contract Drawings and as specified herein. The Temporary Sediment Traps shall be constructed and maintained in accordance with Part 3 of this Section, and Section 3.13 of the VESCH, to the satisfaction of the Engineer and/or local program administrator until a vegetative ground cover has been established. The cost of the Temporary Sediment Traps shall include the excavation, grading, diversion ditches, stone for erosion control, washed stone, geotextile, etc. and all maintenance activities required.

2.03 TEMPORARY DIVERSIONS

A. Temporary Diversions shall be constructed as shown on the Contract Drawings and as specified herein. Temporary Diversions shall be installed and maintained in accordance with Part 3 of this Section, and Section 3.12 of the VESCH, to the satisfaction of the Engineer and/or local program administrator until the site has been stabilized. The cost of Temporary Diversions shall include the excavation and all maintenance and restoration activities required.

2.04 SILT FENCE

A. Silt Fence shall be installed and maintained in accordance with the Maintenance paragraph, and Section 3.05 of the VESCH, to the satisfaction of the Engineer until the site has been stabilized. The cost of Silt Fence shall include the fabric, posts, wire fabric, excavation and all maintenance and restoration activities required.

B. Silt Fence shall be a woven geotextile filter fabric made specifically for sediment control. Filter fabric shall not rot when buried and shall resist attack from soil chemicals, alkalies and acids in the pH range from 2 to 13, and shall resist damage due to prolonged ultraviolet exposure. Filter fabric shall be Type FX-11, as manufactured by Carthage Mills, Type 910SC, as manufactured by Synthetic Industries, Inc., Amoco 2130 as manufactured by Amoco Fabrics & Fibers Co.

C. Filter fabric for the silt fence shall have the following minimum properties:

	Value	Test Method
Grab Tensile Strength	100 lbs	ASTM D 4632
Grab Elongation	15%	ASTM D 4632
Trapezoid Tear Strength	50 lbs	ASTM D 4533
Mullen Burst Strength	265 lbs	ASTM D 3786
Puncture Strength	58 lbs	ASTM D 4833
Retained Strength (500 hrs. accelerated UV exposure)	80%	ASTM D 4355
Filtration Efficiency	75%	VTM-51
Flow Rate	10/gal/min/ft.^{2}	ASTM D 4491
Height	36 inches	

D. Posts for silt fence shall be steel and shall have the following properties:

ASTM Designation:	ASTM A702
Length:	5-Feet Long (T-Type)
Weight:	1.25 lbs/foot (min.)
Area of Anchor Plate:	14 Sq. In.

Note: Five (T) Fasteners shall be furnished with each post.

E. Wire Fabric for the silt fence shall have the following properties:

Wire Fabric Designation:	832-12-10-12.5 Class 1
Designation:	ASTM A116
Width:	32"
Number of Line Wires:	8
Stay Wire Spacing:	12"
Line and Stay Wires:	12.5 Ga.
Top and Bottom Wires:	10 Ga.
Wire Coating:	ASTM Class 1 Zinc Coating

2.05 RIP RAP

A. The Design/Builder shall place rip rap as shown on the Drawings and as specified in Section 204 of the VDOT Road and Bridge Specifications. The stone for rip rap shall at a minimum be Class B and consist of field stone or rough unhewn quarry stone. The stone shall be sound, durable, and free from seams, cracks, or other structural defects.

2.06 CULVERT INLET PROTECTION

A. Culvert Inlet Protection shall be constructed as shown on the Drawings and as specified herein. The culvert inlet protection shall be constructed at the upstream end of all culverts as indicated and maintained in accordance with Part 3 of this Section, and Section 3.08 of the VESCH, to the satisfaction of the Engineer until the site has been stabilized. The cost of the culvert inlet protection shall include the excavation, grading, stone for erosion control, riprap, etc. and all maintenance activities required.

2.07 STRAW WITH NET TEMPORARY SOIL STABILIZATION BLANKET (SSB)

A. The Design/Builder shall place straw with net temporary channel and slope SSB as shown on the Drawings. The blanket shall consist of clean wheat straw from agricultural crops made into a knitted straw blanket that is machine assembled. The straw shall be evenly distributed throughout the blanket. The blanket shall be covered with a photodegradable synthetic mesh attached to the straw with degradable thread.

B. The Design/Builder shall place the straw with net temporary channel and slope SSB where directed immediately after the channel or slope has been properly graded and prepared, fertilized, and seeded. The netting shall be on top with the straw in contact with the soil.

C. The Design/Builder will immediately repair or replaced section of straw with net temporary channel and slope SSB which is not functioning properly or has been damaged in any way until a stable growth of grass has been established.

D. Straw with net SSB shall be North American Green S150 matting, American Excelsior Co., Curlex I, Contech SFB1, or equal with a minimum shear stress value of 1.50 lb./ft.^{2}

2.08 CURLED WOOD OR COCONUT FIBER TEMPORARY SOIL STABILIZATION BLANKET (SSB)

A. The Design/Builder shall place curled wood or coconut fiber channel and slope SSB in channels or on slopes as shown on the Drawings. The blanket shall consist of machine-produced mat of curled wood excelsior or coconut fiber with consistent thickness and the fibers evenly distributed over the entire area of the blanket. The top of the blanket shall be covered with a biodegradable synthetic mesh. The mesh shall be attached to the curled wood excelsior or coconut fiber with photodegradable synthetic yarn.

B. The Design/Builder shall place the curled wood or coconut fiber channel and slope SSB where directed immediately after the ditch has been properly graded and prepared, fertilized, and seeded. The mesh shall be on top with the fibers in contact with the soil.

C. The Design/Builder will immediately repair or replace section of blanket which is not functioning properly or has been damaged in any way until a stable growth of grass has been established.

D. Blanket shall be American Excelsior Curlex II, North American Green C125, Contech EFB4 or equal matting with a minimum shear stress value of 2.0 lb./ft.^{2}.

2.09 SYNTHETIC SOIL STABILIZATION MATTING (SSM)

A. The Design/Builder shall place synthetic channel and slope SSM in channel or on slope as shown on the Drawings. The mat shall consist of entangled nylon, polypropylene or polyester monofilaments mechanically joined at their intersections forming a three dimensional structure. The mat shall be crush-resistant, pliable, water-permeable, and highly resistant to chemical and environmental degradation.

B. The Design/Builder shall place the synthetic SSM where directed immediately after the channel or slope has been properly graded and prepared.

C. After the SSM has been placed, the area shall be properly fertilized and seeded as specified allowing the fertilizer and seeds to drop through the net.

D. The Design/Builder will immediately repair or replace section of SSM which is not functioning properly or has been damaged in any way until a stable growth of grass has been established.

E. Synthetic SSM shall be Enkamat 7020 as manufactured by Colband Geosynthetics, Synthetic Industries Landlock Erosion Mat TRM 1060, TH8 as manufactured by TC Mirifi, or equal matting with a minimum shear stress value of 5.0 lb./ft.^{2}.

2.10 TEMPORARY GRAVEL CONSTRUCTION ENTRANCES

A. Temporary gravel construction entrances shall be constructed as shown on the Drawings and as specified herein. Temporary gravel construction entrances shall be maintained in accordance with Part 3 of this Section, and Section 3.02 of the VESCH, to the satisfaction of the Engineer until the site has been stabilized. The cost of temporary gravel construction entrances shall include the gravel, truck wash racks and washwater, etc. and all maintenance activities required.

2.11 TEMPORARY SOIL STABILIZER

A. The temporary agent for soil erosion control shall consist of an especially prepared highly concentrated powder which, when mixed with water, forms a thick liquid such as "Enviroseal 2001" by Enviroseal Corporation, "Terra Control" by Quattro Environmental, Inc., or "CHEM-CRETE ECO-110" by International CHEM-CRETE Corporation, and having no growth or germination inhibiting factors. The agent shall be used for hydroseeding grass seed in combination with other approved amendments resulting in a highly viscous slurry which, when sprayed directly on the soil, forms a gelatinous crust.

PART 3 -- EXECUTION

3.01 INSTALLATION AND MAINTENANCE

A. Erosion and sedimentation control devices shall be established prior to the clearing operations in a given area. Where such practice is not feasible, the erosion and sedimentation control device(s) shall be established immediately following completion of the clearing operation.

B. The Design/Builder shall furnish the labor, materials and equipment required for routine maintenance of all erosion and sedimentation control devices. Maintenance shall be scheduled as required for a particular device to maintain the removal efficiency and intent of the device. Maintenance shall include but not be limited to 1) the removal and satisfactory disposal of trapped sediments from traps or silt barriers and 2) replacement of filter fabrics used for silt fences. Sediment removed from erosion and sedimentation control devices shall be disposed of in locations that will not result in off site sedimentation as acceptable to the Owner.

C. The Design/Builder shall provide temporary sedimentation traps at all locations shown on the Contract Drawings and for the settling of water pumped from the excavations or intercepted by drainage ditches for keeping water out of the excavations or to protect existing structures. The Design/Builder shall seed and mulch the earthen embankment with temporary or permanent vegetation immediately after installation. The Design/Builder shall remove trapped sediment from the basins when the design capacity has been reduced by 25% to maintain their effectiveness or as indicated by the Engineer. Sediment material removed from the basins shall be disposed by the Design/Builder in locations that will not result in off-site sedimentation as acceptable to the Owner.

1. Inspect temporary sediment traps at least once every 14 days and within 48 hours after each runoff producing rainfall event. Remove sediment and restore the trap to its original dimensions when the sediment has accumulated to one-forth the design volume of the trap. Place the sediment that is removed in a designated disposal area and replace the contaminated part of the aggregate facing.

2. Check the structure for damage from erosion or piping. Periodically check the depth of the spillway to ensure it is a minimum of 1.0 ft. below the low point of the embankment. Immediately fill settlement of the embankment to slightly above design grade. Riprap displaced from the spillway must be replaced immediately.

3. After all sediment-producing areas have been permanently stabilized and permission has been obtained from the plan approving authority, remove the structure and all unstable sediment. Smooth the area to blend with the adjoining areas and stabilize properly.

D. The Design/Builder shall provide temporary diversions at all locations noted on the Contract Drawings. All temporary diversions shall outlet at a temporary sediment trap or other appropriate structure.

1. Inspect temporary diversions at least once every 14 days and within 48 hours after each runoff producing rainfall event. Immediately remove sediment form the flow area and repair the diversion ridge. Carefully check outlets and make timely repairs as needed. When the area protected is permanently stabilized and permission has been obtained from the plan approving authority, remove the ridge and the channel to blend with the natural ground level and appropriately stabilize it.

E. Silt fence shall be erected as shown on the Drawings and specified herein. Silt fence shall be erected and maintained to the satisfaction of the Engineer until a vegetative ground cover has been established. Replacement of the filter fabric, if required by the Engineer, will be at the Design/Builder's expense.

1. Inspect silt fence at least once every 14 days and within 48 hours after each runoff producing rainfall event. Make required repairs immediately.

2. Should the fabric of a silt fence collapse, tear, decompose or become in-effective, replace it promptly.

3. Remove sediment deposits as necessary to provide adequate storage volume for the next rain and to reduce pressure on the fence. Take care to avoid undermining the fence during cleanout.

4. Remove all fencing materials and unstable sediment deposits and bring the area to grade and stabilize it after the contributing drainage area has been properly stabilized. Removal of silt fence shall be permitted only with the prior approval of the Engineer, or the local governing agency.

F. Riprap shall be graded so that the smaller stones are uniformly distributed through the mass. The Design/Builder may place the stone by mechanical methods, augmented by hand placing where necessary or ordered by the Engineer. The placed riprap shall form a properly graded, dense, neat layer of stone. The placed riprap shall have a minimum depth of 24 inches. Filter fabric shall be used under all riprap. The filter fabric must meet the requirements in Section 3.19 of the VESCH.

G. Riprap and stone for erosion control shall be dumped and placed in such manner that the larger rock fragments are uniformly distributed throughout the rock mass and the smaller fragments fill the voids between the larger fragments. Rearranging of individual stones by equipment or by hand shall only be required to the extent necessary to secure the results specified above, to protect structures from damage when rock material is placed against the structures or to protect the underlying Filter Fabric from damage during installation.

H. The Design/Builder shall provide Sit Fence Culvert Inlet Protection at all locations noted on the Contract Drawings.

1. Inspect Silt Fence Culvert Inlet Protection at least once every 14 days and within 48 hours after each runoff producing rainfall event. Remove sediment and restore the inlet protection to its original dimensions when the sediment has accumulated to one-half the design depth. Place the sediment that is removed in a designated disposal area and replace the contaminated part of the gravel facing, if used.

2. Check the structure for damage from tears, erosion, or piping. Filter fabric, posts, stone, or riprap displaced from the berm must be replaced immediately.

3. After all sediment-producing areas have been permanently stabilized and permission has been obtained from the plan approving authority, remove the structure and all unstable sediment. Smooth the area to blend with the adjoining areas and stabilize properly.

I. Engineer may direct the Design/Builder to place Straw with Net, Curled Wood or Coconut Fiber SSB's and Synthetic SSM's in permanent channels or on slopes at other locations not shown on Drawings.

1. All temporary and permanent channel linings shall be unrolled in the ditch in the direction of the flow of water. Temporary and permanent linings shall be installed in accordance with the requirements of Section 3.36 of the VESCH and per manufacturer's specifications.

2. During the establishment period, check grass, SSB and SSM-lined channels at least once every 14 days and within 48 hours after each runoff producing rainfall event. For grass-lined channel once grass is established, check periodically and after every runoff producing rainfall event. Immediately make repairs. It is particularly important to check the channel outlet and all road crossings for bank stability and evidence of piping and scour holes. Give special attention to the outlet and inlet sections and other points where concentrated flow enters. Remove all significant sediment accumulations to maintain the designed carrying capacity. Keep the grass in a healthy, vigorous condition at all times.

J. The Design/Builder shall provide temporary construction entrances at all locations noted on the Contract Drawings, and at all other locations as may be directed by the Engineer.

1. Maintain the gravel pad in a condition to prevent mud or sediment from leaving the construction site. This may require periodic topdressing with VDOT #1 course aggregate. Inspect each construction entrance at least once every 14 days and within 48 hours after each runoff producing rainfall event and clean out as necessary. Immediately remove all objectionable materials spilled, washed, or tracked onto public roadways.

2. Design/Builder shall provide wash rack and wash water for temporary construction entrances. The roadway under the temporary construction entrance shall be graded to drain into temporary sediment traps until construction activities cease and site around temporary construction entrance has been permanently stabilized.

K. Permanent or temporary soil stabilization shall be applied to denuded areas within seven days after final grade is reached on any portion of the site. Temporary soil stabilization shall be applied within seven days to denuded areas that may not be at final grade but will remain dormant (undisturbed) for longer than 30 days. Permanent stabilization shall be applied to areas that are to be left dormant for more than one year. Preparation of areas for permanent stabilization shall be performed in accordance with Section 2.32 of the VESCH.

1. Reseed and mulch temporary seeding areas where seedling emergence is poor, or where erosion occurs, as soon as possible. Do not mow. Protect from traffic as much as possible.

2. Generally, a stand of vegetation cannot be determined to be fully established until soil cover has been maintained for one full year from planting. Inspect seeded areas for failure and make necessary repairs and reseedings within the same season, if possible.

3. Reseeding – If a stand has inadequate cover, re-evaluate choice of plant materials and quantities of lime and fertilizer. Re-establish the stand after seedbed preparation or over-seed the stand. Consider seeding temporary, annual species if the time of year is not appropriate for permanent seeding.

4. If vegetation fails to grow, soil must be tested to determine if acidity or nutrient imbalance is responsible.

5. Fertilization – On the typical disturbed site, full establishment usually requires refertilization in the second growing season. Fine turf requires annual maintenance fertilization. Use soil tests if possible or follow the guidelines given for the specific seeding mixture.

L. Additional Requirements

1. All storm sewer piping shall be blocked at the end of every Working day until the inlet is constructed above grade.

2. All streets around the construction area shall be scraped as necessary to prevent accumulation of dirt and debris.

3. The Design/Builder shall provide adequate means to prevent sediment from entering storm drains, curb inlets (curb inlet filter box), ditches, streams, or bodies of water downstream of any area disturbed by construction. Excavation materials shall be placed upstream of trench or other excavation to prevent sedimentation of offsite areas. In areas where a natural buffer area exists between the Work area and the closest stream or water course, this area shall not be disturbed.

4. The Engineer may direct the Design/Builder to place additional sediment and erosion control devices at other locations not shown on the Drawings.

5. The Design/Builder shall monitor and take precautions to control dust, including, but not limited to, use of water or chemical dust palliative, limiting the number of vehicles allowed on site, minimizing the operating speed of all vehicles.

3.02 INSPECTIONS AND MAINTENANCE

A. The Design/Builder shall be responsible for the implementation of the Maintenance and Inspection Procedures as written by the Engineer. The implementation must comply with guidelines as set forth in General Virginia Pollutant Discharge Elimination System Permit Regulation for Discharges of Storm Water From Construction Activities (9 VAC 25-180) and VPDES General Permit No. VAR10.

B. The Design/Builder shall designate a Qualified Person to perform inspections required by this Section 02276. The following areas are to be inspected and maintenance performed, if needed, at least once every 14 calendar days and within 48 hours of the end of runoff producing storm event.

1. Disturbed areas of the construction site that have not undergone final stabilization

2. Erosion and sediment control structures

3. All locations where vehicles enter or exit the site

4. Material storage and construction laydown areas that are exposed to precipitation and have not been finally stabilized

C. When a Storm Water Pollution Prevention Plan (SWP3) is provided in the Contract Documents, the Qualified Person shall follow the practices inspection and maintenance requirements described in the SWP3. (See the Appendix for the SWP3, if applicable). All appropriate records required by the SWP3 shall be maintained on site.

D. Immediate action will be taken to correct deficiencies to BMP's. The State reserves the right to stop all construction activities not related to maintaining BMP's until such deficiencies are repaired.

E. In areas that have been finally stabilized, inspections and, if necessary, maintenance by Design/Builder will occur at least once per month for the duration of the contract or project, whichever is longer.

F. During inspections the following will be observed and appropriate maintenance procedures taken:

1. The conformance to specifications and current condition of all erosion and sediment control structures.

2. The effectiveness and operational success of all erosion and sediment control measures.

3. The presence of sediments or other pollutants in storm water runoff at all runoff discharge points.

4. If reasonably accessible, the presence of sediments or other pollutants in receiving Waters.

5. Evidence of off-site tracking at all locations where vehicles enter or exit the site.

G. An inspection checklist is included in the SWP3. This checklist must be completed during each inspection, dated, and signed by the Qualified Person conducting the inspection. Completed inspection checklist shall be kept on-site with the Contract Documents and submitted to the Engineer on a monthly basis. The Design/Builder will repair deficiencies within 24 hours of inspection.

3.03 REMOVAL OF TEMPORARY SEDIMENT CONTROL STRUCTURES

A. At such time that temporary erosion and control structures are no longer required under this item, the Design/Builder shall notify the Engineer and the City of Suffolk of its intent and schedule for the removal of the temporary structures, and obtain the Engineer's approval in writing prior to removal. Once the Design/Builder has received such written approval from the Engineer, the Design/Builder shall remove, as approved, the temporary structures and all sediments accumulated at the removed structure shall be returned upgrade. In areas where temporary control structures are removed, the site shall be left in a condition that will restore original drainage. Such areas shall be evenly graded and seeded as specified in Section 02910, Final Grading and Landscaping.

3.04 NOTICE OF TERMINATION

A. When all construction activities have ceased, final stabilization has been implemented by the Design/Builder, and the site is in compliance with the VPDES permit, the Design/Builder, together with the Engineer shall submit a Notice of Termination.

- END OF SECTION -

SECTION 02500

SURFACE RESTORATION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Provide all labor, equipment, and materials necessary for final grading, topsoil placement, and miscellaneous site work not included under other Sections but required to complete the work as shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02200 - Earthwork

B. Section 02276 - Erosion and Sedimentation Control

C. Section 02910 - Final Grading and Landscaping

PART 2 -- MATERIALS

2.01 TOPSOIL

A. Topsoil shall meet the requirements of Section 02200 – Earthwork.

PART 3 -- EXECUTION

3.01 FINAL GRADING

A. Following approval of rough grading the subgrade shall be prepared as follows:

1. For riprap, bare soil 24 inches below finish grade or as directed by Engineer.

2. For topsoil, scarify 2-inches deep at 4 inches below finish grade.

3.02 TOPSOIL PLACEMENT

A. Topsoil shall be placed over all areas disturbed during construction under any contract except those areas which will be paved, graveled or rip rapped.

B. Topsoil shall be spread in place for lawn and road shoulder seed areas at a 4-inch consolidated depth and at a sufficient quantity for plant beds and backfill for shrubs and trees.

C. Topsoil shall not be placed in a frozen or muddy condition.

D. Final surface shall be hand or mechanically raked to an even finished surface to finish grade as shown on Drawings.

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E. All stones and roots over 4-inches and rubbish and other deleterious materials shall be removed and disposed of.

- END OF SECTION -

SECTION 02510

PAVING AND SURFACING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Design/Builder shall furnish all labor, equipment and materials and perform all operations in connection with the construction of asphalt concrete pavement, asphalt concrete overlay, reinforced concrete pavement, gravel roads, concrete curb and gutter, repair and reconstruction of existing asphalt concrete pavement, repair of existing gravel roads, and pavement markings complete as specified herein and as detailed on the Drawings.

B. All new roads including the replacement of portions of the existing roads shall be to the limits, grades, thicknesses and types as shown on the Drawings. Patches for pipe crossings and areas damaged during the construction work shall be asphalt and/or gravel, depending upon the material encountered, unless otherwise indicated.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements of related work are included in Division 1, Division 2 and Division 3 of these Specifications.

1.03 RELATED SECTIONS

A. Section 02200 - Earthwork

B. Section 03300 - Cast-In-Place Concrete

1.04 STANDARD SPECIFICATIONS

A. Except as otherwise provided in the Specifications or on the plans, all work shall be in accordance with the Virginia Department of Transportation Standard Specifications for Roads and Structures, 2016 except that any reference to "VDOT", "Department" or "Unit" shall mean the "Owner". When reference to these Specifications is intended, the description will be VDOT Section _____ or VDOT Specifications.

B. Except with the approval of the Engineer, the placing of concrete or asphalt concrete surface paving shall be subject to the Seasonal and Weather Restrictions set forth in VDOT Specifications.

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PART 2 -- MATERIALS

2.01 SELECT FILL

A. The Design/Builder shall place select fill as necessary to complete the embankments, shoulders, subgrade foundation and replacement for removed unsuitable material in accordance with VDOT Section 303, and Section 02200 - Earthwork.

2.02 GRAVEL

A. All work, including materials, associated with gravel shall be in accordance with VDOT Section 207, Select Material, except that Articles 207.07shall be deleted.

2.03 AGGREGATE STABILIZATION

A. All work, including materials, associated with Aggregate Stabilization shall be in accordance with VDOT Sections 306 and 307, Lime and Hydraulic Cement Stabilization, except that Articles 306.04 and 307.06, shall be deleted.

2.04 AGGREGATE BASE MATERIAL

A. All work, including materials, associated with Aggregate Base Material shall be in accordance with VDOT Section 208, Aggregate Base Material, except that Article 208.08 shall be deleted. Type 21-A or Type 21-B aggregate will be acceptable for this project.

2.05 ASPHALT BINDER FOR PLANT MIX

A. All work, including materials, associated with asphalt binder shall be in accordance with Section 210, Asphalt Materials, Grade PG 64H-22, of the VDOT Standard Specifications for Roads and Structures, except Article 210.09shall be deleted.

2.06 ASPHALT PAVEMENTS

A. All work, including materials, associated with asphalt pavement shall be in accordance with Section 211, Asphalt Concrete, of the VDOT Standard Specifications for Roads and Structures. Surface Course shall be Superpave S-9.5B, Intermediate Course shall be Superpave I-19.0B, and Base Course shall be Superpave B-25.0C. Asphalt pavement mix designs shall be in accordance with TABLE II-14 of the VDOT Specifications.

B. The job mix formulas shall be delivered to the Engineer at least two (2) weeks prior to beginning paving operations.

2.07 RIGID PORTLAND CEMENT CONCRETE PAVEMENT

A. All work, including materials associated with rigid concrete pavement shall be in accordance with Section 03300, Cast-In-Place Concrete and Section 217 of the VDOT Standard Specifications for Roads and Structures . Class A concrete shall be used. Placement shall be in accordance with Section 03300 and VDOT Section 316, Hydraulic Cement Concrete Pavement and Section 710, Concrete Pavement, except that Article 316.06 shall be deleted.

2.08 RIGID CONCRETE PAVEMENT REINFORCING

A. Reinforcing, if specified, shall be as shown on the Structural Drawings and as specified under Section 03200 - Reinforcing Steel.

2.09 CONCRETE CURB AND GUTTERS

A. Concrete shall be Class B in accordance with the requirements of Section 03300 - Cast-In-Place Concrete, except that concrete shall be air-entrained to provide an air content of 6% ± 1.5%.

B. Premolded expansion joint filler for expansion joints shall conform to ASTM D 1751 and shall be 1/2-inch thick, minimum.

2.10 ASPHALT TACK COAT

A. All work, including materials, associated with asphalt tack coat shall be in accordance with Section 310 - Tack Coat, of the VDOT Standard Specifications for Roads and Structures, except that Article 310.04 shall be deleted.

PART 3 -- EXECUTION

3.01 EMBANKMENT

A. The embankment shall be constructed in accordance with Section 02200 - Earthwork.

3.02 SUBGRADE

A. The subgrade, where shown on the Drawings, shall be aggregate stabilized by the addition and mixing of coarse aggregate with the top 3-inches of subgrade in accordance with VDOT Section 305. Aggregate stabilization shall be applied to the subgrade at a rate of 300-pounds per square yard. Following the application of stabilizer aggregate, the subgrade shall be formed true to crown and grade, and shall be compacted with a minimum of four (4) passes of a 15-ton vibratory roller to conform to the maximum densities determined by AASHTO T99 Standard Specifications.

3.03 AGGREGATE BASE MATERIAL

A. The finished base course of all paving shall be Aggregate Base Material and shall be of the thickness shown on the Drawings, formed true to crown and grade. Gravel roads, including repair to existing gravel roads shall be Aggregate Base Material and shall be of the thicknesses shown on the Drawings, formed true to crown and grade. No fill material except new Aggregate Base Material shall be placed on top of existing gravel.

3.04 ASPHALT BASE COURSE (OR INTERMEDIATE COURSE)

A. Asphalt Concrete Base (or Intermediate) Course shall be placed in accordance with VDOT Standard Specifications for Roads and Structures Section 315, Asphalt Concrete Placement. Asphalt Concrete Base (or Intermediate) Course shall be compacted in accordance with the VDOT Standard. Thicknesses shall be as shown on the Drawings.

3.05 ASPHALT CONCRETE SURFACE COURSE

A. Prior to placement of the asphalt concrete surface course, the base/intermediate course shall be inspected for damage or defects and repaired to the satisfaction of the Engineer. The surface of the base/intermediate course shall be approved by the Engineer.

B. The asphalt tack coat shall be applied to the surface of the approved base/binder course as described in VDOT Section 310. Equipment for applying the tack coat shall be power-oriented pressure spraying or distributing equipment suitable for the materials to be applied and approved by the Engineer.

C. The Asphalt Concrete Surface Course shall be placed and compacted on the base/intermediate course in layers not to exceed 2-inches and at the rate of 110-pounds per square yard per inch. Surface Course shall be compacted in accordance with VDOT Standard Specifications. Thicknesses shall be as shown on the Drawings.

3.06 RIGID PORTLAND CEMENT CONCRETE

A. The subgrade and base course beneath portland cement concrete pavement shall be prepared in accordance with the applicable Sections of these Specifications and referenced Standard Specifications.

B. The surface of the base shall be damp at the time the concrete is placed. The Design/Builder shall sprinkle the base when necessary to provide a damp surface. The Design/Builder shall satisfactorily correct all soft areas in the subgrade or base prior to placing concrete.

C. Hauling over the base course shall not be allowed except where specifically permitted by and in writing by the Engineer. The Engineer may allow equipment dumping concrete to operate on the base to the extent and under the conditions the Engineer deems necessary to facilitate placing and spreading the concrete.

D. Installation of the rigid concrete pavement shall be in accordance with the details shown on the Drawings and Division 3 - Concrete. The rigid concrete pavement shall cure a minimum of ten (10) calendar days and until the concrete has attained a minimum flexural strength of 550 psi as indicated by flexural strength testing. The Design/Builder shall coordinate and pay for all flexural strength testing with a minimum of four (4) 6-inch by 6-inch by 20-inch beams for every fifty (50) cubic yards of pavement concrete installed.

E. Contraction joints shall be spaced at intervals as shown on the Drawings. Transverse contraction joints shall be formed by an approved joint insert. Expansion joints shall be placed when the pavement abuts a structure using 1-inch expansion joint material (filler) and sealant as specified herein.

3.07 CONCRETE CURB AND GUTTER

A. The expansion joint filler for concrete curb and gutters shall be cut to conform with the cross section of the curb. Expansion joints shall be spaced at intervals of not more than 25-feet. Formed control joints shall be installed at intervals not exceeding 10 feet. Depth of joint shall be 1/3 the thickness. Curved forms shall be used where radii are indicated; straight segments shall not be permitted. Upon removal of the forms, exposed curb faces shall be immediately rubbed down to a smooth and uniform surface. No plastering shall be permitted.

3.08 UNDERGROUND UTILITY LINES

A. Where an underground utility line is beneath the new roadway, the backfilling shall be carried out with special care, and the final consolidation shall be accomplished by a vibratory roller. Construction of the roadway over the trench shall be deferred as long as practicable.

3.09 JUNCTION WITH OTHER PAVING

A. Where new asphalt concrete pavement abuts existing asphalt concrete pavement, the existing pavement shall be cut back to insure obtaining the specified compaction of the new pavement courses and interlocking adjoining courses. Existing subbase courses shall be cut back from the subgrade level of the new pavement on a one-on-one slope into the existing pavement, and the asphalt courses of the existing pavement shall be removed for an additional 6-inches back from the slope. The edge of the existing asphalt courses shall be saw cut straight and true. The faces between new and existing asphalt courses shall receive an application of tack coat.

B. Where new rigid concrete pavement abuts existing rigid concrete or asphalt concrete paving, the existing paving shall be saw cut straight and true. An expansion joint of a 1/2-inch minimum thickness with filler material and sealant shall be placed between the new concrete pavement and the existing rigid concrete or asphalt concrete paving.

3.10 ASPHALT CONCRETE OVERLAY

A. Where asphalt concrete is proposed to be placed over an existing asphalt or rigid concrete surface, the surfaces shall be thoroughly cleaned by power brooming and a tack coat shall be applied in accordance with VDOT Section 310, Tack Coat, of the VDOT Standard Specifications for Roads and Structures, prior to installing the overlay. The overlay shall be applied in accordance with the Standard Details shown on the Drawings.

-END OF SECTION-

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SECTION 02515

PERVIOUS CONCRETE PAVEMENT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Design/Builder shall furnish all labor, equipment and materials and perform all operations in connection with the construction of pervious concrete pavement complete as specified herein and as detailed on the Contract Drawings.

B. All new areas of pervious concrete pavement shall be to the limits, grades, thicknesses and types as shown on the Contract Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02200 – Earthwork

B. Section 02207 – Aggregate Materials

C. Section 02500 – Surface Preparation

D. Section 02510 – Paving and Surfacing

E. Section 03300 - Cast-In-Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1.	ACI 522	Specification for Pervious Concrete Pavement
2.	ASTM C 29	Standard Test for Unit Weight and Voids in Aggregate
3.	ASTM C 33	Standard Specification for Concrete Aggregates
4.	ASTM C 42	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
5.	ASTM C 14	Standard Specification for Ready-Mixed Concrete
6.	ASTM C 117	Standard Test Method for Material Finer than 75 µm (No. 200) Sieve in Mineral Aggregates by Washing
7.	ASTM C 138	Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete

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8.	ASTM C 150	Standard Specifications for Portland Cement
9.	ASTM C 172	Standard Practice for Sampling Fresh Concrete
10.	ASTM C 174	Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
11.	ASTM C 260	Standard Specification for Air-Entraining Admixtures for Concrete
12.	ASTM C 494	Standard Specification for Chemical Admixtures for Concrete
13.	ASTM C 595	Standard Specifications for Blended Hydraulic Cements
14.	ASTM C 618	Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
15.	ASTM C 989	Standard Specification for Slag Cement for Use in Concrete and Mortars
16.	ASTM C 1077	Recommended Practice for Labs Testing Concrete
17.	ASTM C 1157	Standard Performance Specification for Hydraulic Cement
18.	ASTM C 1688	Standard Test Method for Density and Void Content of Freshly Mixed Pervious Concrete
19.	ASTM D 448	Specification for Standard Sizes of Coarse Aggregate for Highway Construction
20.	ASTM D 1557	Standard Tests for Moisture-Density Relations for Soils and Soil Aggregate Mixtures Using 10-pound Rammer and 18-inch Drop
21.	ASTM E 329	Standard recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction
22.	AASHTO T-180	Moisture-Density Relations of Soils Using a 101 pound (454 kg) Rammer and an 18 inch (457 mm) Drop

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures.

1. Sources of all materials and certifications of compliance with specifications for all materials.

2. Aggregate test results showing compliance with required standards.

3. Manufacturer's data on all admixtures stating compliance with required standards.

4. Pervious concrete mix design.

5. Design/Builder qualifications and concrete producer qualifications including experience with production and placement of pervious concrete pavement.

1.05 QUALITY ASSURANCE

A. The Design/Builder placing the pervious concrete and the producer supplying the pervious concrete shall provide statement of qualifications to Engineer for review. As a minimum, the following information, shall be submitted:

1. Documentation confirming installer of previous concrete pavement is certified by the National Ready Mix Concrete Association (NRMCA) as a pervious concrete craftsman.

2. Evidence of completion of a minimum of two previous placements of pervious concrete pavement including location and references.

3. Unit weight acceptance data from previous projects.

4. In-situ pavement test results including void content and unit weight from previous projects.

5. Sample of previously installed pavement via a core or a test panel.

6. Proposed equipment to be used for placement and compaction.

B. If either the Pervious Concrete Pavement Placing Subcontractor or the Pervious Concrete Pavement Concrete Supplier has no prior experience with Pervious Concrete Pavement, the Design/Builder shall retain an experienced Consultant to supervise base preparation, production, placement, finishing, and curing of the pervious concrete pavement. Cost of consultant shall be exclusively the responsibility of the Design/Builder. Qualifications of consultant shall be submitted to Engineer.

C. Regardless of qualifications the Design/Builder shall place, joint, and cure two test panels of pervious concrete pavement, each over a minimum area of 225 square feet prior to placement of Pervious Concrete Pavement required for project. Test panels can be located in areas where production pervious concrete pavement is required. Test panels shall be of the same thickness and on the same subbase as the production pervious concrete pavement and shall be placed with the same equipment proposed for use on project. The test panel shall be identified by a copy of the truck ticket, including batch date, time, and truck number. Requirements of the test panels are as follow:

1. During placement, concrete for panels shall be tested for density and void content in accordance with ASTM C 1688.

2. Test panels shall be cored per ASTM C 42 and tested for thickness in accordance with ASTM C 174, test for void structure in accordance with ASTM C 138, and for core unit weight in accordance with ASTM C 140, paragraph 9.3.

3. Satisfactory performance of the test panels will be determined by the following:

a. Compacted thickness shall be no less than ¼ inch of specified thickness shown on Contract Drawings.

b. Void structure shall be 20% ± 5% for low porosity, high strength or 30% ± 5% for high porosity, low strength.

c. Core unit weight shall be within ± 5 pcf of the design unit weight. Design unit weight shall be based on unit weight determined in trial mix design and shall be between 105 pcf and 132 pcf.

4. If the requirements in item 2 above are not met, the test panel shall be removed and disposed of offsite at the Design/Builder's expense.

5. If the test panel, meets all of the above-mentioned requirements, it can be left in place and included in the completed work.

PART 2 – MATERIALS

2.01 GENERAL

A. Locally available material having a record of satisfactory performance shall be used.

2.02 HYDRAULIC CEMENT

A. Portland Cement shall be Type I or II meeting the requirements of ASTM C 150 and Specification Section 03300.

B. If Blended Cement is used, blended cement shall be Type IP or IS conforming to ASTM C 595 or ASTM C 1157 and Specification Section 03300.

C. Concrete mixed with Portland Cement shall also contain a pozzolan such as Fly Ash or Slag Cement.

2.03 FLY ASH

A. Fly Ash shall meet the requirements of ASTM C 618 for Class F and Specification Section 03300. Fly Ash may be used in amounts not exceeding 20% of the total cementitious material.

2.04 SLAG CEMENT

A. Slag Cement shall meet the requirements of ASTM C 989 and Specification Section 03300. Slag Cement may be used in amounts not exceeding 50% of the total cementitious material.

2.05 WATER

A. Water used for mixing Pervious Concrete Pavement shall meet the requirements stated in Specification Section 03300.

2.06 AGGREGATE

A. Coarse aggregate shall meet size 3/8 to No. 16 in accordance with ASTM C 33, or No. 89 coarse aggregate (3/8 to No. 50) per ASTM D 448. Crushed rock aggregate should be used instead of smooth rock aggregate.

B. Coarse aggregate shall meet soundness requirements as specified in Specification Section 03300.

2.07 ADMIXTURES

A. Admixtures used for pervious concrete shall be in accordance with requirements of Specification Section 03300. Allowable admixtures include air entrainment admixtures, water reducing admixtures, retarding admixtures, and water reducing/retarding admixtures.

B. A hydration stabilizer may be utilized and is recommended in the design and production of pervious concrete. The admixture's primary function shall be as a hydration stabilizer, but it must also meet the requirements of ASTM C 494 Type B Retarding or Type D Water Reducing/Retarding admixtures.

2.08 STRUCTURAL MACRO FIBERS

A. Structural macro fibers shall be used when specifically required or approved by the Engineer. The use of fibers shall not reduce the property or flow rate of the pavement.

B. Structural macro fibers shall meet requirements of Specification Section 03300.

2.09 PERVIOUS CONCRETE PAVEMENT MIX DESIGN

A. Minimum cementitious materials content shall not be less than 525 pounds per cubic yard. Cementitious refers to the combined weight of all cement, fly, ash, and slag cement contained in the mix.

B. The trial mixes shall be used to determine the design unit weight and porosity of the pervious concrete pavement. The design unit weight shall be between 105 pcf and 132 pcf. The porosity shall be between 13% and 25%.

C. Mix water shall be such that the cement paste displays a wet metallic sheen without causing the paste to flow from the aggregate. Maximum water/cementitious materials content shall be 0.35.

D. The volume of aggregate per cubic yard shall be a minimum of 18 cubic feet when calculated as a function of the unit weight determined in accordance with ASTM C 29 jigging procedure. Fine aggregate, if used, shall not exceed 3 cubic feet and shall be included in the total aggregate volume.

E. Admixtures shall be used in accordance with the manufacturer's instructions and recommendations.

F. Using concrete materials acceptable to the Engineer, a tentative concrete mix shall be designed and tested for the consistency intended for use on the work and specified.

1. High Porosity, Low Strength Modulus of Rupture shall be as follows:

a. Average strength such that 90% of tests are equal to or greater than 150 psi.

b. Any individual test (minimum of two beams) shall be greater than 130 psi.

2. Low Porosity, High Strength Modulus of Rupture, shall be as follows:

a. Average strength such that at least 90% of tests are equal to or greater than 350 psi.

b. Any individual test (minimum of two beams) shall be greater than 300 psi.

3. Modulus of rupture tests shall be in accordance with AASHTO T 23 and T 97, except beams shall be filled in one lift (1 layer), compacted lightly during filling, and finished by rolling a hardened 6" X 12" concrete sample cylinder across its surface. The tests shall be taken at age 14 days. Unit weight (density) and % voids (porosity) shall also be tested and reported.

PART 3 – EXECUTION

3.01 SUBGRADE PREPARATION AND FORMWORK

A. The top six inches of subgrade material shall be composed of select fill in accordance with Specification Section 02207 – Aggregate Materials.

B. Prior to placement of pervious concrete pavement, the subgrade shall be tested for rate of permeability by double ring infiltrometer, or other suitable test of subgrade soil permeability. The tested permeability must reasonably compare to the design permeability.

C. Subgrade Support

1. The subgrade shall be scarified to a depth of 12 inches and compacted by a mechanical vibratory compactor to a minimum density of 92% of a maximum dry density as established by ASTM D 1557 or AASHTO T 180. Subgrade stabilization shall not be permitted.

2. If fill material (embankment) is required to bring the subgrade to final elevation, fill material shall conform to the requirements of and placed in accordance with the requirements of Specification Section 02200 – Earthwork.

D. The subgrade shall be in a moist condition within $\pm$ 3% of the optimum moisture content as determined by the modified compaction test ASTM D 1557 or AASHTO T 180.

E. Forms shall be of wood or steel and shall be the depth of the pavement. Forms shall be of sufficient strength and stability to support mechanical equipment without deformation of plan profiles following spreading, strike-off, and compaction operations. Forms shall also meet requirements of Specification Section 03100 – Concrete Formwork.

3.02 MIXING, HAULING, AND PLACING

A. Truck mixers shall be operated at the speed designated as mixing speed by the pervious concrete manufacturer for 75 to 100 revolutions of the drum.

B. The Portland cement aggregate mixture may be transported or mixed on site and should be used within on (1) hour of the introduction of mix water, unless otherwise approved by an engineer. This time may be increased to 90 minutes when using a hydration stabilizer as per Article 2.07B of this Specification.

C. Each truck delivering pervious concrete to the site shall be inspected for appearance of concrete uniformity in accordance with Article 2.09.B of this Specification. Water may only be added by the concrete supplier to obtain the required mix consistency. A minimum of 20 revolutions at the manufacturer's designated mixing speed shall be required following any addition of water to the mix. Discharge of the concrete shall be a continuous operation and shall be completed as quickly as possible. Concrete shall be deposited as close to its final position as practicable and such that fresh concrete enters the mass of previously placed concrete. The practice of discharging onto subgrade and pulling or shoveling concrete to final placement will not be allowed.

D. Placing and Finishing

1. The pervious concrete pavement shall be placed to the required cross section and shall not deviate more than $\pm$ 3/8 inch in 10 feet from profile grade.

2. Unless otherwise approved by the Owner or Engineer, the Design/Builder shall provide either slip form or form riding equipment with a following compactive unit that will provide a minimum of 10 psi vertical force. If placing equipment does not provide the minimum specified vertical force, a full width roller or other full width compaction device that provides sufficient compactive effort shall be used immediately following the strike-off operation.

3. The Design/Builder shall be restricted to pavement placement widths of a maximum of fifteen (15) feet unless the Design/Builder can demonstrate competence to provide pavement placement widths greater than the maximum specified to the satisfaction of the Engineer.

4. Workers shall avoid stepping on the placed mix immediately after its placement to avoid forcing cement paste into the voids at the bottom of the slab.

5. If vibration, internal or surface applied, is used, it shall be shut off immediately when forward progress is halted for any reason.

6. Any apparent defects in the surface can be carefully remedied by placing some fresh concrete into any depressions and compacting with a hand tamper.

7. After mechanical or other approved strike-off and compaction operation and defect inspection and repair is completed, no other finishing operation will be allowed. Surface shall be immediately cured.

E. Curing procedures shall begin immediately after and no longer than 20 minutes after the final placement operations. The pavement surface shall be covered with a minimum six (6) mil polyethylene sheet or other approved covering material. Prior to covering, a fog or

light mist shall be sprayed above the surface when required due to ambient conditions (temperature, wind, and humidity). The cover shall overlap all exposed edges and shall be secured to prevent dislocation due to winds or adjacent traffic conditions.

F. Minimum cure time for pervious concrete pavement shall be seven (7) days. If Class F fly ash or Type IP blended cement are used in the concrete mix, the minimum cure time shall be increased to ten (10) days. No traffic shall be allowed on pervious concrete pavement for a minimum of ten (10) days.

G. Construction joints in pervious concrete pavement shall be located by the installer of pervious concrete pavement and shall be submitted to the Engineer for review. Joint layout shall also include location of contraction joints. Joints shall be located at maximum 20 foot intervals. Construction joints shall be located such that intersecting joints shall be between 80 and 100 degrees and joints shall intersect free edges of pavement at 90 degrees and shall extend straight for a minimum of 18 inches. Contraction joints shall be installed with a rolling joint tool soon after consolidation or may be saw cut with Engineer's approval. Joints shall be installed at a depth of ¼ the thickness of the pavement to a maximum depth of 1½ inches. If saw cut, the procedure should begin as soon as the pavement has hardened sufficiently to prevent raveling and uncontrolled cracking (normally after curing 24 hours). Polyethylene sheeting placed for curing or pavement shall be removed the minimum amount necessary to allow the saw cutting procedure. At the completion of the saw cutting procedure the exposed pavement shall be rewet and the polyethylene sheeting replaced and properly secured. Transverse construction joints shall be installed whenever placing is suspended a sufficient length of time that concrete may begin to harden. A bonding agent suitable for bonding fresh concrete to existing concrete shall be placed on the existing pavement edge prior to placing new adjacent concrete. Isolation (expansion) joints shall not be used except when pavement is abutting slabs or other adjoining structures.

3.03 TESTING, INSPECTION, AND ACCEPTANCE

A. The Design/Builder will retain an independent testing laboratory. The testing laboratory shall conform to the applicable requirements of ASTM E 329, "Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction" and ASTM C 1077, "Standard Practice for Testing Concrete and Concrete Aggregates for Use in Construction, and Criteria for Laboratory Evaluation". Testing laboratory shall be inspected and accredited by the Construction Materials Engineering Council, Inc. or by an equivalent recognized national authority.

B. The agent of the laboratory performing field sampling and testing of concrete shall be certified by the American Concrete Institute as Concrete Field Testing Technician Grade I and by the NCRMA as a certified pervious concrete technician or equipment. The Concrete producer shall endorse technicians testing proficiency of Portland Cement Pervious Concrete.

C. A minimum of one gradation test of the subgrade is required every 5000 square feet to determine percent passing the No. 200 sieve per ASTM C 117. A minimum of one test for each week's placement of pervious concrete pavement in accordance with ASTM C 172 and ASTM C 29 to verify unit weight shall be conducted. Delivered unit weights shall be determined in accordance with ASTM C 29 using a 0.25 cubic foot cylindrical metal measure. The measure is to be filled and compacted in accordance with ASTM C 29 paragraph 11, jigging procedure. The unit weight shall be $\pm$ 5 pcf of the design unit weight. The design unit weight shall be the unit weight determined and accepted during testing of the trial mixes for the pervious concrete pavement.

D. Each truck delivering pervious concrete to the site shall be tested for density and void content in accordance with ASTM C 1688.

E. Test panels shall have three cores taken from each panel in accordance with ASTM C 42 at a minimum of seven (7) days after placement of the pervious concrete. The cores shall be measured for thickness, void structure, and unit weight. Untrimmed, hardened core samples shall be used to determine placement thickness. The average of all production cores shall not be less than the specified thickness shown on the Contract Drawings with no individual core being more than ½ inch less than the specified thickness. After thickness determination, the cores shall be trimmed and measured for unit weight in the saturated condition as described in paragraph 6.3.1 – Saturation of ASTM C 140 "Standard Methods of Sampling and Testing Concrete Masonry Units". The trimmed cores shall be immersed in water for 24 hours, allowed to drain for one (1) minute, surface water removed with a damp cloth, then weighed immediately. Range of satisfactory unit weight values is $\pm$ 5 pcf of the design unit weight determined and accepted during testing of the trial mixes for the pervious concrete pavement.

F. After a minimum of 7 days following each placement, three cores shall be taken in accordance with ASTM C 42. The cores shall be measured for thickness and unit weight as described above for test panels. Core holes shall be filled with concrete meeting the pervious mix design.

G. In lieu of cores, a Pave Quality Indicator (PQI) may be used to determine density and porosity (quality) of in place pervious concrete pavement.

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SECTION 02604

UTILITY STRUCTURES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, equipment, and tools required for the design, fabrication, delivery and installment of utility structures and appurtenances in accordance with the Drawings and as specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02200 – Earthwork

B. Section 03200 – Reinforcing Steel

C. Section 03250 – Concrete Accessories

D. Section 03300 – Cast-in-Place Concrete

E. Section 03400 – Precast Concrete

F. Section 05540 – Castings

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. ASTM C478 – Specification for Precast Reinforced Concrete Manhole Sections

2. ASTM C857 – Minimum Stuctural Design Loading for Underground Precast Concrete Utility Structures

3. ASTM C990 - Specifications for Joints in Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

1.04 SUBMITTALS

A. Submit samples and/or Shop Drawings in accordance with Section 01 33 00, Submittal Procedures.

B. In addition to items listed in Section 03400, Precast Concrete, Shop Drawings shall include, but not be limited to:

1. Complete layout and installation Drawings and schedules with clearly marked dimensions.

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2. Material certificates on all piping materials.

3. Structural design calculations sealed by a P.E. registered in the Commonwealth of Virginia. Design calculations for precast manholes and vaults shall include confirmation structures adequately resist flotation when they are totally empty and subjected to groundwater full height of structure.

4. Results of leakage test

PART 2 -- PRODUCTS

2.01 PRECAST MANHOLES, VAULTS, AND METER BOXES

A. Precast utility structures shall be furnished with waterstops, sleeves and openings as noted on the Drawings. Box out for wall pipes shall conform accurately to the sizes and elevations of the adjoining pipes. Precast utility structures shall be watertight and conform to the requirements of ASTM C 478 and ASTM C857 with the following modifications there to:

1. Materials shall conform to Section 03400, Precast Concrete.

2. Manholes shall meet the following:

a. Manhole section shall have an internal diameter of 4'-0", unless noted otherwise.

b. Minimum manhole wall thicknesses shall be 5 inches for 4 foot and 5 foot diameter manholes, 6 inches for 6 foot diameter manholes and 7 inches for 7 foot diameter manholes.

c. Manholes and utility structures shall include ballast concrete and/or other means necessary to insure manholes resist flotation when empty and subjected to groundwater full height of structure.

d. Precast manholes and utility structures shall be as manufactured by NC Products/Oldcastle, Tindall Products, or equal.

3. The date and name of manufacturer shall be marked inside each precast section.

4. No more than two lift holes may be cast or drilled in each section.

5. Dimensions shall be as shown on the Drawings.

6. Covers and frames shall be as specified in Section 2.13.

7. Mechanical Details such as piping, electrical, and other details shall be as shown on the Drawings.

B. Joints between manhole and utility structures riser sections and at base slabs shall be groove type.

2.02 BRICK

A. Brick shall be sound, hard-burned common brick conforming to ASTM C32, Grade MS.

2.03 MORTAR

A. Mortar shall conform to Section 04100 Mortar and Masonry Grout.

2.04 CONCRETE

A. Concrete shall conform to Section 03300, Cast-in-Place Concrete.

2.05 REINFORCING

A. Reinforcing shall conform to Section 03200, Reinforcing Steel.

2.06 PRECAST CONCRETE

A. Precast concrete shall conform to Section 03400, Precast Concrete.

2.07 CONCRETE BLOCK

A. Concrete block shall be solid, rectangular concrete masonry units conforming to ASTM C139.

2.08 CASTINGS

A. Castings shall conform to Section 05540, Castings. Casting shall be of the type and size indicated on the Drawings.

2.09 STEPS

A. Steps shall be constructed of Grade 60 steel reinforcing rod (min. 1/2-inch) and completely encapsulated with a wear resistant and chemical resistant rubber.

B. Each step shall have a minimum vertical load resistance of 800 pounds and a minimum pull-out resistance of 400 pounds.

C. The steps shall have 11-inch minimum tread width and shall be placed at 16-inches on center, as shown on the Drawings.

D. Steps shall be cast in place with the concrete.

E. Steps shall only be installed as shown on the Drawings or required in the Specifications.

2.10 JOINT SEALANT

A. Joint sealant shall be a preformed flexible sealant conforming to the requirements of ASTM C990, paragraph 6.2, Butyl Rubber Sealant. Joint sealant shall be Pro-Stik Butyl Sealant by Press-Seal, Butyl-Nek Join Sealant by Henry ,CS-102 Butyl Rubber Sealant for all Precast Structures by ConSeal, or equal.

2.11 FLEXIBLE RUBBER SLEEVE

A. The spring set type shall have a stainless steel interior power sleeve or expander and shall be the PSX assembly by Press-Seal Gasket Corporation, the Kor-N-Seal assembly by National Pollution Control Systems, or Lock Joint Flexible Manhole Sleeve by Interpace Corp.

B. The cast-in-place type shall conform to ASTM C923 and shall include stainless steel take up clamps.

C. Flexible seal assemblies shall permit at least an eight (8) degree deflection from the center line of the opening in any direction while maintaining a watertight connection.

2.12 RUBBER BLADDER

A The rubber bladder seal shall conform to ASTM C923 suitable for pressure testing at 10 psi minimum, with a 3/8 inch minimum wall thickness.

B. The rubber bladder seal shall contain an environmentally safe, anti-bacterial compound which turns into a high viscosity gel when in contact with pressurized water.

C. The rubber bladder seal shall be NPC Contour Seal by Kor-N-Seal, or equal.

2.13 COVERS AND FRAMES

A. Covers and frames shall comply with Section 05540, Castings and shall be provided by the utility structure manufacturer.

B. Manhole covers and frames shall meet the following requirements:

1. Locate so that there is ready access to the manhole steps

2. Clear opening shall be a minimum of 22 inches, unless otherwise indicated on the Drawings.

3. Watertight manhole frames and covers shall be suitable for 20 psi internal pressure and shall be Neenah Model R-1915, Type P or L or equal cast in place.

4. Non-watertight manhole covers shall be perforated and shall be Neenah Model R-1668, or equal.

5. Storm drain grated inlet frames and grates shall be Neenah R-1878-B7G, East Jordan Iron Works V5660, or equal.

6. Curb inlet frames and grates shall be Neenah R-3067, East Jordan Iron Works EJ 7030, or equal, and shall include frame, grate, and hood.

C. Vault covers shall have lifting handles and shall be bolted with stainless steel bolts complying with Section 05050, Metal Fastening.

D. All frames and covers shall be given one shop coat of asphalt or coal tar varnish, unless otherwise specified.

E. Frames and covers shall be identical throughout the Contract.

2.14 GRATES

A. Grates shall comply with Section 05540, Castings.

2.15 CONCRETE BALLAST

A. Concrete ballast shall be Class B concrete in conformance with Section 03300, Cast-in-Place Concrete. Ballast shall be provided as necessary to insure manhole resists flotation when empty and subjected to full height groundwater conditions.

2.16 FLEXIBLE JOINT SEALER

A. Flexible joint sealer shall be a rubber ring waterstop as manufactured by Fernco Joint Sealer Co., or equal.

2.17 EPOXY BONDING AGENT

A. Epoxy bonding agent shall conform to Section 03250, Concrete Accessories.

PART 3 -- EXECUTION

3.01 DESIGN CRITERIA

A. Minimum structural design loading for underground precast concrete vaults shall be as indicated in ASTM C857, unless otherwise noted herein. Precast items subjected to vehicular traffic shall be designed for H-20 traffic loading. Other precast items shall be designed for a vertical live load of 300 psf.

B. Walls of precast items shall be designed for a vertical surcharge of 100 psf.

C. Precast manholes and vaults shall be designed to resist flotation when totally empty and subjected to groundwater full height of the manhole/vault.

3.02 FABRICATION AND CASTING

A. Fabrication and casting shall conform to Section 03400, Precast Concrete, and to Section 03300, Cast-in-Place Concrete.

B. All base sections designated to receive concrete ballast and all electrical manholes shall extend monolithically a minimum of 6 inches beyond the outside face of the wall for the entire periphery. All other utility structures shall have a standard base.

C. Utility structures built around existing pipe shall have a cast-in-place base slab.

3.03 HANDLING, TRANSPORTING, AND STORING

A. Handling, transporting and storing of precast items shall comply with Section 03400, Precast Concrete.

3.04 INSTALLATION

A. Installation shall conform with Section 03400, Precast Concrete and with the manufacturer's recommendations or to Section 03300, Cast-in-Place Concrete.

B. Frames and covers or grates shall be set so that tops are at elevations indicated on the Drawings or flush with finished grade where no elevation is indicated.

C. Joints between riser sections shall be sealed with joint sealant.

D. All openings in utility structures shall have flexible rubber sleeves sized to fit the connecting pipe and installed to provide watertight joints in accordance with the manufacturer's recommendations. The interior of the sleeve shall be filled with Class B concrete.

E. Openings that are too large for flexible rubber sleeves shall utilize rubber bladder seals which are expanded by water injected using a pressure pump.

F. All units shall be installed plumb and level.

G. All lift holes and joints shall be filled with non-shrink grout conforming to Section 03600, grout inside and out.

H. The manhole frames shall be set to their required elevations either with grade rings or with two or three courses of brick masonry laid around the top of the upper wall section. Such brick work shall be given a 1-inch mortar coat on the inside and out.

I. Concrete ballast shall be placed so that it bears directly on the utility structure base against the outer wall monolithically encircling the structure for the full height indicated on the Drawings. Additional ballast may be required where the depth or elevation of the structure varies from the Drawings.

J. Brick or Concrete Block

Brick or concrete block shall be laid with broken joints and all horizontal and vertical joints filled with cement-sand mortar. Outside of walls shall be plastered with a minimum 1-inch thick coat of cement-sand mortar troweled smooth.

K. Connection to Existing Pipe

1. Verify the diameter and invert elevation of existing pipe to be connected to new utility structures prior to beginning work on the structures.

2. Provide adequate protection to prevent damage to the existing pipe.

3. Provide adequate means for plugging and/or transferring the existing flow in the pipe to allow for the construction of inverts and grouting.

4. Cut off the existing pipe sufficiently for connection to the new structure and remove.

5. Thoroughly clean all foreign matter and coat the pipe surface with epoxy adhesive where the pipe joins the new structure.

6. Install a flexible joint sealer around the pipe.

7. Grout inside and outside of wall penetration with nonshrink grout.

L. Backfill structures in accordance with Section 02200, Earthwork.

M. Clean all structures of any accumulation of silt, debris, or foreign matter and keep clean until final acceptance of the work.

N. Excavation shall conform to Section 02200, Earthwork.

O. Structure bases shall bear on a minimum of 8 inches of compacted stone unless otherwise indicated on the Drawings.

P. Channel Inverts

1. Inverts shall be placed using Class B concrete with forms sufficient to provide a smooth half-round shape as shown on the Drawings. Manhole bases employing full depth precast inverts are acceptable.

2. Where the slope of the line does not change through a manhole, a constant slope shall be maintained in the invert. Where slope changes occur within a given manhole, the transition shall be smooth and shall occur at the approximate center of the manhole.

3. Inverts shown on the Drawings are taken at the center of the manhole unless otherwise noted.

3.05 ADJUSTMENTS TO EXISTING UTILITY STRUCTURES

A. Adjust structures as indicated on the Drawings using concrete or cast iron adjustment rings by approved methods.

B. Clean covers and inlet castings of all foreign material and paint with one coat of coal tar epoxy.

3.06 ADJUSTING COLLARS AND FINAL ADJUSTMENTS

A. Adjusting collars shall be as shown on the Drawings. Final adjustments shall be made so that the manhole ring and cover will be smooth and flush with the finished grade of the adjacent surface, or as otherwise indicated on the Drawings for manholes shown above grade.

3.07 FLUSHING AND TESTING

A. Obstruction - After backfilling, all sewers shall be inspected for obstructions and shall be flushed with water. Flushing shall be a minimum velocity of 2.5 feet per second for a duration acceptable to the Engineer. Flushing shall remove all dirt, stones, pieces of wood and other debris which accumulated in the sewer during construction. The Design/Builder shall provide a means acceptable to the Engineer for removal of debris flushed from each section of sewer. If after flushing, any obstructions remain, they shall be removed at the Design/Builder's expense.

B. Visual Inspection - Sewer lines shall be visually inspected from every manhole by use of mirrors, television cameras, or other devices for visual inspection, and the lines shall all exhibit a fully circular pattern when viewed from one manhole to the next. Lines which do not exhibit a true line and grade or have structural defects shall be corrected to meet these qualifications.

C. Leakage - Sewers shall be tested for leakage. The program of testing shall fit the conditions as mutually determined by the Engineer and the Design/Builder. The Design/Builder shall take all necessary precautions to prevent any joints from drawing while the sewers or their appurtenances are being tested. The Design/Builder shall, at his own expense, correct any excess leakage and repair any damage to the pipe and their appurtenances, or to any structures resulting from or caused by these tests.

D. Leakage Test Procedure - Each section of sewer shall be tested by closing the lower end of the sewer to be tested and the inlet sewer of the upper manhole with stoppers and filling the pipe and manhole with water to a point 6 feet above the crown of the open sewer in the upper manhole, or, if ground water is present, 6 feet above the sections average adjacent ground water level as indicated by a monitor well installed adjacent to each manhole. The line shall be filled with water prior to testing and allowed to stand until the pipe has reached its maximum absorption, but not less than two (2) hours. After maximum absorption has been reached, the head shall be re-established and tested for at least six (6) hours maintaining the head specified above by measured additions of water. The sum of these additions shall be the leakage for the test period.

   If ground water is present to a height of at least 6 feet above the crown of the sewer at the upper end of the pipe section to be tested, the leakage test may be made by measuring the rate of infiltration using a suitable weir or other measuring device approved by the Engineer. Whether the test is made by infiltration or exfiltration, the allowable leakage shall not exceed 100 gallons per day per inch of diameter per mile of sewer being tested.

   Where the actual leakage exceeds the allowable, the Design/Builder shall discover the cause and correct it before the sewer will be accepted. For the purpose of this subsection, a section of sewer is defined as that length of sewer between successive manholes or special structures or stubouts for future connections.

E. Low Pressure Compressed Air Test - If the leakage cannot be located by infiltration or exfiltration testing, this type test may be used. The pipeline shall be considered acceptable, when tested at an average pressure of 3.0 psi greater than the average back pressure of any groundwater that may submerge the pipe, if the section under test does not lose air at a rate greater than 0.0030 cfm per sq. ft. of internal pipe surface.

F. Deflection Test - No sooner than thirty (30) days after final backfill installation, each section of PVC pipe shall be checked for vertical deflection using an electronic deflecto-meter or a rigid "Go-No-Go" device. Vertical deflection shall not exceed five (5) percent of the inside pipe diameter for PVC pipe.

   Where the actual deflection exceeds the allowable, the Design/Builder shall discover the cause and correct it before the pipe will be acceptable. For the purpose of this subsection, a section of sewer is defined as that length of sewer between successive manholes or special structures or stubouts for future connections.

G. Cost of Testing and Repairs - Any and all work necessary to bring the line into conformance with the infiltration and deflection specifications shall be performed by the Design/Builder at no extra cost to the Owner. All apparent sources of infiltration and excessive deflection shall be repaired by the Design/Builder.

The Design/Builder shall provide all water, plugs, hoses, pumps, equipment, etc. necessary for the proper flushing and testing of the sewers.

- END OF SECTION -

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SECTION 02710

STORM DRAINS AND ROOF DRAINS

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, equipment and materials in connection with the installation of exterior underground Storm drains and Roof drains as shown on the Contract Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02200 – Earthwork

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. ASTM C 76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

B. ASTM C 150 - Standard Specification for Portland Cement.

C. ASTM C 443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

D. AWWA C 110 – Standard Specification for Ductile Iron Pipe & Fittings for Water and Other Liquids.

E. ASTM C 150 – Standard Specification for Portland Cement

F. ASTM C 443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

E. AWWA C 151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.

F. ASTM D 2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity-Flow Applications.

G. ASTM D 3350 – Standard Specifications for Polyethylene Plastic Pipe and Fitting Material.

H. ASTM F 447 – Standard Specifications for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

I. AASHTO M 198 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

J. AASHTO M 294 – Standard Specifications for Corrugated Polyethylene Pipe (12” to 36”).

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K. AASHTO Section 30 – Thermoplastic Pipe.

1.04 SUBMITTALS

A. Furnish and submit shop drawings and certificates for the piping work as outlined in the General Conditions and Division 1.

B. Special care shall be exercised during delivery, distribution and storage of the pipe and fittings to prevent damage. Damaged pipe will be rejected and shall be replaced at the Design/Builder's expense. Storage of pipe and fittings, prior to use, shall be in such a manner as to keep the materials clean and dry.

PART 2 - PRODUCTS

2.01 REINFORCED CONCRETE PIPE (RCP) - CULVERTS

A. Pipe and Fittings

1. Reinforced concrete pipe and fittings shall conform to ASTM Standard C-76, Class III, Wall thickness B, unless otherwise noted on the Contract Drawings. All pipe shall be of the sizes indicated on the drawings. Elliptical reinforcement will not be permitted. All pipe shall be aged at the manufacturing plant for at least fourteen (14) days before delivery to the job site.

B. Joints

1. Pipe shall be provided with bell and spigot or tongue and grooved ends meeting the physical, design, and performance requirements of ASTM C-990 or C-443 as appropriate. Pipe joints shall be sealed with pre-formed flexible joint sealants of an approved type and manufacture meeting the physical requirements of ASTM C-990, unless otherwise noted. If water-tight joints are specified, pipe joints shall be sealed with rubber gasket seals meeting the physical requirements of ASTM Standard C-443.

C. Joint Lubricant

1. Joint lubricant shall be of the type recommended by the manufacturer. Use of petroleum-based lubricants is not permitted.

2.02 Ductile Iron Pipe (DIP) - Roof Drains

A. Pipe

1. Shall be centrifugally cast in metal molds or sand lined molds in accordance with ANSI A21.51 (AWWA C151) of grade 70-50-05 ductile iron. The above standard covers ductile iron pipe with nominal pipe sizes from three (3) inches up to and including fifty-four (54) inches in diameter.

2. Shall have a rated working pressure of 150 psi.

3. Shall be a minimum PC 150.

B. Fittings

1. Shall be manufactured in accordance with ANSI A21.10 (AWWA C110).

2. Shall be manufactured of grade 70 - 50 - 05 ductile iron.

3. Shall have a rated working pressure of 250 psi.

4. Grey iron fittings which conform to the specifications contained herein may be used with ductile iron pipe providing the piping systems minimum working pressure is met or exceeded, and only where ductile iron fittings are not manufactured for a specific fitting.

C. Coatings and Linings for Pipe and Fittings

1. The standard asphaltic coating shall be applied to the exterior wall of the pipe and fittings in accordance with ANSI A21.51 (AWWA C151).

2. The pipe and fittings shall be cement mortar lined to twice the standard thickness in accordance with ANSI A21.4 (AWWA C104) except as specified in the pipe schedule. A seal coat of asphaltic material shall be applied to the mortar lining.

D. Joints

1. Joints shall be push on type in accordance with ANSI A21.11 (AWWA CIII).

2.03 SMOOTH LINED CORRUGATED POLYETHYLENE PIPE - STORM DRAINS

A. General

1. Smooth lined corrugated polyethylene pipe shall be used for storm drains and shall be BLUE SEAL watertight HDPE pipe as manufactured by Hancor, Inc., N-12 WT IB (Watertight) Pipe by ADS, Inc., or approved equal.

B. Pipe and Fittings

1. Smooth lined corrugated polyethylene pipe and fittings shall conform to AASHTO M252-TYPE S for 4" to 10"φ and AASHTO M294 - TYPE S for 12" to 36"φ. All pipes shall be of the sizes indicated on the drawings.

C. Joints

1. Joints shall be watertight bell and spigot type; Hancor, Inc. BLUE SEAL, ADS, Inc. N-12 WT IB, or equal.

BACKFILL MATERIAL

A. Locally available materials shall be used for pipe backfill if Design/Builder demonstrates the soils meet one of the acceptable soil classifications outlined in Table 1. Imported materials meeting the criteria of Table 1 may also be used.

TABLE 1 – ACCEPTABLE BACKFILL MATERIAL AND COMPACTION REQUIREMENTS

SOIL CLASSIFICATIONS				
DESCRIPTION	ASTM D 2321	ASTM D 2487	AASHTO M 43	Minimum Standard Proctor Density %
Graded or crushed, crushed stone, gravel	Class I	--	5 56	Dumped
Well-graded sand, gravels and gravel/sand mixtures, poorly graded sand, gravels and gravel/sand mixtures; little or no fines	Class II	GW GP SW SP	57 6	95%
Silty or clayey gravels, gravel/sand/silt or gravel and clay mixtures; silty or clayey sands, sand/clay or sand/silt mixtures	Class III	GM GC SM SC	Gravel and Sand (<10% fines)	95%

PART 3 – EXECUTION

3.01 INSPECTION

A. Each length of pipe and fittings delivered to the property shall be inspected by the Design/Builder, in the presence of the Engineer, for flaws, cracks, dimensional tolerances and compliance with the referenced Standards. The Design/Builder shall provide the Engineer with suitable templates or calipers for checking pipe dimensions. Only lengths of pipe and fittings accepted by the Engineer and so marked may be installed in the work.

3.02 INSTALLATION

A. Trenching, bedding and backfilling shall be as specified in Section 02200 - Earthwork of these Specifications and Section 2.04 Backfill Material of this Specification. Under no condition shall pipe be laid in water or when trench conditions or weather are unsuitable for such work.

B. All pipes and fittings shall be handled carefully in loading and unloading. They shall be lifted by hoists or lowered on skidways in such a manner as to avoid shock. Derricks, ropes or other suitable equipment shall be used for lowering the pipe into the trench. Pipe and fittings shall not be dropped or dumped.

C. Each pipe and fitting shall be inspected before it is lowered into the trench. The interior of

the pipe and all joint surfaces shall be thoroughly cleaned and shall thereafter be maintained clean. The open ends of pipe shall be securely plugged whenever pipe laying is not in progress.

D. Pipe and fittings shall be selected so that there will be as small a deviation as possible at the joints and so that inverts present a smooth surface. All joints shall be installed, made up and inspected in accordance with approved printed instructions of the manufacturer. Pipe and fittings which do not fit together to form a tight joint will be rejected.

E. Cutting of reinforced concrete pipe will be permitted only at connections to structures and be accomplished by abrasive saws. Cutting of other pipe materials shall be done only with mechanical cutters and in accordance with the manufacturer's recommendations.

F. Pipe shall be laid accurately to the lines and grades shown on the drawings or as directed by the Engineer.

G. If an adequate foundation for the pipe is not available at the desired depth, additional excavation shall be required and the foundation brought to desired grade with suitable granular material.

H. Rock outcroppings, very soft soils such as muck, and other similar materials not providing proper foundation support shall be removed/replaced with suitable granular material.

I. Bedding material directly under the pipe invert shall be left in native condition and not compacted. Pipe shall be placed on the bedding, then backfilled under the pipe haunches before further backfill is placed.

J. Class I materials may be dumped around pipe. Voids shall be eliminated by knifing under and around the pipe or by other approved technique.

L. Inorganic silts, and gravelly, sandy, or silty clays, and other Class IV materials (not shown in Table 1) shall not be used for pipe backfill.

M. Any section of the pipe that is found defective in material, alignment, grade, joints, or otherwise, shall be satisfactorily corrected by the Design/Builder at no additional cost to the Owner.

3.03 COMPACTION

A. General

1. Place and assure backfill and fill materials achieve an equal or higher degree of compaction than undisturbed materials adjacent to the work.

2. In no case shall degree of compaction below “Minimum Compactions” specified be accepted.

B. Compaction Requirements: Unless noted otherwise on the Drawings or more stringently by other sections of these Specifications, comply with following trench compaction criteria:

TABLE 2 – - MINIMUM COMPACTIONS

LOCATION	SOIL TYPE	DENSITY
1. Compacted select backfill:		
All applicable areas	Cohesive soil	95 percent of maximum dry density by ASTM D698
	Cohensionless soils	75 percent of maximum relative density by ASTM D4253 and ASTM D4254
2. Common trench backfill:		
Under pavements roadways surfaces, D698 within highway right-of-ways, adjacent to retaining walls	Cohesive soils	95 percent of maximum dry density by ASTM D698
	Cohensionless soils	75 percent of maximum relative density by ASTM D4253 and ASTM D4254
Under turfed, sodded plant seeded, non-traffic areas	Cohesive soils	95 percent of maximum dry density by ASTM D698
	Cohensionless soils	75 percent of maximum relative density by ASTM D4253 and ASTM D4254

C. Ensure backfill materials have moisture content within three (3) percent of optimum moisture content at the time of placement.

3.04 TESTING

A. General

1. The Design/Builder shall provide at his own expense, all labor, material, measuring devices and water necessary to perform the required tests. All tests shall be performed in the presence of the Engineer. Disposal of water shall be in accordance with Section 01010.

B. Tests by Manufacturer

1. An infiltration and exfiltration test for the pipe shall be made at the place of manufacture. Certified test results shall be submitted. The infiltration or exfiltration allowance shall not exceed 250 gallons per inch of pipe diameter per mile per day. One joint test for each two hundred feet of pipe to be furnished.

C. Exfiltration and Infiltration Tests

1. The pipe shall be tested for leakage by exfiltration and/or infiltration tests after installation and back-filling. Exfiltration or infiltration shall not exceed 250 gallons per inch of pipe diameter per mile per day. If the leakage is greater than that volume allowed, the Design/Builder shall locate and repair or replace defective joints or pipes at his expense until the leakage is within the specified allowance.

2. Exfiltration tests shall be performed on all pipe where the ground- water elevation is one foot above the crown of the pipe or less. Exfiltration tests shall impose a head of at least 2 feet on the pipe at the maximum elevation of the length to be tested. An allowance of an additional 10 percent of gallonage shall be permitted for each additional 2 feet of head over the initial 2 foot minimum. Infiltration tests shall be performed for all other pipe where the groundwater table is greater than one foot above the crown of the pipe.

-END OF SECTION-

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SECTION 02910

FINAL GRADING AND LANDSCAPING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, equipment, and materials necessary for final grading, topsoiling, seeding, and miscellaneous site work not included under other Sections, but required to complete the work as shown on the Drawings and specified herein. Under this Section, all areas of the project site disturbed by excavation, materials storage, temporary roads, etc., shall be reseeded as specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02276 - Erosion and Sedimentation Control.

B. Section 02500 - Surface Restoration.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01300 - Submittals.

1. Product Data

2. Certification of all materials

3. Three (3) copies of composition and germination certification and of test results for grass seed.

PART 2 -- PRODUCTS

2.01 DESIGN/BUILDER'S RESPONSIBILITIES

A. Furnish and submit certification for the materials used as specified in the General Conditions, Division 1 and Division 2.

2.02 TOPSOIL

A. Upon completion and Engineer's approval of the rough grading, the Design/Builder shall place the topsoil over all areas disturbed during construction under any contract except those areas which will be paved, graveled or rip rapped. Topsoil shall not be placed in a frozen or muddy condition and shall contain no toxic materials harmful to grass growth. Topsoil shall be as defined under Section 02200 - Earthwork.

2.03 WATER

A. Water shall be furnished to the Design/Builder by the Owner from existing facilities as directed by the Engineer.

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B. The Design/Builder shall furnish all hoses and connections necessary to complete the landscaping work.

2.04 FERTILIZER

A. Fertilizer shall be a complete commercial fertilizer with components derived from commercial sources. Fertilizer composition shall be determined from field soil sampling in appropriate number taken by the Design/Builder and analyzed by the Cooperative Extension Service Soil Testing Laboratory at VPI & SU or by a reputable commercial laboratory. Design/Builder shall furnish fertilizer in accordance with the recommendations of the testing laboratory and Section 3.32 of the Virginia Erosion and Sediment Control Handbook (VESCH).

B. Fertilizer shall be delivered in standard size bags marked with the weight, analysis of contents, and the name of the manufacturer. Fertilizer shall be stored in weatherproof storage areas and in such a manner that its effectiveness will not be impaired.

2.05 LIME

A. Design/Builder shall use an agricultural grade of limestone. Quantity shall be determined from field soil sampling in appropriate number taken by the Design/Builder and analyzed by the Cooperative Extension Service Soil Testing Laboratory at VPI & SU or by a reputable commercial laboratory. Design/Builder shall furnish lime in accordance with the recommendations of the testing laboratory and Section 3.32 of the VESCH.

B. At least 50% shall pass a No. 200 U.S.S. mesh sieve. At least 90% shall pass a No. 100 U.S.S. mesh sieve and 100% shall pass a No. 10 U.S.S. mesh sieve. Total carbonates shall not be less than 80% or 44.8% Calcium Oxide equivalent. For the purpose of calculation, total carbonates shall be considered as Calcium Carbonate.

2.06 GRASS SEED

A. Provide the kinds and amounts of seed to be seeded in areas disturbed by the construction work. All seed shall bear an official “Certified Seed” labeled and meet the requirements in Section 3.32 of the VESCH. All seed must have been certified by Virginia Crop Improvement Association within twelve (12) months immediately preceding the planting of such material on the job.

B. The inoculant for treating legume seed mixture shall be a pure culture of nitrogen-fixing bacteria prepared specifically for the species. Inoculants shall not be used later than the date indicated on the container. Inoculants should be applied at two times the supplier’s recommended rate on dry seedings and five times the recommended rate when included in hydroseeder slurry. The quality of the seed shall conform to the following:

Type	Minimum Seed Purity (%)	Minimum Germination (%)	Maximum Weed Seed (%)
Zoysia Grass	97	85	0.50
Perennial Ryegrass	98	90	0.50
Annual Ryegrass	97	90	0.50

Type	Minimum Seed Purity (%)	Minimum Germination (%)	Maximum Weed Seed (%)
Weeping Lovegrass	98	87	0.50
German Millet	98	85	0.50
Cereal (Winter) Rye	98	85	0.50

C. Seed mixtures to be used on the project shall be as follows:

P - 90#/acre Zoysia Grass , 10#/acre Perennial Ryegrass,

TW - 50#/acre Annual Ryegrass, 50#/acre Cereal (Winter) Rye

TSP -- 100#/acre Annual Ryegrass

TSU -- 50#/acre German Millet

Note:
PW - Permanent Seeding
TW - Temporary Winter Seeding
TSP - Temporary Spring Seeding
TSU - Temporary Summer Seeding

D. On cut and fill slopes 2:1 or steeper add 20#/acre of Weeping Lovegrass to the P seed mixture in the Spring and add 20#/acre Annual Ryegrass in Fall and Winter.

2.07 WOOD CELLULOSE FIBER MULCH

A. For use in hydroseeding grass seed in combination with fertilizers and other approved additions, shall consist of especially prepared wood cellulose fibers such as "Conwed", "Silva-Fiber", or approved substitute, and have no growth or germination inhibiting factors, and be dyed green.

B. The wood cellulose fiber shall have the additional characteristic of dispersing rapidly in water to form a homogeneous slurry and remain in such state when agitated in the hydraulic mulching unit, or adequate equal, with the specified materials.

C. When applied, the wood cellulose fiber with additives will form an absorptive mat but not a plant inhibiting membrane, which will allow moisture, natural or mechanical, to percolate into underlying soil.

D. Fiber mulch can be applied over top of newly seeded areas immediately after seed mixture is applied to soil bed or applied as part of the hydroseeded slurry containing the seed mixture. Anchored straw mulch shall be used in place of fiber mulch during hot and dry summer months and late fall. Fiber mulch can be used to tack (anchor) straw mulch. All fiber mulch shall adhere to requirements set forth in Section 3.35 of the VESCH.

E. The mulch shall be supplied, compressed in packages containing 50 pounds of material having an equilibrium air dry moisture content at time of manufacture of 12% plus or minus 2%. Wood cellulose fiber mulch shall be stored in a weatherproof storage area and in such a manner that effectiveness will not be impaired.

2.08 STRAW MULCH

A. Straw used for mulch shall be wheat or oats. Straw shall be undamaged, air dry, threshed straw, free of undesirable weed seed. Straw mulch shall be spread by hand or machine and must be anchored or tacked down. Straw mulch is not required for seeded areas treated with a temporary soil stabilizer. All straw mulch shall adhere to requirements set forth in Section 3.35 of the VESCH.

2.09 TEMPORARY SOIL STABILIZER

A. The temporary agent for soil erosion control shall consist of an especially prepared highly concentrated powder which, when mixed with water, forms a thick liquid such as "Enviroseal 2001" by Enviroseal Corporation, "Terra Control" by Quattro Environmental, Inc., or "CHEM-CRETE ECO-110" by International CHEM-CRETE Corporation, and having no growth or germination inhibiting factors. The agent shall be used for hydroseeding grass seed in combination with other approved amendments resulting in a highly viscous slurry which, when sprayed directly on the soil, forms a gelatinous crust.

2.10 SOIL STABILIZATION BLANKET (SSB)

A. The SSB shall be as specified in Section 02276 - Erosion and Sedimentation Control.

2.11 SYNTHETIC SOIL STABILIZATION MAT (SSM)

A. The SSM shall be as specified in Section 02276 – Erosion and Sedimentation Control.

2.12 RIPRAP AND HERBICIDES

A. Furnish and install sufficient quantity of landscape gravel or riprap to cover over the ground to a minimum 4-inch depth for gravel and 24-inch depth for riprap, unless otherwise noted, or indicated on the Drawings. Also furnish and apply an approved herbicide to the subgrade surface just prior to installing the landscape gravel or riprap.

B. During placing, the stone shall be graded so that the smaller stones are uniformly distributed through the mass. The Design/Builder may place the stone by mechanical methods, augmented by hand placing where necessary or ordered by the Engineer. The placed riprap shall form a properly graded, dense, neat layer of stone.

C. All topsoil and vegetative matter shall be removed from the subgrade surfaces prior to the application of the weed killer (herbicide) and to the placement of landscape gravel or riprap. Apply commercial-type herbicide as preemergence control of miscellaneous grasses and broadleaf weeds in granular or liquid form such as "Treflan", "Dymid", or approved substitute. Methods and rates of application shall be in strict compliance to manufacturer's directions and acceptable to the Engineer.

D. The herbicide selected shall be safe for use around ornamental plantings, have long-lasting weed control, and shall be resistant to leaching away under excessive rainfall.

E. A second application of the herbicide shall be made on the surface of the landscape gravel or riprap sometime after the first six (6) months, but not later than twelve (12) months. Same methods and rates apply as specified previously.

2.13 TREE SHRUB PLANTING

A. Provide trees and shrubs as shown on the Drawings and as specified in Section 3.37 of VESCH.

PART 3 -- EXECUTION

3.01 GRADING

A. After approval of the rough grading, the Design/Builder shall commence his preparations of the subgrade for the various major conditions of the work as follows:

1. Bare soil for riprap area at subgrade (24-inches below final grade, or as directed by the Engineer).

2. Topsoil for lawn and road shoulder seed area - scarify 2-inch depth of subgrade (4-inches below final grade) prior to placing topsoil.

B. Final surface grading of the topsoiled, landscape graveled, and riprapped areas shall be mechanically raked or hand raked to an even finished surface alignment.

3.02 TOPSOIL

A. Topsoil shall be spread in place for quantity required for lawn and road shoulder seed areas at 4-inch consolidated depth, and sufficient quantity for certain plant beds and backfill for shrubs and trees as specified.

B. Topsoil shall be hospitable as a growth medium meeting all requirements as indicated by Sections 3.30 & 3.32 of VESCH.

3.03 HYDROSEEDING AND GRASS

A. The Design/Builder shall grow a stand of grass on disturbed areas. The Design/Builder shall be responsible for any defects in the grass planted during the correction period specified in the contract documents.

B. The Design/Builder's work shall include the preparation of the topsoil and bare soil seed bed, application of fertilizer, limestone, mulching, inoculant, temporary soil stabilizer, watering, and other operations necessary to provide a satisfactory growth of sod.

C. When hydraulic seeding method is used, include all additives and amendments required. A "Reinco", "Finn", or "Bowie" type hydromulcher with adjustable nozzles and extension hoses, or approved substitute, shall be utilized. General capacity of tank should range from 500 to 2,500 gallons, or as approved by the Engineer.

D. Hydraulic seeding shall be carried out in three steps. Step one shall consist of the application of lime. In step two the seed mixture shall be mixed with the fertilizer, wood cellulose fiber mulch, and any required inoculants and applied to the seed bed. The seed

mixture can be applied as a separate process prior to the application of the slurry mixture. Step three shall consist of application of top dressing during the first spring or fall, whichever comes first, after step two.

E. Top dressing shall consist of a commercial grade fertilizer plus Nitrogen or other analysis as may be recommended by soil testing. Types and application rates of seed mixtures shall be as shown in the Seeding Schedule.

F. Ingredients for the mixture and steps should be dumped into a tank of water and thoroughly mixed to a homogeneous slurry and sprayed out under a minimum of 300-350 pounds pressure, in suitable proportions to accommodate the type and capacity of the hydraulic machine to be used. Applications shall be evenly sprayed over the ground surface. The Design/Builder shall free the topsoil of stones, roots, rubbish, and other deleterious materials and dispose of same off the site. The bare soil, except existing steep embankment area, shall be rough raked to remove stones, roots, and rubbish over 4-inches in size, and other deleterious materials and dispose of same off the site.

G. No seeding should be undertaken in windy or unfavorable weather, when the ground is too wet to rake easily, when it is in a frozen condition, or too dry. Any bare spots shown in two to three weeks shall be recultivated, fertilized at half the rate, raked, seeded, and mulched again by mechanical or hand broadcast method acceptable to the Engineer.

H. Areas that have been seeded with a temporary seed mixture shall be mowed to a height of less than 2-inches and scarified prior to seeding with the permanent seed mixture.

I. The Design/Builder shall provide, at his own expense, protection for all seeded areas against trespassing and damage at all times until acceptance of the work. Slopes shall be protected from damage due to erosion, settlement, and other causes and shall be repaired promptly at the Design/Builder's expense.

J. The Design/Builder shall water newly seeded areas of the lawn and road shoulder mix once a week until the grasses have germinated sufficiently to produce a healthy turf, or unless otherwise directed by the Engineer. Each watering shall provide three (3) gallons per square yard. The Design/Builder shall furnish all necessary hoses, sprinklers, and connections.

K. The first and second cutting of the lawn grasses only shall be done by the Design/Builder. All subsequent cuttings will be done by the Owner's forces in a manner specified by the Design/Builder.

3.04 SOIL STABILIZATION BLANKET (SSB)

A. All channels and slopes indicated on the Drawings shall be lined with a SSB. The area to be covered shall be properly graded and hydroseeded before the blanket is applied. Installation shall be in accordance with Section 02276, Erosion and Sedimentation Control.

3.05 SOIL STABILIZATION MAT (SSM)

A. All channels and slopes indicated on the Drawings shall be lined with a SSM. The area to be covered shall be properly graded before the mat is applied. Once the mat is placed and anchored, the area shall be seeded and mulched in accordance to this Specification and Section 3.36 of the VESCH. Installation shall be in accordance with Section 02276, Erosion and Sediment Control.

3.06 CLEANUP

A. The Design/Builder shall remove from the site all subsoil excavated from his work and all other debris including, but not limited to, branches, paper, and rubbish in all landscape areas, and remove temporary barricades as the work proceeds.

B. All areas shall be kept in a neat, orderly condition at all times. Prior to final acceptance, the Design/Builder shall clean up the entire landscaped area to the satisfaction of the Engineer.

3.07 SEEDING SCHEDULE

A. All seeding and mulching to be completed by the Design/Builder shall conform to Sections 3.32 and 3.35 of the VESCH. No permanent seeding shall be performed from March 1 - May 1 and September 1 – February 31. Temporary seed mixtures will be used during these times if seeding is necessary. Areas seeded with temporary seed mixtures shall be reseeded by the Design/Builder at no additional cost to the Owner with permanent seed as directed by the Engineer.

B. Application rates of seed mixtures, lime, fertilizer, mulch and top dressing are shown in the schedule.

SEEDING SCHEDULE

Application Rates (Pounds/Acre)

Seed[b] Mixture	Planting Season	Lime[a]	Seed	Fertilizer[a,d]	Straw[e] Mulch	Topdressing[a]	Annual Fertilizer	Comments
P	Feb. 15-April 30 Sept. 1-Oct. 31	4000	200	1000 of 10-20-10	4000	500 of 10-10-10 60 of Nitrogen	Same as Topdressing	Preferred planting seasons are May 1 – Aug. 31.
TW	Sept. 1-Feb. 15	-[c]	100	600	4000	-	-	Over seed with Type P seed mixture during next planting season.
TSP	Feb. 16-Apr. 30	-[c]	100	600	4000	-	-	Over seed with Type P seed mixture during next planting season.
TSU	May 1-Aug. 31	-[c]	50	600	4000	-	-	Over seed with Type P seed mixture during next planting season.

Footnotes:

a. Application rates and/or chemical analysis shall be confirmed or established by soil test.

b. On cut and fill slopes 2:1 or steeper add 20#/acre of Weeping Lovegrass to the P seed mixture in the Spring and add 20#/acre Annual Ryegrass in Fall and Winter.

c. Lime requirements for temporary seeding shall be based on pH test results for site, according to the following table:

pH Test	Recommended Application
Below 4.2	3 tons/acre
4.2 to 5.2	2 tons/acre
5.2 to 6	1 ton/acre

d. Fertilizer shall be a 10-20-10 mix or equivalent nutrients.

e. Alternative methods of mulching may be utilized. Alternative methods shall conform to requirements in the Virginia Erosion and Sediment Control Handbook.

- END OF SECTION -

SECTION 02920

BIORETENTION CELL

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

A. The Design/Builder is responsible for installing bioretention cell(s) to manage post-construction stormwater runoff. This item covers the work necessary for installation of the bioretention cell. The Design/Builder shall furnish all material, labor, and equipment necessary for the proper installation of this facility.

B. All excavations shall be in conformity with the lines, grades, and cross sections shown on the Contract Drawings or established by the Engineer.

C. It is the intent of this Specification that the Design/Builder conducts the construction activities in such a manner that erosion of disturbed areas and off site sedimentation be absolutely minimized.

D. Installation of the bioretention cell should occur after the contributing watershed has been stabilized. It shall be the responsibility of the Design/Builder to make any necessary repairs if the performance of the system is impacted by sediment during construction or due to improper construction sequencing. The Design/Builder shall implement additional measures as deemed necessary to prevent sediment impacts to the bioretention cell during construction.

E. Activities related to the installation of a bioretention cell shall include but not be limited to the following items of work:

1. Excavation of bioretention basin

2. Preparation of bioretention soil media

3. Installation of bioretention cell components, including drainage layers, overflow structures, drainage pipes, and soil media

4. Installation of bioretention plants

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02100 - Clearing, Grubbing, and Site Preparation

B. Section 02200 – Earthwork

C. Section 02276 – Erosion and Sedimentation Control

C. Section 02500 – Surface Restoration

D. Section 02604 – Utility Structures

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E. Section 02710 – Storm Drains and Roof Drains

F. Section 02910 – Final Grading and Landscaping

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of these specifications, all work hereunder shall conform to the applicable requirements of the referenced portions of the following documents, to the extent that the requirements therein are not in conflict with the provisions of this Section.

1. Code of Virginia Title 10-1, Chapter 5, Article 4
2. Virginia Stormwater Management Handbook

3. Local stormwater permitting authority

4. Virginia Department of Transportation (VDOT) 2016 Road and Bridge Specification Book

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the General Conditions Division 1 and Section 01 33 00 – Submittal Procedures, the Design/Builder shall submit the following:

1. Name and location of all material suppliers.

2. Certificate of compliance with the standards specified above for each source of each material.

3. List of disposal sites for waste and unsuitable materials and all required permits for use of those sites.

4. Analysis results for soil media before placement in bioretention cell.

5. Inspection/maintenance reports for the bioretention cell until the Bioretention Operation and Maintenance Agreement is in effect.

1.05 WARRANTEE

A. All work related to the installation of the bioretention cell shall be subject to the one-year correction period specified in the Contract Documents.

PART 2 -- MATERIALS

2.01 MATERIALS

A. Materials for use in bioretention cells shall be in accordance with the Virginia Stormwater Management Handbook and this specification.

2.02 SOIL MEDIA

A. The soil media should be uniform and free of stones, stumps, roots or other similar material greater than 2 inches. No other materials or substances shall be mixed or dumped within the bioretention area that may be harmful to plant growth or prove a hindrance to the planting or maintenance operations. The soil media shall be free of noxious weeds.

B. The soil media should be a homogenous mix of 85-88 percent by volume sand (USDA Soil Textural Classification), 8 to 12 percent fines (silt and clay), and 3 to 5 percent organic matter (such as peat moss). Higher (12 percent) fines content should be reserved for areas where TN is the target pollutant. In areas where phosphorus is the target pollutant, lower (8 percent) fines should be used.

C. Soil media should be analyzed by the Virginia Department of Agriculture and Consumer Services lab or other approved testing facility. If more than one sample is tested, all testing shall be performed by the same testing facility. In addition to having a textural analysis performed, the soil shall be tested for and shall meet the following criteria:

1.	pH range	5.5 – 6.5
2.	Phosphorus Index	10 - 30

D. The soil media should be tested to determine an actual drainage rate after placement. The permeability should fall between 1 and 6 inches per hour. A permeability of 1-2 inches per hour is preferred. The infiltration rates should be approximately 2 in/hr and 1 in/hr for 8% and 12% fines, respectively.

2.03 MULCH

A. Mulch shall be placed in a uniform 3” layer above the soil media.

1. Mulch shall be triple shredded hardwood mulch, free of weed seeds, soil, roots, and other material that is not bole or branch wood or bark. No pine needles, pine bark, or wood chips shall be used.

2. Mulch shall be at least 6 months old.

2.04 PLANTS

A. Plant materials shall be as specified on the planting plan.

1. All plant material shall conform to the standards of the current edition of the American Standard for Nursery Stock as approved by the American Standards Institute, Inc. All plant grades shall be those established by the current edition of American Standards for Nursery Stock.

2. All plant materials shall have normal, well-developed branches and vigorous root systems, and be free from physical defects, plant diseases, and insect pests.

3. All plant materials shall be tagged for identification when delivered.

4. Plant size should be no less than 2.5” diameter at breast height (DBH) for trees, 3-gallon for shrubs, and 1-quart for herbaceous plants.

2.05 OUTLET STRUCTURES

A. The primary overflow structure shall consist of a precast watertight concrete drop inlet and reinforced concrete pipe.

1. The sizes of the concrete drop inlet and concrete pipe shall be as detailed on the Contract Drawings.

2. Materials shall be as described in Sections 02604 and 02710 of these specifications.

B. If required, an emergency overflow spillway shall be constructed in the earthen impoundment as shown on the Contract Drawings.

1. The emergency overflow spillway shall be installed on the earthen impoundment and lined with crushed stone, minimum Grade B riprap.

2. Grade B riprap for the spillway and outlet protection apron shall be as specified in Section 204 of the VDOT Standard Specifications.

3. Stabilization for the remainder of the earthen impoundment shall be as shown on the Contract Drawings.

PART 3 -- EXECUTION

3.01 CONSTRUCTION SEQUENCING

A. The bioretention cell shall not be constructed until the contributing watershed has been stabilized.

1. If the cell is excavated before the watershed is stabilized, additional excavation may be required to remove accumulated sediments from the base of the cell in order to restore the permeability of the in-situ soil.

2. If soil media is installed before the watershed is stabilized, removal and replacement of all or a portion of the media may be required if the media is clogged by sediment from the site.

3.02 EXCAVATION

A. Excavation of the bioretention cell shall be completed so as to minimize compaction of the subsoil beneath the cell.

1. When possible, excavation hoes shall be used to remove original soil.

2. If cells are excavated using a loader, use low ground pressure (LGP) equipment (< 6 psi). Engineer shall approve equipment in advance.

3. Use of equipment with narrow tracks, narrow tires, rubber tires with large lugs, or high pressure tires shall be avoided.

B. If subsoil beneath the cell is compacted during excavation of the cell, compaction shall be alleviated by using a primary tilling operation such as a chisel plow, ripper, or subsoiler to refracture the soil profile through the 12 inch compaction zone. The method of refracturing must be approved by the Engineer. Rototillers are not acceptable.

3.03 OUTLET STRUCTURE INSTALLATION

A. The primary outlet of the bioretention cell shall consist of a precast concrete drop inlet and concrete pipe. The drop inlet and pipe shall be installed in accordance with Sections 02604 and 02710.

B. The bioretention cell may be surrounded by an earthen impoundment.

1. Fill material for the impoundment shall be free of roots, woody vegetation, rocks, and other objectionable materials.

2. Fill shall be placed in 6 to 8 inch layers and compacted.

3. Construct the embankment to an elevation 10 percent higher than the design height to allow for settling.

4. Install the emergency spillway in the earthen impoundment and line with Class B riprap.

5. Stabilize the remainder of the impoundment as shown on the Contract Drawings immediately upon completion of the grading.

3.04 SOIL MEDIA PREPARATION

A. The components of the soil media (sand, silt and clay fines, organic material, and any other prescribed additives) shall be thoroughly mixed so that the media is homogeneous.

B. Prior to placement in the bioretention cell, the soil media shall be tested as described in Part 2 of this Section. Analysis criteria for the soil media are listed herein. The soil analysis shall be submitted to the Engineer prior to placement in the bioretention cell.

3.05 SOIL MEDIA INSTALLATION

A. Soil media shall be placed in the bioretention cell above the sand, choking stone, and gravel drainage layer.

1. Soil media shall be installed in lifts of 12 – 18 inches. Water lifts lightly to encourage natural settlement.

2. Heavy equipment shall not be used within the bioretention cell. The use of heavy equipment around the perimeter of the cell is acceptable to supply soils and sand.

3. Grade soil media by hand or with light (LGP) equipment. Minimal compaction may be applied with the bucket from a dozer or backhoe.

4. Backfill the remainder of the soil media to final grade. Overfill by 10 – 15% to allow for settlement of soil media.

3.06 MULCH INSTALLATION

A. Mulch all plantings and the earth saucers surrounding plantings to a depth of 3 inches immediately after plant installation.

1. Do not place mulch in contact with trunk of trees or shrubs.

2. Aged (6 months or older) triple shredded hardwood mulch is the only allowable type of mulch. Pine mulch and wood chips shall not be used because of their tendency to float and clog the outlet structure.

3.07 PLANT INSTALLATION

A. Plants shall be installed in locations and with spacing as shown on the planting plan.

1. Root stock of the plant material shall be kept moist during transport and on-site storage.

2. The diameter of the planting pit shall be at least six inches larger than the diameter of the root ball.

3. The plants shall be installed such that 1/3 of the root ball is above the soil media.

4. Set and maintain the plant straight during the entire planting process.

5. Pack backfill soil around base of root ball to stabilize. Backfill remainder of planting pit with soil media in 12” layers and water each layer until settled.

6. Trees shall be braced using 2” x 2” stakes for the first growing season and as necessary thereafter. Stakes shall be equally spaced around the outside of the tree ball.

7. Plants shall be watered thoroughly after installation and twice every week until they are established. Watering may be required periodically after establishment during periods of drought.

8. The soil media specifications provide enough organic material to adequately supply nutrients from natural cycling. The primary function of the bioretention structure is to improve water quality. Adding fertilizers defeats, or at a minimum impedes this goal.

3.08 DRAINAGE TESTING

A. On-site infiltration testing shall be performed by a licensed soil scientist after the bioretention cell has been completed. Infiltration test results shall be sent to the Engineer.

1. The permeability should range between 1 and 6 inches per hour.

2. A permeability of 1-2 inches per hour is preferred.

B. If the infiltration rate is outside the acceptable range, remediation shall be required.

1. If soils and/or mulch are clogged with sediment, remove and replace the affected layers. Dispose of removed soil and/or mulch in an appropriate offsite location.

2. If infiltration rate does not improve, consult Engineer for recommendations.

3.09 LONG-TERM INSPECTION AND MAINTENANCE

A. Monthly and after every rainfall during the first year:

1. Inspect trees and shrubs and replace specimens that did not survive planting or are severely diseased.

2. Remove mulch from outlet structures.

3. Repair damaged tree stakes and replace with longer stakes if necessary.

4. Inspect inlets for gullies, rills, and other signs of erosion. Add riprap and armor as necessary.

5. Contact Engineer if standing water remains for longer than 48 hours. Remediation may be necessary.

6. Inspect edge of bioretention cell for excess settlement relative to surrounding soil. Maintain 3:1 maximum slopes.

B. Annually:

1. Add coarse shredded hardwood mulch to maintain 3” thick layer over bioretention soil media. Grassed areas should not receive mulch.

2. Mulch shall be removed and replaced every 2-3 years to ensure that design volume is maintained and to increase surface infiltration.

3. Remove dead branches, debris, and litter from cell.

4. Inspect drop inlet for blockage and clean as necessary.

5. Test planting soil for pH. If the pH is below 5.2, apply limestone. If the pH is above 7.0, apply iron sulfate plus sulfur.

6. Remove particular species that fail to establish after multiple attempts.

7. Remove tree stakes after 2 years.

C. Inspection and Maintenance Reporting

- All inspection and maintenance activities should be reported. Copies of the reports shall be sent to the Engineer on a monthly basis. The reports shall include the following.

  a. Date of inspection

b. Name of inspector
c. Condition of the bioretention cell
d. Perimeter
e. Inlet device
f. Pretreatment area
g. Vegetation
h. Soils and mulch
i. Outlet structure(s)
j. Receiving water
k. Maintenance work performed
l. Issues noted for future maintenance

- END OF SECTION -

SECTION 03100

CONCRETE FORMWORK

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Provide materials, labor, and equipment required for the design and construction of all concrete formwork, bracing, shoring and supports in accordance with the provisions of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03200 - Reinforcing Steel

B. Section 03250 - Concrete Accessories

C. Section 03290 - Joints in Concrete

D. Section 03300 - Cast-in-Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Virginia Uniform Statewide Building Code

2. ACI 318 - Building Code Requirements for Structural Concrete

3. ACI 301 - Specifications for Structural Concrete for Buildings

4. ACI 347 - Recommended Practice for Concrete Formwork

5. U.S. Product Standard for Concrete Forms, Class I, PS 1

6. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures.

1. Manufacturer's data on proposed form release agent

2. Manufacturer's data on proposed formwork system including form ties

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1.05 QUALITY ASSURANCE

A. Concrete formwork shall be in accordance with ACI 301, ACI 318, and ACI 347.

PART 2 -- PRODUCTS

2.01 FORMS AND FALSEWORK

A. All forms shall be smooth surface forms unless otherwise specified.

B. Wood materials for concrete forms and falsework shall conform to the following requirements:

1. Lumber for bracing, shoring, or supporting forms shall be Douglas Fir or Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS20. All lumber used for forms, shoring or bracing shall be new material.

2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine high density overlaid (HDO) plywood manufactured especially for concrete formwork and shall conform to the requirements of PS1 for Concrete Forms, Class I, and shall be edge sealed. Thickness shall be as required to support concrete at the rate it is placed, but not less than 5/8-inch thick.

C. Other form materials such as metal, fiberglass, or other acceptable material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line and grade indicated may be submitted to the Engineer for approval, but only materials that will produce a smooth form finish equal or better than the wood materials specified will be considered.

2.02 FORMWORK ACCESSORIES

A. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 7/8-inch, and all such fasteners shall be such as to leave holes of regular shape for reaming.

B. Form ties for water-retaining structures shall have integral waterstops. Removable taper ties may be used when acceptable to the Engineer. A preformed mechanical EPDM rubber plug shall be used to seal the hole left after the removal of the taper tie. Plug shall be X-Plug by the Greenstreak Group, Inc., or approved equal. Friction fit plugs shall not be used.

C. Form release agent shall be a blend of natural and synthetic chemicals that employs a chemical reaction to provide quick, easy and clean release of concrete from forms. It shall not stain the concrete and shall leave the concrete with a paintable surface. Formulation of the form release agent shall be such that it would minimize formation of "bug holes" in cast-in-place concrete.

PART 3 -- EXECUTION

3.01 FORM DESIGN

A. Forms and falsework shall be designed for total dead load, plus all construction live load as outlined in ACI 347. Design and engineering of formwork and safety considerations during construction shall be the responsibility of the Design/Builder.

B. Forms shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. The maximum deflection of facing materials reflected in concrete surfaces exposed to view shall be 1/240 of the span between structural members.

C. All forms shall be designed for predetermined placing rates per hour, considering expected air temperatures and setting rates.

3.02 CONSTRUCTION

A. The type, size, quality, and strength of all materials from which forms are made shall be subject to the approval of the Engineer. No falsework or forms shall be used which are not clean and suitable. Deformed, broken or defective falsework and forms shall be removed from the work.

B. Forms shall be smooth and free from surface irregularities. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Joints between the forms shall be sealed to eliminate any irregularities. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to a practical minimum.

C. Forms shall be true to line and grade, and shall be sufficiently rigid to prevent displacement and sagging between supports. Curved forms shall be used for curved and circular structures. Straight panels joined at angles will not be acceptable for forming curved structures. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly-placed concrete. Facing material shall be supported with studs or other backing which shall prevent both visible deflection marks in the concrete and deflections beyond the tolerances specified.

D. Forms shall be mortar tight so as to prevent the loss of water, cement and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1 to 1-1/2 inch diameter polyethylene rod held in position to the underside of the wall form.

E. All vertical surfaces of concrete members shall be formed, and side forms shall be provided for all footings, slab edges and grade beams, except where placement of the concrete against the ground is called for on the Drawings. Not less than 1-inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

F. All forms shall be constructed in such a manner that they can be removed without hammering or prying against the concrete. Wood forms shall be constructed for wall openings to facilitate loosening and to counteract swelling of the forms.

G. Adequate clean-out holes shall be provided at the bottom of each lift of forms. Temporary openings shall be provided at the base of column forms and wall forms and at other points to facilitate cleaning and observation immediately before the concrete is deposited. The size, number and location of such clean-outs shall be as acceptable to the Engineer.

H. Construction joints shall not be permitted at locations other than those shown or specified, except as may be acceptable to the Engineer. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. For flush surfaces at construction joints exposed to view, the contact surface of the form sheathing over the hardened concrete in the previous placement shall be lapped by not more than 1 inch. Forms shall be held against hardened concrete to prevent offset or loss of mortar at construction joints and to maintain a true surface.

I. The formwork shall be cambered to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete and due to construction loads. Set forms and intermediate screed strips for slabs accurately to produce the designated elevations and contours of the finished surface. Ensure that edge forms and screed strips are sufficiently strong to support vibrating screeds or roller pipe screeds if the nature of the finish specified requires the use of such equipment. When formwork is cambered, set screeds to a like camber to maintain the proper concrete thickness.

J. Positive means of adjustment (wedges or jacks) for shores and struts shall be provided and all settlement shall be taken up during concrete placing operation. Shores and struts shall be securely braced against lateral deflections. Wedges shall be fastened firmly in place after final adjustment of forms prior to concrete placement. Formwork shall be anchored to shores or other supporting surfaces or members to prevent upward or lateral movement of any part of the formwork system during concrete placement. If adequate foundation for shores cannot be secured, trussed supports shall be provided.

K. Runways shall be provided for moving equipment with struts or legs. Runways shall be supported directly on the formwork or structural member without resting on the reinforcing steel.

3.03 TOLERANCES

A. Unless otherwise indicated in the Contract Documents, formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits listed in ACI 117.

B. Structural framing of reinforced concrete around elevators and stairways shall be accurately plumbed and located within 1/4 in. tolerance from established dimensions.

C. The Design/Builder shall establish and maintain in an undisturbed condition and until final completion and acceptance of the project, sufficient control points and bench marks to be used for reference purposes to check tolerances. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by Desigin/Builder's personnel and by the Engineer and shall be in sufficient number and properly installed. During concrete placement, the Design/Builder shall continually monitor plumb and string line form positions and immediately correct deficiencies.

D. Regardless of the tolerances specified, no portion of the building shall extend beyond the legal boundary of the building.

3.04 FORM ACCESSORIES

A. Suitable moldings shall be placed to bevel or round all exposed corners and edges of beams, columns, walls, slabs, and equipment pads. Chamfers shall be 3/4 inch unless otherwise noted.

B. Form ties shall be so constructed that the ends, or end fasteners, can be removed without causing appreciable spalling at the faces of the concrete. After ends, or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than 2 inches from the formed face of the concrete that is exposed to wastewater or enclosed surfaces above the wastewater, and not less than 1 inch from the formed face of all other concrete. Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as specified in Section 03350 - Concrete Finishing. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete member. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. No snap ties shall be broken off until the concrete is at least three days old. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste.

3.05 APPLICATION - FORM RELEASE AGENT

A. Forms for concrete surfaces that will not be subsequently waterproofed shall be coated with a form release agent. Form release agent shall be applied on formwork in accordance with manufacturer's recommendations.

3.06 INSERTS AND EMBEDDED ITEMS

A. Sleeves, pipe stubs, inserts, anchors, expansion joint material, waterstops, and other embedded items shall be positioned accurately and supported against displacement prior to concreting. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.

3.07 FORM CLEANING AND REUSE

A. The inner faces of all forms shall be thoroughly cleaned prior to concreting. Forms may be reused only if in good condition and only if acceptable to the Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture. Unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the Engineer.

3.08 FORM REMOVAL AND SHORING

A. Forms shall not be disturbed until the concrete has attained sufficient strength. Sufficient strength shall be demonstrated by structural analysis considering proposed loads, strength of forming and shoring system, and concrete strength data. Shoring shall not be removed until the supported member has acquired sufficient strength to support its weight and the load upon it. Members subject to additional loads during construction shall be adequately shored to sustain all resulting stresses. Forms shall be removed in such manner as not to impair safety and serviceability of the structure. All concrete to be exposed by form removal shall have sufficient strength not to be damaged thereby.

B. Provided the strength requirements specified above have been met and subject to the Engineer's approval, forms may be removed at the following minimum times. The Design/Builder shall assume full responsibility for the strength of all such components from which forms are removed prior to the concrete attaining its full design compressive strength. Shoring may be required at the option of the Engineer beyond these periods.

Ambient Temperature (°F.) During Concrete Placement

	Over 95°	70°-95°	60°-70°	50°-60°	Below 50°
Walls	5 days	2 days	2 days	3 days	Do not remove until directed by Engineer (7 days minimum)
Columns	7 days	2 days	3 days	4 days	
Beam Soffits	10 days	7 days	7 days	7 days	
Elevated Slabs	12 days	7 days	7 days	7 days	

C. When, in the opinion of the Engineer, conditions of the work or weather justify, forms may be required to remain in place for longer periods of time.

D. An accurate record shall be maintained by the Design/Builderof the dates of concrete placings and the exact location thereof and the dates of removal of forms. These records shall be available for inspection at all times at the site, and two copies shall be furnished the Engineer upon completion of the concrete work.

3.09 RESHORING

A. When reshoring is permitted or required the operations shall be planned in advance and subjected to approval by the Engineer.

B. Reshores shall be placed after stripping operations are complete but in no case later than the end of the working day on which stripping occurs.

C. Reshoring for the purpose of early form removal shall be performed so that at no time will large areas of new construction be required to support their own weight. While reshoring is under way, no construction or live loads shall be permitted on the new construction. Reshores shall be tightened to carry their required loads but they shall not be overtightened so that the new construction is overstressed. Reshores shall remain in place until the concrete has reached its specified 28-day strength, unless otherwise specified.

D. For floors supporting shores under newly placed concrete, the original supporting shores shall remain in place or reshores shall be placed. The shoring or reshoring system shall have a capacity sufficient to resist the anticipated loads and in all cases shall have a capacity equal to at least one-half of the capacity of the shoring system above. Reshores shall be located directly under a reshore position above unless other locations are permitted.

E. In multi-story buildings, reshoring shall extend over a sufficient number of stories to distribute the weight of newly placed concrete, forms, and construction live loads so the design superimposed loads of the floors supporting shores are not exceeded.

- END OF SECTION -

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SECTION 03200

REINFORCING STEEL

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

A. Provide all concrete reinforcing including all cutting, bending, fastening and any special work necessary to hold the reinforcing steel in place and protect it from injury and corrosion in accordance with the requirements of this section.

B. Provide deformed reinforcing bars to be grouted into reinforced concrete masonry walls.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03100 - Concrete Formwork

B. Section 03250 - Concrete Accessories

C. Section 03300 - Cast-in-Place Concrete

D. Section 03400 - Precast Concrete

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available.

1. Virginia Uniform Statewide Building Code

2. CRSI - Concrete Reinforcing Institute Manual of Standard Practice

3. ACI SP66 - ACI Detailing Manual

4. ACI 315 - Details and Detailing of Concrete Reinforcing

5. ACI 318 - Building Code Requirements for Structural Concrete

6. WRI - Manual of Standard Practice for Welded Wire Fabric

7. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcing

8. ASTM A 1064 - Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

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1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures.

1. Detailed placing and shop fabricating drawings, prepared in accordance with ACI 315 and ACI Detailing Manual - (SP66), shall be furnished for all concrete reinforcing. These drawings shall be made to such a scale as to clearly show joint locations, openings, and the arrangement, spacing and splicing of the bars.

2. Mill test certificates - 3 copies of each.

3. Description of the reinforcing steel manufacturer's marking pattern.

4. Requests to relocate any bars that cause interferences or that cause placing tolerances to be violated.

5. Proposed supports for each type of reinforcing.

6. Request to use splices not shown on the Drawings.

7. Request to use mechanical couplers along with manufacturer's literature on mechanical couplers with instructions for installation, and certified test reports on the couplers' capacity.

8. Request for placement of column dowels without the use of templates.

9. Request and procedure to field bend or straighten partially embedded reinforcing.

10. International Code Council–Evaluation Services Evaluation Services Report (ICC-ES ESR) for dowel adhesives.

11. Certification that all installers of dowel adhesive are certified as Adhesive Anchor Installers in accordance with the ACI-CRSI Anchor Installer Certification Program.

12 Adhesive dowel testing plan.

1.05 QUALITY ASSURANCE

A. If requested by the Owner, the Design/Builder shall provide samples from each load of reinforcing steel delivered in a quantity adequate for testing. Costs of initial tests will be paid by the Owner. Costs of additional tests due to material failing initial tests shall be paid by the Design/Builder.

B. Installer Qualifications for Drilled-In Rebar: Drilled-in rebar shall be installed by an Installer with at least three years of experience performing similar installations. Installer shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.

C. Installer Training: Conduct a thorough training with the manufacturer or the manufacturer's representative for the Installer on the project. Training shall consist of a review of the complete installation process for drilled-in anchors, to include but not be limited to the following:

1. Hole drilling procedure.

2. Hole preparation and cleaning technique.

3. Adhesive injection technique and dispenser training/maintenance.

4. Rebar doweling preparation and installation.

5. Proof loading/torquing.

D. Special inspections for adhesive dowels shall be conducted in accordance with the manufacturer's instructions and Specification Section 01 45 33. Downward installations require periodic inspection and horizontal and overhead installations require continuous inspection.

PART 2 -- PRODUCTS

2.01 REINFORCING STEEL

A. Bar reinforcing shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel reinforcing. All reinforcing steel shall be from domestic mills and shall have the manufacturer's mill marking rolled into the bar which shall indicate the producer, size, type and grade. All reinforcing bars shall be deformed bars. Smooth reinforcing bars shall not be used unless specifically called for on Drawings.

B. Welded wire fabric reinforcing shall conform to the requirements of ASTM A 1064 and the details shown on the Drawings.

C. A certified copy of the mill test on each load of reinforcing steel delivered showing physical and chemical analysis shall be provided, prior to shipment. The Owner reserves the right to require the Design/Builder to obtain separate test results from an independent testing laboratory in the event of any questionable steel. When such tests are necessary because of failure to comply with this Specification, such as improper identification, the cost of such tests shall be borne by the Design/Builder.

D. Field welding of reinforcing steel will not be allowed.

E. Use of coiled reinforcing steel will not be allowed.

2.02 ACCESSORIES

A. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers and other devices to position reinforcing during concrete placement. Slab bolsters shall have gray plastic-coated legs.

B. Concrete blocks (dobies), used to support and position bottom reinforcing steel, shall have the same or higher compressive strength as specified for the concrete in which it is located.

2.03 MECHANICAL COUPLERS

A. Mechanical couplers shall develop a tensile strength which exceeds 100 percent of the ultimate tensile strength and 125 percent of the yield strength of the reinforcing bars being spliced. The reinforcing steel and coupler used shall be compatible for obtaining the required strength of the connection.

B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied.

C. Hot forged sleeve type couplers shall not be used. Acceptable mechanical couplers are Dayton Superior Dowel Bar Splicer System by Dayton Superior, Dayton, Ohio, or approved equal. Mechanical couplers shall only be used where shown on the Drawings or where specifically approved by the Engineer.

D. Where the threaded rebar to be inserted into the coupler reduces the diameter of the bar, the threaded rebar piece shall be provided by the coupler manufacturer.

2.04 DOWEL ADHESIVE SYSTEM

A. Where shown on the Drawings, reinforcing bars anchored into hardened concrete with a dowel adhesive system shall use a two-component adhesive mix which shall be injected with a static mixing nozzle following manufacturer's instructions.

B. All holes shall be drilled in accordance with the manufacturer’s instructions except that core drilled holes shall not be permitted unless specifically allowed by the Engineer. Cored holes, if allowed by the manufacturer and approved by the Engineer, shall be roughened in accordance with manufacturer’s requirements.

C. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with manufacturer’s instructions with compressed air and a wire brush prior to installation of adhesive and reinforcing bar.

D. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be either dry or water-saturated. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer.

E. Injection of adhesive into the hole shall be performed in a manner to minimize the formation of air pockets in accordance with the manufacturer’s instructions.

F. Embedment Depth:

1. The embedment depth of the bar shall be as shown on the Drawings. Although all manufacturers listed below are permitted, the embedment depth shown on the Drawings is based on “PE 1000+” by Powers Fasteners If the Design/Builder submits one of the other named dowel adhesives from the list below, the Engineer shall evaluate the required embedment and the Design/Builder shall provide the required embedment depth stipulated by the Engineer specific to the approved dowel adhesive.

2. Where the embedment depth is not shown on the Drawings, the embedment depth shall be determined to provide the minimum allowable bond strength equal to the tensile strength of the rebar according to the manufacturer's ICC-ES ESR.

3. The embedment depth shall be determined using the actual concrete compressive strength, a cracked concrete state, maximum long term temperature of 110 degrees F, and maximum short term temperature of 140 degrees F. In no case shall the embedment depth be less than the minimum, or more than the maximum, embedment depths stated in the manufacturer's ICC-ES ESR.

G. Engineer's approval is required for use of this system in locations other than those shown on the Drawings.

H. The adhesive system shall be IBC compliant for use in both cracked and uncracked concrete in all Seismic Design Categories and shall be "Epcon C6+ Adhesive Anchoring System" as manufactured by ITW Redhead, " HIT-HY 200 Adhesive Anchoring System" as manufactured by Hilti, Inc. "SET-XP Epoxy Adhesive Anchors" as manufactured by Simpson Strong-Tie Co. or "PE-1000+ Epoxy Adhesive Anchor System" by Powers Fasteners. Fast-set epoxy formulations shall not be acceptable. No or equal products will be considered, unless pre-qualified and approved.

I. All individuals installing dowel adhesive system shall be certified as an Adhesive Anchor Installer in accordance with the ACI-CRSI Anchor Installation Certification Program.

PART 3 – EXECUTION

3.01 TEMPERATURE REINFORCING

A. Unless otherwise shown on the Drawings or in the absence of the concrete reinforcing being shown, the minimum cross sectional area of horizontal and vertical concrete reinforcing in walls shall be 0.0033 times the gross concrete area and the minimum cross sectional area of reinforcing perpendicular to the principal reinforcing in slabs shall be 0.0020 times the gross concrete area. Temperature reinforcing shall not be spaced further apart than five times the slab or wall thickness, nor more than 18 inches.

3.02 FABRICATION

A. Reinforcing steel shall be accurately formed to the dimensions and shapes shown on the Drawings and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings.

B. The Design/Builder shall fabricate reinforcing bars for structures in accordance with the bending diagrams, placing lists and placing Drawings.

C. No fabrication shall commence until approval of Shop Drawings has been obtained. All reinforcing bars shall be shop fabricated unless approved to be bent in the field. Reinforcing bars shall not be straightened or rebent in a manner that will injure the material. Heating of bars will not be permitted.

D. Welded wire fabric with longitudinal wire of W9.5 size or smaller shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches. Welded wire fabric with longitudinal wires larger than W9.5 size shall be furnished in flat sheets only.

3.03 DELIVERY, STORAGE AND HANDLING

A. All reinforcing shall be neatly bundled and tagged for placement when delivered to the job site. Bundles shall be properly identified for coordination with mill test reports.

B. Reinforcing steel shall be stored above ground on platforms or other supports and shall be protected from the weather at all times by suitable covering. It shall be stored in an orderly manner and plainly marked to facilitate identification.

C. Reinforcing steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.

D. The surfaces of all reinforcing steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcing shall be reinspected and if necessary recleaned.

3.04 PLACING

A. Reinforcing steel shall be accurately positioned as shown on the Drawings and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcing steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcing steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used in sufficient numbers to support the reinforcing bars without settlement. In no case shall concrete block supports be continuous.

B. The portions of all accessories in contact with the formwork shall be made of plastic or steel coated with a 1/8 inch minimum thickness of plastic which extends at least 1/2 inch from the concrete surface. Plastic shall be gray in color.

C. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.

D. Reinforcing bars additional to those shown on the Drawings, which may be found necessary or desirable by the Design/Builder for the purpose of securing reinforcing in position, shall be provided by the Design/Builder at no additional cost to the Owner.

E. Reinforcing placing, spacing, and protection tolerances shall be within the limits specified in ACI 318 except where in conflict with the Building Code, unless otherwise specified.

F. Reinforcing bars may be moved within one bar diameter as necessary to avoid interference with other concrete reinforcing, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed placing tolerances, the resulting arrangement of bars shall be as acceptable to the Engineer.

G. Welded wire fabric shall be supported on slab bolsters spaced not less than 30 inches on centers, extending continuously across the entire width of the reinforcing mat and supporting the reinforcing mat in the plane shown on the Drawings.

H. Reinforcing shall not be straightened or rebent unless specifically shown on the drawings. Bars with kinks or bends not shown on the Drawings shall not be used. Coiled reinforcement shall not be used.

I. Dowel Adhesive System shall be installed in strict conformance with the manufacturer's recommendations and as required in Article 2.04 above. A representative of the manufacturer must be on site prior to adhesive dowel installation to provide instruction on proper installation procedures for all adhesive dowel installers. Testing of adhesive dowels shall be as indicated below. If the dowels have a hook at the end to be embedded in subsequent work, an approved mechanical coupler shall be provided at a convenient distance from the face of existing concrete to facilitate adhesive dowel testing while maintaining required hook embedment in subsequent work.

J. Adhesive Dowel Testing

1. At all locations where adhesive dowels are shown on the Drawings, at least 10 percent of all adhesive dowels installed shall be tested to the value indicated on the Drawings, with a minimum of one tested dowel per group. If no test value is indicated on the Drawings but the installed dowel is under direct tension, the Design/Builder shall notify the Engineer to verify the required test value.

2. Design/Builder shall submit a plan and schedule indicating locations of dowels to be tested, load test values and proposed dowel testing procedure (including a diagram of the testing equipment proposed for use) prior to conducting any testing. The testing equipment shall have a minimum of three support points and shall be of sufficient size to locate the edge of supports no closer than two times the anchor embedment depth from the center of the anchor.

3. Where Contract Documents indicate adhesive dowel design is the Design/Builder's responsibility, the Design/Builder shall submit a plan and schedule indicating locations of dowels to be tested and load test values, sealed by a Professional Engineer currently registered in the Commonwealth of Virginia. The Design/Builder shall also submit documentation indicating the Design/Builder's testing procedures have been reviewed and the proposed procedures are acceptable.

4. Adhesive Dowel shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the dowel after loading shall be considered a failure. Dowels exhibiting damage shall be removed and replaced. If more than 5 percent of tested dowels fail, then 100 percent of dowels shall be proof tested.

5. Proof testing of adhesive dowels shall be performed by an independent testing laboratory hired directly by the Design/Builder. The Design/Builder shall be responsible for costs of all testing, including additional testing required due to previously failed tests.

3.05 SPLICING

A. Reinforcing bar splices shall only be used at locations shown on the Drawings. When it is necessary to splice reinforcing at points other than where shown, the splice shall be as acceptable to the Engineer.

B. The length of lap for reinforcing bars, unless otherwise shown on the Drawings shall be in accordance with ACI 318 for a class B splice.

C. Laps of welded wire fabric shall be in accordance with ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

D. Mechanical splices shall be used only where shown on the drawings or when approved by the Engineer.

E. Couplers which are located at a joint face shall be a type which can be set either flush or recessed from the face as shown on the Drawings. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering. After the concrete is placed, couplers intended for future connections shall be plugged and sealed to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged with plastic plugs which have an O-ring seal.

3.06 INSPECTION

A. The Design/Builder shall advise the Engineer of his intentions to place concrete and shall allow him adequate time to inspect all reinforcing steel before concrete is placed.

B. The Design/Builder shall advise the Engineer of his intentions to place grout in masonry walls and shall allow him adequate time to inspect all reinforcing steel before grout is placed.

3.07 CUTTING OF EMBEDDED REBAR

A. The Design/Builder shall not cut embedded rebar cast into structural concrete without prior approval.

- END OF SECTION -

SECTION 03250

CONCRETE ACCESSORIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor and equipment required to provide all concrete accessories including waterstops, expansion joint material, joint sealants, expansion joint seals, contraction joint inserts, and epoxy bonding agent.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03100 - Concrete Formwork

B. Section 03290 - Joints in Concrete

C. Section 03300 - Cast-in-Place Concrete

D. Section 07900 - Joint Fillers, Sealants, and Caulking

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available.

1.	ASTM C881	Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
2.	ASTM D412	Standard Tests for Rubber Properties in Tension
3.	ASTM D 624	Standard Test method for Rubber Property - Tear Resistance
4.	ASTM D 638	Standard Test Method for Tensile Properties of Plastics
5.	ASTM D1751	Standard Specifications for Preformed Expansion Joint fillers for Concrete Paving and Structural Construction (nonextruding and resilient bituminous types)
6.	ASTM D 1752	Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
7.	ASTM D 1171	Standard Test Method for Ozone Resistance at 500 pphm
8.	ASTM D 471	Standard Test Method for Rubber Properties

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1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures.

1. Manufacturer's literature on all products specified herein including material certifications.

2. Proposed system for supporting PVC waterstops in position during concrete placement

3. Samples of products if requested by the Engineer.

PART 2 -- PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) WATERSTOPS

A. PVC waterstops for construction joints shall be flat ribbed type, 6 inches wide with a minimum thickness at any point of 3/8 inches.

B. Waterstops for expansion joints shall be ribbed with a center bulb. They shall be 9 inches wide with a minimum thickness at any point of 3/8 inch unless shown or specified otherwise. The center bulb shall have a minimum outside diameter of 1 inch and a minimum inside diameter of 1/2 inch.

C. The waterstops shall be manufactured from virgin polyvinyl chloride plastic compound and shall not contain any scrap or reclaimed material or pigment whatsoever. The properties of the polyvinyl chloride compound used, as well as the physical properties of the waterstops, shall exceed the requirements of the U.S. Army Corps. of Engineers' Specification CRD-C572. The waterstop material shall have an off-white, milky color.

D. The required minimum physical characteristics for this material are:

1. Tensile strength - 1,750 psi (ASTM D-638).

2. Ultimate elongation - not less than 280% (ASTM D-638).

E. No reclaimed PVC shall be used for the manufacturing of the waterstops. The Design/Builder shall furnish certification that the proposed waterstops meet the above requirements.

F. PVC waterstops shall be as manufactured by BoMetals, Inc., DuraJoint Concrete Accessories, or Sika Greenstreak.

G. All waterstop intersections, both vertical and horizontal, shall be made from factory fabricated corners and transitions. Only straight butt joint splices shall be made in field.

2.02 RETROFIT WATERSTOPS

A. Retrofit waterstops shall be used where specifically shown on Drawings for sealing joints between existing concrete construction and new construction.

B. Retrofit waterstops shall be PVC waterstops fabricated from material as described in Section 2.01 of this Specification.

C. Retrofit waterstop shall be attached to existing concrete surface as shown on Drawings.

D. Use of split waterstop in lieu of specially fabricated retrofit waterstop will not be acceptable.

E. Retrofit Waterstop manufacturer must provide a complete system including all Waterstop, stainless steel anchoring hardware, and epoxy for installation.

F. For construction joints, retrofit waterstop shall be style number 609 by Sika Greenstreak, RF-638 by BoMetals, Inc., Type 18 kit by DuraJoint Concrete Accessories, or approved equal. For expansion joints, retrofit waterstop shall be style number 667 by Sika Greenstreak, Type 18-9 kit by DuraJoint Concrete Accessories, or approved equal.

2.03 CHEMICAL RESISTANT WATERSTOPS

A. Where specifically noted on Contract Drawings, chemical resistant waterstops shall be used instead of PVC waterstops.

B. Chemical resistant waterstops for construction joints shall be ribbed with a center bulb. They shall be 6 inches wide with a minimum thickness at any point of 3/16 inches.

C. Chemical resistant waterstops for expansion joints shall be ribbed tear web. They shall be 9 inches wide with a tear web designed to accommodate 1 inch of free movement minimum.

D. Chemical resistant retrofit waterstop shall be a minimum of 2½" wide along the ribbed side and a minimum 5" wide along the side attached to the existing concrete surface. Retrofit waterstop shall include a centerbulb and shall have a minimum thickness of 3/16". Retrofit waterstop manufacturer shall provide a complete system including waterstop, stainless steel anchoring hardware and epoxy for installation.

E. Chemical resistant waterstops shall be manufactured from a fully crosslinked thermoplastic vulcanizate rubber.

F. Waterstops shall be TPE-R by BoMetals, Inc., Earth Shield TPV/TPE-R by JP Specialties, Inc., Westec TPE-R by Westec Barrier Technologies, or TPE-R by DuraJoint Concrete Accessories.

2.04 HYPALON RUBBER WATERSTOPS

A. Hypalon rubber waterstops shall be Sikadur Combiflex by Sika Corporation or approved equal. Minimum width of waterstop material shall be twelve (12) inches unless shown otherwise on Contract Drawings.

2.05 EXPANDING RUBBER WATERSTOP

A. Expanding rubber shall be designed to expand under hydrostatic conditions. Waterstops shall be Adeka Ultra Seal MC-2010M by Adeka Ultra Seal/OCM, Inc., or Hydrotite CJ-1020-2K by Sika Greenstreak, for concrete thickness greater than nine inches. For thicknesses less than nine inches, Adeka Ultra Seal KBA-1510FF or Hydrotite CJ-1020-2K shall be used.

B. Waterstop shall be a chemically modified natural rubber product with a hydrophilic agent.

C. Waterstop has a stainless steel mesh or coextrusion of non-hydrophilic rubber to direct expansion in the thickness direction and restrict the expansion in the longitudinal direction.

2.06 WATERSTOP ADHESIVE

A. Adhesive between waterstops and existing concrete shall be 20+F Contact Cement by Miracle Adhesives Corporation, Neoprene Adhesive 77-198 by JGF Adhesives, Sikadur 31 Hi-Mod Gel by Sika Corporation, DP-605 NS Urethane Adhesive by 3M Adhesive Systems.

B. Hydrophilic, non-bentonite water swelling elastic sealant shall be used to bond expanding rubber waterstops to rough surfaces. Hydrophilic elastic sealant shall be P-201 by Adeka Ultra Seal/OCM, Inc., Leakmaster LV-1 by Sika Greenstreak, or approved equal.

2.07 JOINT SEALANTS

A. Joint sealants shall comply with Section 07900, Joint Fillers, Sealants, and Caulking.

2.08 EXPANSION JOINT MATERIAL

A. Preformed expansion joint material shall be non-extruding, and shall be of the following types:

1. Type I - Sponge rubber, conforming to ASTM D1752, Type I.

2. Type II - Cork, conforming to ASTM D1752, Type II.

3. Type III - Self-expanding cork, conforming to ASTM D1752, Type III.

4. Type IV - Bituminous fiber, conforming to ASTM Designation D1751.

2.09 EXPANSION JOINT SEAL

A. Expansion Joint Seal System shall consist of a preformed neoprene profile, installed using the same dimensions as the joint gap, bonded with a two-component epoxy adhesive and pressurized during the adhesive cure time.

B. The expansion joint system shall be Hydrozo/Jeene Structural Sealing joint system by Hydrozo/Jeene, Inc.

2.10 CONTRACTION JOINT INSERTS

A. Contraction joint inserts shall be ZipCap Control Joint former by Greenstreak Plastic Products.

2.11 EPOXY BONDING AGENT

A. Epoxy bonding agent shall conform to ASTM C881 and shall be Sikadur 32 Hi-Mod, Sika Corporation, Lyndhurst, N.J.; Euco #452 Epoxy System, Euclid Chemical Company, Cleveland, OH, MasterInject 1500 by BASF Master Builder Solutions (BASF).

2.12 EPOXY RESIN BINDER

A. Epoxy resin binder shall conform to the requirements of ASTM C-881, Type III, Grade 3, Class B and C for epoxy resin binder and shall be Sikadur 23, Low-Mod-Gel, manufactured by the Sika Corporation, Lyndhurst, N.J., Flexocrete Gel manufactured by DuraJoint Concrete Accessories or Euco #352 Gel, Euclid Chemical Company, MasterEmaco ADH 327 or 327 RS by BASF Master Builder Solutions.

PART 3 -- EXECUTION

3.01 PVC AND CHEMICAL RESISTANT WATERSTOPS

A. PVC and chemical resistant waterstops shall be provided in all construction and expansion joints in water bearing structures and at other such locations as required by the Drawings.

B. Waterstops shall be carefully positioned so that they are embedded to an equal depth in concrete on both sides of the joint. They shall be kept free from oil, grease, mortar or other foreign matter. To ensure proper placement, all waterstops shall be secured in correct position at 12" on center along the length of the waterstop on each side, prior to placing concrete. Such method of support shall be submitted to the Engineer for review and approval. Grommets or small pre-punched holes as close to the edges as possible will be acceptable for securing waterstops.

C. Splices in PVC waterstops and chemical resistant waterstops shall be made with a thermostatically controlled heating element. Only straight butt joint splices will be allowed in the field. Factory fabricated corners and transitions shall be used at all intersections. Splices shall be made in strict accordance with the manufacturer's recommended instructions and procedures. At least three satisfactory sample splices shall be made on the site. The Engineer may require tests on these splices by an approved laboratory. The splices shall exhibit not less than 80 percent of the strength of the unspliced material.

D. All splices in waterstops will be subject to rigid review for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, discoloration, charring, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which will pass said review and all faulty material shall be removed from the site and disposed of by the Design/Builder at no additional cost to the Owner.

E. Retrofit waterstops shall be installed as shown on Contract Drawings using approved waterstop adhesive and Type 316 stainless steel batten bars and expansion anchors.

F. Waterstop installation and splicing defects which are unacceptable include, but are not limited to the following:

1. Tensile strength not less than 80 percent of parent material.

2. Overlapped (not spliced) Waterstop.

3. Misalignment of Waterstop geometry at any point greater than 1/16 inch.

4. Visible porosity or charred or burnt material in weld area.

5. Visible signs of splice separation when splice (24 hours or greater) is bent by hand at sharp angle.

3.02 HYPALON RUBBER AND EXPANDING RUBBER WATERSTOPS

A. Waterstops shall be installed only where shown on the Drawings.

B. Waterstops shall be installed in strict accordance with manufacturer's recommendations.

3.03 WATERSTOP ADHESIVE

A. Adhesive shall be applied to both contact surfaces in strict accordance with manufacturer's recommendations.

B. Adhesive shall be used where waterstops are attached to existing concrete surfaces.

3.04 INSTALLATION OF EXPANSION JOINT MATERIAL AND SEALANTS

A. Type I, II, or III shall be used in all expansion joints in structures and concrete pavements unless specifically shown otherwise on the Drawings. Type IV shall be used in sidewalk and curbing and other locations specifically shown on the Drawings.

B. All expansion joints exposed in the finish work, exterior and interior, shall be sealed with the specified joint sealant. Expansion joint material and sealants shall be installed in accordance with manufacturer's recommended procedures and as shown on the Drawings.

C. Expansion joint material that will be exposed after removal of forms shall be cut and trimmed to ensure a neat appearance and shall completely fill the joint except for the space required for the sealant. The material shall be held securely in place and no concrete shall be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.

D. A bond breaker shall be used between expansion joint material and sealant. The joint shall be thoroughly clean and free from dirt and debris before the primer and the sealant are applied. Where the finished joint will be visible, masking of the adjoining surfaces shall be carried out to avoid their discoloration. The sealant shall be neatly tooled into place and its finished surfaces shall present a clean and even appearance.

E. Type 1 joint sealant shall be used in all expansion and contraction joints in concrete, except where Type 7 or Type 8 is required as stated below, and wherever else specified or shown on the Drawings. It shall be furnished in pour grade or gun grade depending on installation requirements. Primers shall be used as required by the manufacturer. The sealant shall be furnished in colors as directed by the Engineer.

F. Type 8 joint sealant shall be used in all concrete pavements and floors subject to heavy traffic and wherever else specified or shown on the Drawings.

G. Type 7 joint sealant shall be used for all joints in chlorine contact tanks and wherever specified or shown on the Drawings.

3.05 EXPANSION JOINT SEAL

A. The expansion joint seal system shall be installed as shown on the Drawings in strict accordance with the manufacturer's recommendations.

3.06 CONTRACTION JOINT INSERTS

A. For contraction joints in slabs, inserts shall be floated in fresh concrete during finishing.

B. For contraction joints in walls, inserts shall be secured in place prior to casting wall.

C. Inserts shall be installed true to line at the locations of all contraction joints as shown on the Drawings.

D. Inserts shall extend into concrete sufficient depth as indicated on the Drawings or specified in Section 03290, Joints in Concrete.

E. Inserts shall not be removed from concrete until concrete has cured sufficiently to prevent chipping or spalling of joint edges due to inadequate concrete strength.

3.07 EPOXY BONDING AGENT

A. The Design/Builder shall use an epoxy bonding agent for bonding fresh concrete to existing concrete as shown on the Drawings.

B. Bonding surface shall be clean, sound and free of all dust, laitance, grease, form release agents, curing compounds, and any other foreign particles.

C. Application of bonding agent shall be in strict accordance with manufacturer's recommendations.

D. Fresh concrete shall not be placed against existing concrete if epoxy bonding agent has lost its tackiness.

3.08 EPOXY RESIN BINDER

A. Epoxy resin binder shall be used to seal all existing rebar cut and burned off during demolition operations. Exposed rebar shall be burned back 1/2-inch minimum into existing concrete and the resulting void filled with epoxy resin binder.

- END OF SECTION -

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SECTION 03290

JOINTS IN CONCRETE

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

A. Provide all materials, labor and equipment required for the construction of all joints in concrete specified herein and shown on the Drawings.

B. Types of joints in concrete shall be as follows:

1. Construction Joints - Joints between adjacent concrete placements continuously connected with reinforcement.

2. Expansion Joints - Joints in concrete which allow thermal expansion and contraction of concrete. Reinforcement terminates within concrete on each side of joint.

3. Contraction Joints - Joints formed in concrete to provide a weakened plane in concrete section to control formation of shrinkage cracks.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03100 - Concrete Formwork

B. Section 03250 - Concrete Accessories

C. Section 03300 - Cast-in-Place Concrete

D. Section 07900 - Joint Fillers, Sealants and Caulking

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available.

1. ACI 301 - Specifications for Structural Concrete for Buildings

2. ACI 318 - Building Code Requirements for Structural Concrete

3. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures.

32414-000

1. Layout drawings showing location and type of all joints to be placed in each structure.

2. Details of proposed joints in each structure.

PART 2 -- MATERIALS

2.01 MATERIALS

A. All materials required for joint construction shall comply with Section 03250 - Concrete Accessories, and Section 07900 - Joint Fillers, Sealants and Caulking.

PART 3 -- EXECUTION

3.01 CONSTRUCTION JOINTS

A. Construction joints shall be as shown on the Drawings. Otherwise, Design/Builder shall submit description of the joint and its location to Engineer for approval.

B. Unless noted otherwise on the Drawings, construction joints shall be located near the middle of the spans of slabs, beams, and girders unless a beam intersects a girder at this point. In this case, the joints in the girders shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and the top of footings or floor slabs unless noted otherwise on Drawings. Beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.

C. Maximum distance between horizontal joints in slabs and vertical joints in walls shall be 45'-0". For exposed walls with fluid or earth on the opposite side, the spacing between vertical and horizontal joints shall be a maximum of 25’-0”.

D. All corners shall be part of a continuous placement, and should a construction joint be required, the joint shall not be located closer than five feet from a corner.

E. All reinforcing steel and welded wire fabric shall be continued across construction joints. Keys and inclined dowels shall be provided as shown on the Drawings or as directed by the Engineer. Longitudinal keys shall be provided in all joints in walls and between walls and slabs or footings, except as specifically noted otherwise on the Drawings. Size of keys shall be as shown on the Drawings.

F. All joints in water bearing structures shall have a waterstop. All joints below grade in walls or slabs which enclose an accessible area shall have a waterstop.

3.02 EXPANSION JOINTS

A. Size and location of expansion joints shall be as shown on the Drawings.

B. All expansion joints in water-bearing structures shall have a center-bulb type waterstop. All expansion joints below grade in walls or slabs which enclose an accessible area shall have a center-bulb type waterstop. Waterstop shall be as shown on Drawings and specified in Section 03250, Concrete Accessories.

3.03 CONTRACTION JOINTS

A. Location of contraction joints shall be as shown on the Drawings.

B. Contraction joints shall be formed with contraction joint inserts as specified in Section 03250, Concrete Accessories.

C. Sawcutting of contraction joints in lieu of forming will not be allowed unless otherwise noted on the Drawings. Where sawcutting is allowed, joints shall be sawed as soon as the concrete can support foot traffic without leaving any impression, normally the same day as concrete is placed and in no case longer than 24 hours after concrete is placed.

D. Unless noted otherwise on Drawings, depth of contraction joints shall be 1-1/2 inches in reinforced concrete and 1/3 of concrete thickness in unreinforced concrete.

3.04 JOINT PREPARATION

A. No concrete shall be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.

B. The surface of the concrete at all joints shall be thoroughly cleaned and all laitance removed by wire brushing, air or light sand blasting.

C. The joint shall be thoroughly clean and free from dirt and debris before the primer and the sealant are applied. Where the finished joint will be visible, masking of the adjoining surfaces shall be carried out to avoid their discoloration. The sealant shall be neatly tooled into place and its finished surface shall present a clean and even appearance.

D. All joints shall be sealed as shown on the Drawings and specified in Section 03250, Concrete Accessories.

- END OF SECTION -

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SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Provide all labor, equipment, materials and services necessary for the manufacture, transportation and placement of all plain and reinforced concrete work, as shown on the Drawings or as ordered by the Engineer.

B. The requirements in this section shall apply to the following types of concrete:

1. Class A1 Concrete: Normal weight structural concrete to be used in all structures qualifying as environmental concrete structures that are designed in accordance with ACI 350 including pump stations, tanks, basins, process structures, and any structures containing fluid or process chemicals or other materials used in treatment process.

2. Class A2 Concrete: Normal weight structural concrete in all structures other than structures qualifying as environmental concrete structures as described above, and for all sidewalks and pavement.

3. Class A3 Concrete: Normal weight structural concrete to be used for interior slabs where a Type ”D” Steel Troweled Finish or Type “G” Hardened Finish is required. Class A3 concrete shall not contain entrained air.

4. Class A4 Concrete: Normal weight structural concrete to be used where specifically called for on Contract Drawings or areas where specifically requested by Design/Builder and approved by Engineer. Class A4 concrete is identical to Class A2 concrete except that coarse aggregate specified in Article 2.05 below shall be Size #8 in accordance with ASTM C33.

5. Class A5 Concrete: Normal weight structural concrete used where concrete is indicated to be placed underwater (tremie concrete).

6. Class B Concrete: Normal weight structural concrete used for duct bank encasements, catch basins, fence and guard post embedment, concrete fill, and other areas where specifically noted on Contract Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03100 - Concrete Formwork

B. Section 03200 - Reinforcing Steel

C. Section 03250 - Concrete Accessories

32414-000

D. Section 03290 - Joints in Concrete

E. Section 03350 - Concrete Finishes

F. Section 03370 - Concrete Curing

G. Section 03600 - Grout

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available.

1. Virginia Uniform Statewide Building Code

2.	ACI 214	Recommended Practice for Evaluation of Strength Test Results of Concrete
3.	ACI 301	Specifications for Structural Concrete for Buildings
4.	ACI 304	Guide for Measuring, Mixing, Transporting, and Placing Concrete
5.	ACI 305	Hot Weather Concreting
6.	ACI 306	Cold Weather Concreting
7.	ACI 309	Recommended Practice for Consolidation of Concrete
8.	ACI 318	Building Code Requirements for Structural Concrete
9.	ACI 350	Code Requirements for Environmental Engineering Concrete Structures
10.	ASTM C 31	Standard Methods of Making and Curing Concrete Test Specimens in the Field
11.	ASTM C 33	Standard Specification for Concrete Aggregates
12.	ASTM C 39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
13.	ASTM C42	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
14.	ASTM C 88	Standard Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate
15.	ASTM C 94	Standard Specification for Ready-Mixed Concrete

16. ASTM C 114 Standard Test Method for Chemical Analysis of Hydraulic Cement

17. ASTM C 136 Standard Method for Sieve Analysis of Fine and Coarse Aggregate

18. ASTM C 138 Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete

19. ASTM C 143 Standard Test Method for Slump of Portland Cement Concrete

20. ASTM C 150 Standard Specification for Portland Cement

21. ASTM C 172 Standard Method of Sampling Fresh Concrete

22. ASTM C 192 Standard Method of Making and Curing Concrete Test Specimens in the Laboratory

23. ASTM C 231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

24. ASTM C 260 Standard Specification for Air-Entraining Admixtures for Concrete

25. ASTM C 295 Standard Guide for Petrographic Examination of Aggregates for Concrete

26. ASTM C 457 Standard Recommended Practice for Microscopical Determination of Air-Void Content and Parameters of the Air-Void System in Hardened Concrete

27. ASTM C 494 Standard Specification for Chemical Admixtures for Concrete

28. ASTM C 595 Standard Specification for Blended Hydraulic Cements

29. ASTM C 618 Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete

30. ASTM C 989 Standard Specification for Slag Cement for Use in Concrete and Mortars

31. ASTM C 1077 Recommended Practice for Labs Testing Concrete

32. ASTM C 1260 Test Method for Potential Alkali Reactivity of Aggregates (Mortar Bar Method)

33. ASTM C 1567 Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)

34. ASTM C 1602 Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

35. ASTM C 1778 Reducing the Risk of Deleterious Alkali – Aggregate Reaction in Concrete

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittals.

1. Sources of all materials and certifications of compliance with specifications for all materials.

2. Certified current (less than 1 year old) chemical analysis of the Portland Cement or Blended Cement to be used.

3. Certified current (less than 1 year old) chemical analysis of fly ash or slag cement to be used.

4. Aggregate test results showing compliance with required standards, i.e., sieve analysis, aggregate soundness tests, petrographic analysis, mortar bar expansion testing, etc.

5. Manufacturer's data on all admixtures stating compliance with required standards.

6. Concrete mix design for each class of concrete specified herein.

7. Field experience records and/or trial mix data for the proposed concrete mixes for each class of concrete specified herein.

1.05 QUALITY ASSURANCE

A. Tests on materials used in the production of concrete shall be required as specified in PART 2 -- PRODUCTS. These tests shall be performed by an independent testing laboratory approved by the Engineer at no additional cost to the Owner.

B. Trial concrete mixes shall be tested when required in accordance with Article 3.01 at no additional cost to the Owner.

C. Field quality control tests, as specified in Article 3.10, unless otherwise stated, will be performed by a materials testing consultant employed by the Design/Builder. Any individual who samples and tests concrete to determine if the concrete is being produced in accordance with this Specification shall be certified as a Concrete Field Testing Technician, Grade I, in accordance with ACI CP-2. Testing laboratory shall conform to requirements of ASTM C-1077.

1.06 CONCRETE COORDINATION CONFERENCE

A. Unless waived by the Engineer, prior to any concrete submittals and at least 5 days prior to the start of the concrete construction schedule, the Design/Builder shall conduct a meeting at the site. The purpose of the meeting is to review the proposed concrete mix designs, to discuss the proposed approaches and procedures for mixing, transporting, placing, testing, finishing, and curing of all aspects of concrete work to ensure the concrete construction is performed in accordance with the Specifications, and to clarify roles of the parties involved.

The Design/Builder shall send a concrete coordination conference agenda to all attendees 2 days prior to a mutually agreed upon date for the conference.

B. As a minimum the agenda shall include:

1. Concrete Materials and Mix Designs

2. Inspection Responsibilities

3. Concrete Sampling and Testing Specification Requirements

4. Cylinder Storage and Transportation

5. Acceptance/Rejection Responsibility and Authority for Fresh Concrete

6. Concrete finishing

7. Concrete Curing

8. Test Report Distribution

9. Miscellaneous Items

C. The Design/Builder shall require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:

1. Design/Builder's superintendent

2. Engineer

3. Owner's representative (if he chooses to attend)

4. Laboratory retained for trial batching and construction quality control testing for the concrete.

5. Any subDesign/Builders involved in placing, finishing, and curing of concrete

6. Concrete supplier

7. Concrete pumping subDesign/Builder (if pumping is being proposed)

D. Minutes of the meeting shall be recorded, typed, and printed by the Design/Builder and distributed to all attendees and any other concerned parties within five days of the meeting.

PART 2 -- PRODUCTS

2.01 HYDRAULIC CEMENT

A. Portland Cement

1. Portland Cement shall be Type II conforming to ASTM C 150. Type I cement may be used provided either fly ash or slag cement is also included in the mix in accordance with Articles 2.02 or 2.03 respectively.

2. When potentially reactive aggregates as defined in Article 2.05 are to be used in concrete mix, cement shall meet the following requirements:

a. For concrete mixed with only Portland Cement, the total alkalies in the cement (calculated as the percentage of NA_2O plus 0.658 times the percentage of K_2O) shall not exceed 0.40%.

b. For concrete mixed with Portland Cement and an appropriate amount of fly ash (Article 2.02) or slag cement (Article 2.03) the total alkalies in the Portland Cement (calculated as the percentage of NA_2O plus 0.658 times the percentage of K_2O) shall not exceed 0.85%.

3. When non-reactive aggregates as defined in Article 2.05 are used in concrete mix, total alkalies in the cement shall not exceed 1.0%.

4. The proposed Portland Cement shall not contain more than 8% tricalcium aluminate and more than 12% tetracalcium aluminoferrite.

B. Blended Cement

1. Blended cements shall be Type IP (Portland Fly Ash Cement) or Type IS (Portland Slag Cement) conforming to ASTM C 595.

2. Type IP cement shall be an interground blend of Portland Cement and fly ash in which the fly ash constituent is between 15% and 25% of the weight of the total blend.

3. Type IS cement shall be an interground blend of Portland Cement and slag cement in which the slag constituent is between 35% and 50% of the weight of the total blend.

4. Fly ash and slag cement used in the production of blended cements shall meet the requirements of Articles 2.02 and 2.03, respectively.

5. When reactive aggregates as defined in Article 2.05 are used in concrete mix, the total alkalies in the Portland Cement (calculated as the percentage of Na_2O plus 0.658 times the percentage of K_2O) shall not exceed 0.85%. The percentage of fly ash or slag cement shall be set to meet provisions of Article 2.05.G.3.

C. Different types of cement shall not be mixed nor shall they be used alternately except when authorized in writing by the Engineer. Different brands of cement or the same brand from different mills may be used alternately. A resubmittal will be required if different cements are proposed during the Project.

D. Cement shall be stored in a suitable weather-tight building so as to prevent deterioration or contamination. Cement which has become caked, partially hydrated, or otherwise damaged will be rejected.

2.02 FLY ASH

A. Fly ash shall meet the requirements of ASTM C 618 for Class F, except that the loss on ignition shall not exceed 4%. Fly ash shall also meet the optional physical requirements for uniformity as shown in Table 3 of ASTM C 618.

B. For fly ash to be used in the production of type IP cement, the Pozzolan Activity Index shall be greater than 75% as specified in Table 3 of ASTM C 595.

C. Where reactive aggregates as defined in Article 2.05 are used in concrete mix, the fly ash constituent shall be between 15% and 25% of the total weight of the combined Portland Cement and fly ash. The percentage of fly ash shall be set to meet the provisions of Article 2.05.G.3.

D. For Type A1 concrete as required for use in environmental concrete structures, i.e. process structures or fluid containing structures, inclusion of fly ash or slag cement in the concrete mix, is mandatory.

E. Additional fly ash shall not be included in concrete mixed with Type IS or IP cement.

2.03 SLAG CEMENT

A. Slag cement shall meet the requirements of ASTM C 989 including tests for effectiveness of slag in preventing excessive expansion due to alkali-aggregate reactivity as described in Appendix X-3 of ASTM C 989.

B. Where reactive aggregates as defined in Article 2.05 are used in concrete mix, the slag cement constituent shall be between 35% and 40% of the total weight of the combined Portland Cement and slag. The percentage of slag cement shall be set to meet the provisions of Article 2.05.G.3.

C. For Type A1 concrete as required for use in environmental concrete structures, i.e. process structures or fluid containing structures, inclusion of fly ash or slag cement in the concrete mix, is mandatory.

D. Additional slag cement shall not be included in concrete mixed with type IS or IP cement.

2.04 WATER

A. Water used for mixing concrete shall be clear, potable and free from deleterious substances such as objectionable quantities of silty organic matter, alkali, salts and other impurities.

B. Water shall not contain more than 100 PPM chloride.

C. Water shall not contain more than 500 PPM dissolved solids.

D. Water shall have a pH in the range of 4.5 to 8.5.

E. Water shall meet requirements of ASTM C 1602.

2.05 AGGREGATES

A. All aggregates used in normal weight concrete shall conform to ASTM C 33.

B. Fine Aggregate (Sand) in the various concrete mixes shall consist of natural or manufactured siliceous sand, clean and free from deleterious substances, and graded within the limits of ASTM C 33.

C. Coarse aggregates shall consist of hard, clean, durable gravel, crushed gravel or crushed rock. Coarse aggregate shall be size #57 or #67 as graded within the limits given in ASTM C 33 unless otherwise specified.

D. For Class A4 concrete, coarse aggregate shall be Size #8 in accordance with ASTM C33.

E. Aggregates shall be tested for gradation by sieve analysis tests in conformance with ASTM C 136.

F. Aggregates shall be tested for soundness in accordance with ASTM C 88. The loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using either magnesium sulfate or sodium sulfate.

G. Non-reactive aggregates shall meet the following requirements:

1. All aggregates shall be evaluated in accordance with ASTM C 1778 to determine potential reactivity.

2. A petrographic analysis in accordance with ASTM C295 shall be performed to identify the constituents of the fine and coarse aggregate. Non-reactive aggregates shall meet the following limitations:

(1) Optically strained, microfractured, or microcrystalline quartz, 5.0%, maximum.

(2) Chert or chalcedony, 3.0%, maximum.

(3) Tridymite or cristobalite, 1.0%, maximum.

(4) Opal, 0.5%, maximum.

(5) Natural volcanic glass in volcanic rocks, 3.0%, maximum.

3. If aggregates are deemed potentially reactive as per ASTM C-1778 and fly ash or slag cement is included in proposed concrete mix design, proposed concrete mix including proposed aggregates shall be evaluated by ASTM C-1567. Mean mortar bar expansions at 16 days shall be less than 0.08%. Tests shall be made using exact proportion of all materials proposed for use on the job in design mix submitted.

4. If aggregates are deemed potentially reactive as per ASTM C-1778 and a straight cement mix without fly ash or slag cement is proposed for concrete mix design, aggregates shall be evaluated by ASTM C-1260. Mean mortar bar expansions at 16 days shall be less than 0.08%.

H. All aggregates shall be considered reactive unless they meet the requirements above for non-reactive aggregates. Aggregates with a lithology essentially similar to sources in the same region found to be reactive in service shall be considered reactive regardless of the results of the tests above.

I. Design/Builder shall submit a new trial mix to the Engineer for approval whenever a different aggregate or gradation is proposed.

2.07 ADMIXTURES

A. Air entraining agent shall be added to all concrete unless noted otherwise. The agent shall consist of a neutralized vinsol resin solution or a purified hydrocarbon with a cement catalyst which will provide entrained air in the concrete in accordance with ASTM C 260. The admixture proposed shall be selected in advance so that adequate samples may be obtained and the required tests made. Air content of concrete, when placed, shall be within the ranges given in the concrete mix design.

B. The following admixtures are required or used for water reduction, slump increase, and/or adjustment of initial set. Admixtures permitted shall confirm to the requirements of ASTM C 494. Admixtures shall be non-toxic after 30 days and shall be compatible with and made by the same manufacturer as the air-entraining admixtures.

1. Water reducing admixture shall conform to ASTM C 494, Type A and shall contain no more than 0.05% chloride ions. Acceptable products are “Eucon Series” by the Euclid Chemical Company, “Master Pozzolith Series” by BASF, and “Plastocrete Series” by Sika Corporation.

2. High range water reducer shall be sulfonated polymer conforming to ASTM C 494, Type F or G. The high range water reducer shall be added to the concrete at either the batch plant or at the job site and may be used in conjunction with a water reducing admixture. The high range water reducer shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day’s operation of the job site system. Concrete shall be mixed at mixing speed for a minimum of 100 mixer revolutions after the addition of the high range water reducer. Acceptable products are “Eucon 37” or Plastol 5000 by the Euclid Chemical Company, “Master Rheobuild 1000 or Master Glenium Series” by BASF, and “Daracem 100 or Advaflow Series” by W.R. Grace.

3. A non-chloride, non-corrosive accelerating admixture may be used where specifically approved by the Engineer. The admixture shall conform to ASTM C 494, Type C or E, and shall not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures. Acceptable products are "Accelguard 80/90 or NCA" by the Euclid Chemical Company and "Daraset" by W.R. Grace.

4. A water reducing retarding admixture may be used where specifically approved by the Engineer. The admixture shall conform to ASTM C494, Type D and shall not contain more than 0.05% chloride ions. Acceptable products are "Eucon NR or Eucon Retarder 100" by the Euclid Chemical Company, "Pozzolith Retarder" by BASF, and "Plastiment" by Sika Corporation.

C. Admixtures containing calcium chloride, thiocyanate or more than 0.05 percent chloride ions are not permitted. The addition of admixtures to prevent freezing is not permitted.

D. The Design/Builder shall submit manufacturer's data including the chloride ion content of each admixture and certification from the admixture manufacturer that all admixtures utilized in the design mix are compatible with one another and properly proportioned prior to mix design review.

2.08 CONCRETE MIX DESIGN

A. The proportions of cement, aggregates, admixtures and water used in the concrete mixes shall be based on the results of field experience or preferably laboratory trial mixes in conformance with Section 5.3. "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318 and ACI 350. When trial mixes are used they shall also conform to Article 3.01 of this Section of the Specifications. If field experience records are used, concrete strength results shall be from concrete mixed with all of the ingredients proposed for use on job used in similar proportions to mix proposed for use on job. Design/Builder shall submit verification confirming this stipulation has been followed. Field experience records and/or trial mix data used as the basis for the proposed concrete mix design shall be submitted to the Engineer along with the proposed mix.

B. Structural concrete shall conform to the following requirements. Cementitious materials refer to the total combined weight of all cement, fly ash, and slag cement contained in the mix.

1. Compressive Strength (28-Day)

a.	Concrete Class A1, A5	4,500 psi (minimum)
b.	Concrete Class A2, A3, A4	4,000 psi (minimum)
c.	Concrete Class B	3,000 psi (minimum)

2. Water/cementitious materials ratio, by weight

		Maximum	Minimum
a.	Concrete Class A1, A5,	0.42	0.39
b.	Concrete Class A2, A3, A4	0.45	0.39

c.	Concrete Class B	0.50	0.39

3. Slump range — 4" nominal unless high range water reducing admixture is used.
   8" max if high range water reducing admixture is used.

4. Air Content

   a. Class A1, A2, A4, A5 — 6% ±1.5%

   b. Class A3, B — 3% Max (non air-entrained)

C. Lightweight concrete (Class C) shall be composed of cement, lightweight aggregate, sand, water, and admixtures, and shall conform to the following requirements:

1. Compressive Strength (28-Day) — 4,000 psi (minimum)

2. Minimum Cementitious Materials Content — 550 lb/cy

3. Air Content — 6% ±1.5%

4. Maximum Slump — 4"-8" after addition of high range water reducer

5. Maximum Unit Weight — 115 PCF

6. Lightweight aggregate shall be presoaked for 48 hours prior to mixing concrete.

PART 3 -- EXECUTION

3.01 TRIAL MIXES

A. When trial mixes are used to confirm the quality of a proposed concrete mix in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318 and ACI 350, an independent qualified testing laboratory designated and retained by the Design/Builder shall test a trial batch of each of the preliminary concrete mixes submitted by the Design/Builder. The trial batches shall be prepared using the aggregates, cement and admixtures proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain enough samples to satisfy requirements stated below. Tests on individual materials stated in PART 2 -- PRODUCTS should already be performed before any trial mix is done. The cost of laboratory trial batch tests for each specified concrete mix will be borne by the Design/Builder and the Design/Builder shall furnish and deliver the materials to the testing laboratory at no cost to the Owner.

B. The independent testing laboratory shall prepare a minimum of fifteen (15) standard test cylinders in accordance with ASTM C 31 in addition to conducting slump (ASTM C 143), air content (C 231) and unit weight (C 138) tests. Compressive strength test on the cylinders shall subsequently be performed by the same laboratory in accordance with ASTM C 39 as follows: Test 3 cylinders at age 7 days; test 3 cylinders at age 21 days; test 3 cylinders at

age 28 days and test 3 cylinders at 56 days. The cylinders shall be carefully identified as "Trial Mix, Contract No. _____, Product _____." If the average 28-day compressive strength of the trial mix is less than that specified, or if any single cylinder falls below the required strength by more than 500 psi, the mix shall be corrected, another trial batch prepared, test cylinders taken, and new tests performed as before. Any such additional trial batch testing required shall be performed at no additional cost to the Owner.

3.02 PRODUCTION OF CONCRETE

A. All concrete shall be machine mixed. Hand mixing of concrete will not be permitted. The Design/Builder may supply concrete from a ready mix plant or from a site mixed plant. In selecting the source for concrete production the Design/Builder shall carefully consider its capability for providing quality concrete at a rate commensurate with the requirements of the placements so that well bonded, homogenous concrete, free of cold joints, is assured.

B. Ready-Mixed Concrete

1. At the Design/Builder's option, ready-mixed concrete may be used meeting the requirements for materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94.

2. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.

3. Each batch of concrete shall be mixed in a truck mixer for not less than 100 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.

4. Truck mixers and their operation shall be such that the concrete throughout the mixed batch, as discharged, is within acceptable limits of uniformity with respect to consistency, mix and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than one inch when the specified slump is 3 inches or less, or if they differ by more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.

5. Ready-mixed concrete shall be delivered to the site for the work and discharge shall be completed before the drum has been revolved 300 revolutions and within the time requirements stated in Article 3.03 of this Section.

6. Each and every concrete delivery shall be accompanied by a delivery ticket containing at least the following information:

a. Date and truck number
b. Ticket number
c. Mix designation of concrete
d. Cubic yards of concrete
e. Cement brand, type and weight in pounds
f. Weight in pounds of fine aggregate (sand)
g. Weight in pounds of coarse aggregate (stone)
h. Air entraining agent, brand, and weight in pounds and ounces
i. Other admixtures, brand, and weight in pounds and ounces
j. Water, in gallons, stored in attached tank
k. Water, in gallons, maximum that can be added without exceeding design water/cementitious materials ratio
l. Water, in gallons, actually used (by truck driver)
m. Time of loading
n. Time of delivery to job (by truck driver)

7. Any truck delivering concrete to the job site, which is not accompanied by a delivery ticket showing the above information will be rejected and such truck shall immediately depart from the job site.

8. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the Engineer.

C. Site Mixed Concrete

1. Scales for weighing concrete ingredients shall be accurate when in use within ±0.4 percent of their total capacities. Standard test weights shall be available to permit checking scale accuracy.

2. Operation of batching equipment shall be such that the concrete ingredients are consistently measured within the following tolerances:

a.	Cement, fly ash, or slag cement	± 1 percent
b.	Water	± 1 percent
c.	Aggregates	± 2 percent
d.	Admixtures	± 3 percent

3. Each batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregates. Water shall continue for a period which may extend to the end of the first 25 percent of the specified mixing time. Controls shall be provided to prevent batched ingredients from entering the mixer before the previous batch has been completely discharged.

4. The concrete shall be mixed in a batch mixer capable of thoroughly combining the aggregates, cement, and water into a uniform mass within the specified mixing time, and of discharging the concrete without harmful segregation. The mixer shall bear a manufacturer's rating plate indicating the rate capacity and the recommended revolutions per minute and shall be operated in accordance therewith.

5. Mixers with a rate capacity of 1 cu.yd. or larger shall conform to the requirements of the Plant Mixer Manufacturers' Division of the Concrete Plant Manufacturers' Bureau.

6. Except as provided below, batches of 1 cu. yd. or less shall be mixed for not less than 1 minute. The mixing time shall be increased 15 seconds for each cubic yard or fraction thereof of additional capacity.

7. Shorter mixing time may be permitted provided performance tests made in accordance with of ASTM C 94 indicate that the time is sufficient to produce uniform concrete.

8. Controls shall be provided to insure that the batch cannot be discharged until the required mixing time has elapsed. At least three-quarters of the required mixing time shall take place after the last of the mixing water has been added.

9. The interior of the mixer shall be free of accumulations that will interfere with mixing action. Mixer blades shall be replaced when they have lost 10 percent of their original height.

10. Air-entraining admixtures and other chemical admixtures shall be charged into the mixer as solutions and shall be measured by means of an approved mechanical dispensing device. The liquid shall be considered a part of the mixing water. Admixtures that cannot be added in solution may be weighed or may be measured by volume if so recommended by the manufacturer.

11. If two or more admixtures are used in the concrete, they shall be added separately to avoid possible interaction that might interfere with the efficiency of either admixture or adversely affect the concrete.

12. Addition of retarding admixtures shall be completed within 1 minute after addition of water to the cement has been completed, or prior to the beginning of the last three-quarters of the required mixing, whichever occurs first. Retarding admixtures shall not be used unless approved by the Engineer.

13. Concrete shall be mixed only in quantities for immediate use and within the time and mixing requirements of ASTM C 94.

3.03 CONCRETE PLACEMENT

A. No concrete shall be placed prior to approval of the concrete mix design. Concrete placement shall conform to the recommendations of ACI 304.

B. Prior to concrete placement, all reinforcement shall be securely and properly fastened in its correct position. Formwork shall be clean, oiled and form ties at construction joints shall be retightened. All bucks, sleeves, castings, hangers, pipe, conduits, bolts, anchors, wire, and any other fixtures required to be embedded therein shall be in place. Forms for openings to be left in the concrete shall be in place and anchored by the Design/Builder. All loose debris in bottoms of forms or in keyways shall be removed and all debris, water, snow, ice and foreign matter shall be removed from the space to be occupied by the concrete. The Design/Builder shall notify the Engineer in advance of placement, allowing sufficient time for a concurrent inspection and for any corrective measures which are subsequently required.

C. On horizontal joints where concrete is to be placed on hardened concrete, flowing concrete containing a high range water reducing admixture or cement grout shall be placed with a slump not less than 8 inches for the initial placement at the base of the wall. Concrete or cement grout shall meet all strength and service requirements specified herein for applicable class of concrete. This concrete shall be worked well into the irregularities of the hard surface.

D. All concrete shall be placed during the daylight hours except with the consent of the Engineer. If special permission is obtained to carry on work during the night, adequate lighting must be provided.

E. When concrete arrives at the project with slump below that suitable for placing, as indicated by the Specifications, water may be added to bring the concrete within the specified slump range provided that the design water-cementitious materials ratio is not exceeded. The water shall be incorporated by additional mixing equal to at least half of the total mixing required. Water may be added only to full trucks. On-site tempering shall not relieve the Design/Builder from furnishing a concrete mix that meets all specified requirements.

F. Concrete shall be conveyed as rapidly as practicable to the point of deposit by methods which prevent the separation or loss of the ingredients. It shall be so deposited that rehandling will be unnecessary. Discharge of the concrete to its point of deposit shall be completed within 90 minutes after the addition of the cement to the aggregates. In hot weather, or under conditions contributing to quick stiffening of the concrete, the time between the introduction of the cement to the aggregates and discharge shall not exceed the requirements stated in Article 3.09 of this Section.

G. Where concrete is conveyed to position by chutes, a practically continuous flow in the chute shall be maintained. The angle and discharge arrangement of the chute shall be such as to prevent segregation of the concrete ingredients. The delivery end of the chute shall be as close as possible to the point of deposit and in no case shall the free pour from the delivery end of the chute exceed five feet, unless approved otherwise.

H. Special care must be exercised to prevent splashing of forms or reinforcement with concrete, and any such splashes or accumulations of hardened or partially hardened concrete on the forms or reinforcement above the general level of the concrete already in place must be removed before the work proceeds. Concrete shall be placed in all forms in such way as to prevent any segregation.

I. Placing of concrete shall be so regulated that the pressure caused by the wet concrete shall not exceed that used in the design of the forms.

J. All concrete for walls shall be placed through openings in the form spaced at frequent intervals or through tremies (heavy duct canvas, rubber, etc.), equipped with suitable hopper heads. Tremies shall be of variable lengths so the free fall shall not exceed five (5) feet and a sufficient number shall be placed in the form to ensure the concrete is kept level at all times.

K. When placing concrete which is to be exposed, sufficient illumination shall be provided in the interior of the forms so the concrete, at places of deposit, is visible from deck and runways.

L. Concrete shall be placed so as to thoroughly embed all reinforcement, inserts, and fixtures.

M. When forms are removed, surfaces shall be even and dense, free from aggregate pockets or honeycomb. To achieve this, concrete shall be consolidated using mechanical vibration, supplemented by forking and spading by hand in the corners and angle of forms and along form surfaces while the concrete is plastic under the vibratory action. Consolidation shall conform to ACI 309.

N. Mechanical vibration shall be applied directly to the concrete, unless otherwise approved by the Engineer. The bottom of vibrators used on floor slabs must not be permitted to ride the form supporting the slab. Vibration shall be applied at the point of deposit and in the area of freshly placed concrete by a vertical penetration of the vibrator. Vibrators shall not be used to move concrete laterally within the forms.

O. The intensity of vibration shall be sufficient to cause settlement of the concrete into place and to produce monolithic joining with the preceding layer. It shall be of sufficient duration to accomplish thorough compaction and complete embedment of reinforcement and fixtures with a vibrator transmitting not less than 7,500 impulses per minute. Since the duration of vibration per square foot of surface is dependent on the frequency (impulses per minute), size of vibrator, and slump of concrete, the length of time must therefore be determined in the field. Vibration, however, shall not be continued in any one location to the extent that pools of grout are formed.

P. Care shall be taken to prevent cold joints when placing concrete in any portion of the work. The concrete placing rate shall be such as to ensure that each layer is placed while the previous layer is soft or plastic, so that the two layers can be made monolithic by penetration of the vibrators. Maximum thickness of concrete layers shall be 18 inches. The surface of the concrete shall be level whenever a run of concrete is stopped.

Q. To prevent featheredges, construction joints located at the tops of horizontal lifts near sloping exposed concrete surfaces shall be inclined near the exposed surface, so the angle between such inclined surface and the exposed concrete surface will be not less than 50°.

R. In placing unformed concrete on slopes, the concrete shall be placed ahead of a non-vibrated slip-form screed extending approximately 2-1/2 feet back from its leading edge. The method of placement shall provide a uniform finished surface with the deviation from the straight line less than 1/8 inch in any concrete placement. Concrete ahead of the slip-form screed shall be consolidated by internal vibrators so as to ensure complete filling under the slip-form. Prior to placement of concrete on sloped walls or slabs, the Design/Builder shall submit a plan specifically detailing methods and sequence of placements, proposed concrete screed equipment, location of construction joints and waterstops, and/or any proposed deviations from the aforementioned to the Engineer for review and approval.

S. Concrete shall not be placed during rains sufficiently heavy or prolonged to wash mortar from coarse aggregate on the forward slopes of the placement. Once placement of concrete has commenced in a block, placement shall not be interrupted by diverting the placing equipment to other uses.

3.04 PLACING FLOOR SLABS ON GRADE

A. The subgrade for slabs on ground shall be well drained and of adequate and uniform loadbearing nature. The in-place density of the subgrade soils shall be at least the minimum required by the specifications. No foundation, slab, or pavement concrete shall be placed

until the depth and character of the foundation soils have been inspected and approved by the materials testing consultant.

B. The subgrade shall be free of frost before concrete placing begins. If the temperature inside a building where concrete is to be placed is below freezing it shall be raised and maintained above 50° long enough to remove all frost from the subgrade.

C. The subgrade shall be moist at the time of concreting. If necessary, it shall be dampened with water in advance of concreting, but there shall be no free water standing on the subgrade nor any muddy or soft spots when the concrete is placed.

D. Thirty-pound felt paper shall be provided between edges of slab-on-grade and vertical and horizontal concrete surfaces, unless otherwise indicated on the Drawings.

E. Contraction joints shall be provided in slabs-on-grade at locations indicated on the Drawings. Contraction joints shall be installed as per Section 03290 - Joints in Concrete.

F. Floor slabs shall be screeded level or pitched to drain as indicated on the Drawings. Finishes shall conform with requirements of Section 03350 - Concrete Finishes. Interior floor slabs shall be placed with non-air-entrained concrete (Class A3) if a steel troweled or hardened finish is required.

3.05 PLACING CONCRETE UNDERWATER (CLASS A5 CONCRETE)

A. Placing concrete underwater (tremie concrete) will be permitted only when shown on the Drawings. Concrete deposited under water shall be carefully placed in a compacted mass in final position by means of a tremie, a closed bottom dump bucket or other approved method. Care must be exercised to maintain still water at the point of deposit. Concrete shall not be placed in running water. Underwater formwork shall be watertight. The consistency of the concrete shall be regulated to prevent segregation of materials. The method of depositing concrete shall be regulated such that the concrete enters the mass of the previously placed concrete from within, displacing water with a minimum disturbance to the surface of the concrete.

B. Tremie shall consist of a tube having a diameter of not less than 10 inches and constructed in sections having flanged couplings fitted with gaskets. The tremie shall be supported to permit free movement of the discharge and over the entire top surface of the work and shall permit rapid lowering when necessary to choke off or retard the flow. The discharge end shall be entirely sealed at all times and the tremie tube kept full to the bottom of the hopper. When a batch is dumped into the hopper, the tremie shall be slightly raised, but not out of the concrete at the bottom, until the batch discharges to the bottom of the hopper. The flow shall then be stopped by lowering the tremie. The flow shall be continuous until the placement has been completed.

3.06 PLACING CONCRETE UNDER PRESSURE

A. Where concrete is conveyed and placed by mechanically applied pressure, the equipment shall have the capacity for the operation. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. To obtain the least line resistance, the layout of the pipeline system shall contain a minimum number of bends with no change in pipe size. If two sizes of pipe must be used, the smaller diameter should be used at the pump end and the larger at the discharge end. When pumping is completed, the

concrete remaining in the pipelines, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients.

B. Priming of the concrete pumping equipment shall be with cement grout only. Use of specialty mix pump primers or pumping aids will not be allowed.

C. No aluminum parts shall be in contact with the concrete during the entire placing of concrete under pressure at any time.

D. Prior to placing concrete under pressure, the Design/Builder shall submit the concrete mix design together with test results from a materials testing consultant proving the proposed mix meets all requirements. In addition, an actual pumping test under field conditions is required prior to acceptance of the mix. This test requires a duplication of anticipated site conditions from beginning to end. The batching and truck mixing shall be the same as will be used; the same pump and operator shall be present and the pipe and pipe layouts will reflect the maximum height and distance contemplated. All submissions shall be subject to approval by the Engineer.

E. If the pumped concrete does not produce satisfactory end results, the Design/Builder shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.

F. The pumping equipment must have two cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the Design/Builder may have a standby pump on the site during pumping.

G. The minimum diameter of the hose (conduits) shall be four inches.

H. Pumping equipment and hoses (conduits) that are not functioning properly shall be replaced.

I. Concrete samples for quality control in accordance with Article 3.10 will be taken at the placement (discharge) end of the line.

3.07 ORDER OF PLACING CONCRETE

A. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown on the Drawings and maximum lengths as indicated on Drawings. Where required on the Drawings and wherever else practical, the placing of such units shall be done in a strip pattern in accordance with ACI 302.1. A minimum of 72 hours shall pass prior to placing concrete directly adjacent to previously placed concrete.

3.08 CONCRETE WORK IN COLD WEATHER

A. Cold weather concreting procedures shall conform to the requirements of ACI 306.

B. The Engineer may prohibit the placing of concrete at any time when air temperature is 40°F. or lower. If concrete work is permitted, the concrete shall have a minimum temperature, as placed, of 55°F. for placements less than 12" thick, 50°F. for placements 12" to 36" thick, and 45°F. for placements greater than 36" thick. The temperature of the concrete as placed shall not exceed the aforementioned minimum values by more than 20°F, unless otherwise approved by the Engineer.

C. All aggregate and water shall be preheated. Precautions shall be taken to avoid the possibility of flash set when aggregate or water are heated to a temperature in excess of 100°F. in order to meet concrete temperature requirements. The addition of admixtures to the concrete to prevent freezing is not permitted. All reinforcement, forms, and concrete accessories with which the concrete is to come in contact shall be defrosted by an approved method. No concrete shall be placed on frozen ground.

3.09 CONCRETE WORK IN HOT WEATHER

A. Hot weather concreting procedures shall conform to the requirements of ACI 305.

B. When air temperatures exceed 85°F., or when extremely dry conditions exist even at lower temperatures, particularly if accompanied by high winds, the Design/Builder and his concrete supplier shall exercise special and precautionary measures in preparing, delivering, placing, finishing, curing and protecting the concrete mix. The Design/Builder shall consult with the Engineer regarding such measures prior to each day's placing operation and the Engineer reserves the right to modify the proposed measures consistent with the requirements of this Section of the Specifications. All necessary materials and equipment shall be on hand an in position prior to each placing operation.

C. Preparatory work at the job site shall include thorough wetting of all forms, reinforcing steel and, in the case of slab pours on ground or subgrade, spraying the ground surface on the preceding evening and again just prior to placing. No standing puddles of water shall be permitted in those areas which are to receive the concrete.

D. The temperature of the concrete mix when placed shall not exceed 90°F.

E. Temperature of mixing water and aggregates shall be carefully controlled and monitored at the supplier's plant, with haul distance to the job site being taken into account. Stockpiled aggregates shall, if necessary, be shaded from the sun and sprinkled intermittently with water. If ice is used in the mixing water for cooling purposes, it must be entirely melted prior to addition of the water to the dry mix.

F. Delivery schedules shall be carefully planned in advance so that concrete is placed as soon as practical after it is properly mixed. For hot weather concrete work (air temperature greater than 85°F), discharge of the concrete to its point of deposit shall be completed within 60 minutes from the time the concrete is batched.

G. The Design/Builder shall arrange for an ample work force to be on hand to accomplish transporting, vibrating, finishing, and covering of the fresh concrete as rapidly as possible.

3.10 QUALITY CONTROL

A. Field Testing of Concrete

1. The Design/Builder shall coordinate with the Engineer's project representative the on-site scheduling of the materials testing consultant personnel as required for concrete testing.

2. Concrete for testing shall be supplied by the Design/Builder at no additional cost to the Owner, and the Design/Builder shall provide assistance to the materials testing

consultant in obtaining samples. The Design/Builder shall dispose of and clean up all excess material.

B. Consistency

1. The consistency of the concrete will be checked by the materials testing consultant by standard slump cone tests. The Design/Builder shall make any necessary adjustments in the mix as the Engineer and/or the materials testing consultant may direct and shall upon written order suspend all placing operations in the event the consistency does not meet the intent of the specifications.

2. Slump tests shall be made in accordance with ASTM C 143. Slump tests will be performed as deemed necessary by the materials testing consultant and each time compressive strength samples are taken.

3. Concrete with a specified nominal slump shall be placed having a slump within 1" (higher or lower) of the specified slump. Concrete with a specified maximum slump shall be placed having a slump less than the specified slump.

C. Unit Weight

1. Samples of freshly mixed concrete shall be tested for unit weight by the materials testing consultant in accordance with ASTM C 138.

2. Unit weight tests will be performed as deemed necessary by the Engineer and each time compressive strength samples are taken.

D. Air Content

1. Samples of freshly mixed concrete will be tested for entrained air content by the materials testing consultant in accordance with ASTM C 231.

2. Air content tests will be performed as deemed necessary by the materials testing consultant and each time compressive strength samples are taken.

3. In the event test results are outside the limits specified, additional testing shall occur. Admixture quantity adjustments shall be made immediately upon discovery of incorrect air entrainment.

E. Compressive Strength

1. Samples of freshly mixed concrete will be taken by the materials testing consultant and tested for compressive strength in accordance with ASTM C 172, C 31 and C 39, except as modified herein.

2. In general, one sampling shall be taken for each placement in excess of five (5) cubic yards, with a minimum of one (1) sampling for each day of concrete placement operations, or for each one hundred (100) cubic yards of concrete, or for each 5,000 square feet of surface area for slabs or walls, whichever is greater.

3. Each sampling shall consist of at least five (5) 6x12 cylinders or (8) 4x8 cylinders. Each cylinder shall be identified by a tag, which shall be hooked or wired to the side

of the container. The materials testing consultant will fill out the required information on the tag, and the Design/Builder shall satisfy himself that such information shown is correct.

4. The Design/Builder shall be required to furnish labor for assisting in preparing test cylinders for testing. The Design/Builder shall provide approved curing boxes for storage of cylinders on site. The insulated curing box shall be of sufficient size and strength to contain all the specimens made in any four consecutive working days and to protect the specimens from falling over, being jarred or otherwise disturbed during the period of initial curing. The box shall be erected, furnished and maintained by the Design/Builder. Such box shall be equipped to provide the moisture and to regulate the temperature necessary to maintain the proper curing conditions required by ASTM C 31. Such box shall be located in an area free from vibration such as pile driving and traffic of all kinds and such that all specimen are shielded from direct sunlight and/or radiant heating sources. No concrete requiring inspection shall be delivered to the site until such storage curing box has been provided. Specimens shall remain undisturbed in the curing box until ready for delivery to the testing laboratory but not less than sixteen hours.

5. The Design/Builder shall be responsible for maintaining the temperatures of the curing box during the initial curing of test specimens with the temperature preserved between 60°F and 80°F as measured by a maximum-minimum thermometer. The Design/Builder shall maintain a written record of curing box temperatures for each day curing box contains test specimens. Temperature shall be recorded a minimum of three times a day with one recording at the start of the work day and one recording at the end of the work day.

6. When transported, the cylinders shall not be thrown, dropped, allowed to roll, or be damaged in any way.

7. Compression tests shall be performed in accordance with ASTM C 39. For 6x12 cylinders, two test cylinders will be tested at seven days and two at 28 days. For 4x8 cylinders, three test cylinders will be tested at seven days, three at 28 days. The remaining cylinders will be held to verify test results, if needed.

F. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 214, ACI 318, and ACI 350.

2. The strength level of concrete will be considered satisfactory if all of the following conditions are satisfied.

   a. Every arithmetic average of any three consecutive strength tests equals or exceeds the minimum specified 28-day compressive strength for the mix (see Article 2.08).

   b. No individual compressive strength test results falls below the minimum specified strength by more than 500 psi.

   c. No more than 10% of the compressive tests have strengths greater than the maximum strength specified.

3. In the event any of the conditions listed above are not met, the mix proportions shall be corrected for the next concrete placing operation.

4. In the event that condition 2B is not met, additional tests in accordance with Article 3.10, paragraph H shall be performed.

5. When a ratio between 7-day and 28-day strengths has been established by these tests, the 7-day strengths shall subsequently be taken as a preliminary indication of the 28-day strengths. Should the 7-day test strength from any sampling be more than 10% below the established minimum strength, the Design/Builder shall:

    a. Immediately provide additional periods of curing in the affected area from which the deficient test cylinders were taken.

    b. Maintain or add temporary structural support as required.

    c. Correct the mix for the next concrete placement operation, if required to remedy the situation.

6. All concrete which fails to meet the ACI requirements and these specifications is subject to removal and replacement at no additional cost to the Owner.

G. When non-compliant concrete is identified, test reports shall be sent immediately to the Engineer for review.

H. Additional Tests

1. When ordered by the Engineer, additional tests on in-place concrete shall be provided and paid for by the Design/Builder.

2. In the event the 28-day test cylinders fail to meet the minimum strength requirements as outlined in Article 3.10, paragraph F, the Design/Builder shall have concrete core specimens obtained and tested from the affected area immediately.

    a. Three cores shall be taken for each sample in which the strength requirements were not met.

    b. The drilled cores shall be obtained and tested in conformance with ASTM C 42. The tests shall be conducted by a materials testing consultant approved by the Engineer.

    c. The location from which each core is taken shall be approved by the Engineer. Each core specimen shall be located, when possible, so its axis is perpendicular to the concrete surface and not near formed joints or obvious edges of a unit of deposit.

    d. The core specimens shall be taken, if possible, so no reinforcing steel is within the confines of the core.

e. The diameter of core specimens should be at least 3 times the maximum nominal size of the course aggregate used in the concrete, but must be at least 2-inches in diameter.

f. The length of specimen, when capped, shall be at least twice the diameter of the specimen.

g. The core specimens shall be taken to the laboratory and when transported, shall not be thrown, dropped, allowed to roll, or damaged in any way.

h. Two (2) copies of test results shall be mailed directly to the Engineer. The concrete in question will be considered acceptable if the average compressive strength of a minimum of three test core specimens taken from a given area equal or exceed 85% of the specified 28-day strength and if the lowest core strength is greater than 75% of the specified 28-day strength.

3. In the event that concrete placed by the Design/Builder is suspected of not having proper air content, the Design/Builder shall engage a materials testing consultant approved by the Engineer, to obtain and test samples for air content in accordance with ASTM Specification C 457.

4. Concrete placed with compressive strengths greater than the maximum strength specified shall be removed and replaced or repaired as deemed necessary by the Engineer.

3.11 CARE AND REPAIR OF CONCRETE

A. The Design/Builder shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the Owner. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Care shall be exercised to avoid jarring forms or placing any strain on the ends of projecting reinforcing bars. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at no additional cost to the Owner.

B. Areas of honeycomb shall be chipped back to sound concrete and repaired as directed.

C. Concrete formwork blowouts or unacceptable deviations in tolerances for formed surfaces due to improperly constructed or misaligned formwork shall be repaired as directed. Bulging or protruding areas, which result from slipping or deflecting forms shall be ground flush or chipped out and redressed as directed.

D. Areas of concrete in which cracking, spalling, or other signs of deterioration develop prior to final acceptance shall be removed and replaced, or repaired as directed. This stipulation includes concrete that has experienced cracking due to drying or thermal shrinkage of the concrete. Structural cracks shall be repaired using an approved epoxy injection system. Non-structural cracks shall be repaired using an approved hydrophilic resin pressure injected grout system, unless other means of repair are deemed necessary and approved. All repair work shall be performed at no additional cost to the Owner.

E. Concrete which fails to meet the strength requirements as outlined in Article 3.10, paragraph F, will be analyzed as to its adequacy based upon loading conditions, resultant stresses and exposure conditions for the particular area of concrete in question. If the concrete in question is found unacceptable based upon this analysis, that portion of the structure shall be strengthened or replaced by the Design/Builder at no additional cost to the Owner. The method of strengthening or extent of replacement shall be as directed by the Engineer.

- END OF SECTION -

SECTION 03350

CONCRETE FINISHES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide finishes of all concrete surfaces specified herein and shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03100 – Concrete Formwork

B. Section 03300 – Cast-in-Place Concrete

C. Section 03600 – Grout

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available.

1. ACI 301 – Specifications for Structural Concrete for Buildings

2. ACI 318 – Building Code Requirements for Structural Concrete

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Manufacturer's literature on all products specified herein.

PART 2 -- PRODUCTS

2.01 CONCRETE FLOOR SEALER

A. Floor sealer shall be Diamond Clear VOX or Super Diamond Clear VOX by the Euclid Chemical Company, MasterKure CC 300 SB by BASF Master Builder Solutions.

2.02 CONCRETE LIQUID DENSIFIER AND SEALANT

A. Concrete liquid densifier and sealant shall be a high performance, deeply penetrating concrete densifier and sealant. Product shall be odorless, colorless, VOC-compliant, non-yellowing siliconate based solution designed to harden, dustproof and protect concrete floors subjected to heavy vehicular traffic and to resist black rubber tire marks on concrete

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surfaces. The product must contain a minimum solids content of 20% of which 50% is siliconate. Acceptable products are Diamond Hard by the Euclid Chemical Company,Seal Hard by L&M Construction Chemicals and MasterKure HD 210 WB by BASF Master Builder Solutions.

2.03 NON-METALLIC FLOOR HARDENER

A. The specified non-metallic mineral aggregate hardener shall be formulated, processed, and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a factory-blended mixture of specifically processed graded mineral aggregate, selected Portland cement, and necessary plasticizing agents. Acceptable products shall be "Surflex" by the Euclid Chemical Company, "Harcol" by Sonneborn, "Maximent" by BASF, and "Mastercon" by BASF.

2.04 NON-OXIDIZING HEAVY DUTY METALLIC FLOOR HARDENER

A. Non-oxidizing heavy duty metallic floor hardener shall be formulated, processed, and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a mixture of specifically processed non-rusting aggregate, selected Portland cement, and necessary plasticizing agents. Product shall be "Diamond-Plate" by the Euclid Chemical Company, or Masterplate by BASF Construction Chemicals.

2.05 NON-SLIP FLOORING ADDITIVE

A. Non-slip flooring additives for slip resistant floors shall be non-metallic. Non-slip flooring additives shall be Frictex NS by BASF Construction Chemicals, A-H Alox by Anti-Hydro, or Euco Grip by the Euclid Chemical Company.

PART 3 -- EXECUTION

3.01 FINISHES ON FORMED CONCRETE SURFACES

A. After removal of forms, the finishes described below shall be applied in accordance with Article 3.05 - Concrete Finish Schedule. Unless the finish schedule specifies otherwise, all surfaces shall receive at least a Type I finish. The Engineer shall be the sole judge of acceptability of all concrete finish work.

1. Type I - Rough: All fins, burrs, offsets, marks and all other projections left by the forms shall be removed. Projections, depressions, etc. below finished grade required to be removed will only be those greater than ¼-inch. All holes left by removal of ends of ties, and all other holes, depressions, bugholes, air/blow holes or voids shall be filled solid with cement grout after first being thoroughly wetted and then struck off flush. The only holes below grade to be filled will be tie holes and any other holes larger than ¼-inch in any dimension. Honeycombs shall be chipped back to solid concrete and repaired as directed by the Engineer. All holes shall be filled with tools, such as sponge floats and trowels, that will permit packing the hole solidly with cement grout. Cement grout shall consist of one part cement to three parts sand, epoxy bonding agent (for tie holes only) and the amount of mixing water shall be as little as consistent with the requirements of handling and placing. Color of cement grout shall match the adjacent wall surface.

2. Type II - Grout Cleaned: Where this finish is required, it shall be applied after completion of Type I finish. After the concrete has been predampened, a slurry consisting of one part cement (including an appropriate quantity of white cement in order to produce a color matching the surrounding concrete) and 1-1/2 parts sand passing the No. 16 sieve, by damp loose volume, shall be spread over the surface with clean burlap pads or sponge rubber floats. Mix proportions shall be submitted to the Engineer after a sample of the work is established and accepted. Any surplus shall be removed by scraping and then rubbing with clean burlap.

3. Type III - Smooth Rubbed: Where this finish is required, it shall be applied after the completion of the Type II finish. No rubbing shall be done before the concrete is thoroughly hardened and the mortar used for patching is firmly set. A smooth, uniform surface shall be obtained by wetting the surface and rubbing it with a carborundum stone to eliminate irregularities. Unless the nature of the irregularities requires it, the general surface of the concrete shall not be cut into. Corners and edges shall be slightly rounded by the use of the carborundum stone. Brush finishing or painting with grout or neat cement will not be permitted. A 100 square foot example shall be established at the beginning of the project to establish acceptability.

3.02 SLAB AND FLOOR FINISHES

A. The finishes described below shall be applied to floors, slabs, flow channels and top of walls in accordance with Article 3.05 - Concrete Finish Schedule. The Engineer shall be the sole judge of acceptability of all such finish work.

1. Type "A" - Screeded: This finish shall be obtained by placing screeds at frequent intervals and striking off to the surface elevation required. When a Type "F" finish is subsequently to be applied, the surface of the screeded concrete shall be roughened with a concrete rake to 1/2” minimum deep grooves prior to final set.

2. Type "B" - Wood or Magnesium Floated: This finish shall be obtained after completion of a Type "A" finish by working a previously screeded surface with a wood or magnesium float or until the desired texture is reached. Floating shall begin when the water sheen has disappeared and when the concrete has sufficiently hardened so that a person's foot leaves only a slight imprint. If wet spots occur, water shall be removed with a squeegee. Care shall be taken to prevent the formation of laitance and excess water on the finished surface. All edges shall be edged with an 1/8-inch tool as directed by the Engineer. The finished surface shall be true, even, and free from blemishes and any other irregularities.

3. Type "C" - Cork Floated: This finish shall be similar to Type "B" but slightly smoother than that obtained with a wood float. It shall be obtained by power or band floating with cork floats.

4. Type "D" - Steel Troweled: This finish shall be obtained after completion of a Type "B" finish. When the concrete has hardened sufficiently to prevent excess fine material from working to the surface, the surface shall be compacted and smoothed with not less than two thorough and complete steel troweling operations. In areas which are to receive a floor covering such as tile, resilient flooring, or carpeting, the applicable Specification Sections and Contract Drawings shall be reviewed for the required finishes and degree of flatness. In areas that are intermittently wet such as pump rooms, only one troweling operation is required to provide some trowel marks for slip resistance. All edges shall be edged with an 1/8-inch tool as directed by the Engineer. The finish shall be brought to a smooth, dense surface, free from defects and blemishes.

5. Type "E" - Broom or Belt: This finish shall provide the surface with a transverse scored texture by drawing a broom or burlap belt across the surface immediately after completion of a Type "B" finish. All edges shall be edged with an 1/8-inch tool as directed by the Engineer.

6. Type "F" - Swept in Grout Topping: This finish shall be applied after a completion of a Type "A" finish. The concrete surface shall be properly cleaned, washed, and coated with a mixture of water and Portland Cement. Cement grout in accordance with Section 03600 shall then be plowed and swept into neat conformance with the blades or arms of the apparatus by turning or rotating the previously positioned mechanical equipment. Special attention shall be paid to true grades, shapes and tolerances as specified by the manufacturer of the equipment. Before beginning this finish, the Design/Builder shall notify the Engineer and the equipment manufacturer of the details of the operation and obtain approval and recommendations.

7. Type “G” Hardened Finish: This finish shall be applied after completion of a Type “B” or Type “C” finish and prior to application of a Type “D” finish. Hardeners shall be applied in strict accordance with the manufacturer’s requirements. Hardeners shall be applied using a mechanical spreader. The hardener shall be applied in two shakes with the first shake comprising 2/3 of the total amount. Type “D” finish shall be applied following completion of application of the hardener.

    a. Non-metallic floor hardener shall be applied where specifically required on the Contract Drawings at the rate of 1.0 pounds/ft.^{2}.

    b. Non-oxidizing heavy duty metallic floor hardener shall be applied at the loading docks and where specifically required on the Contract Drawings or specified herein at the rate of 1.5 pounds/ft.^{2}.

8. Type "H" - Non-Slip Finish: This finish shall be provided by applying a non-slip flooring additive concurrently with the application of a Type "D" finish and/or installation of floor sealants. Application procedure shall be in accordance with manufacturer's instructions. Finish shall be applied where specifically required on the Contract Drawings or specified herein.

9. Type "J" - Raked Finish: This finish shall be provided by raking the surface as soon as the condition of the concrete permits by making depressions of ±1/4 inch.

3.03 CONCRETE SEALERS

A. Concrete sealers shall be applied where specifically required on the Contract Drawings or specified herein.

B. Sealers shall be applied after installation of all equipment, piping, etc. and after completion of any other related construction activities. Application of sealers shall be in strict accordance with manufacturer's requirements.

C. Sealers shall be applied to all floor slabs not painted and not intended to be immersed.

D. Floor slabs subjected to vehicular traffic shall be sealed with the concrete liquid densifier and sealer.

E. All other floor slabs to receive sealer shall be sealed with concrete floor sealer.

3.04 FINISHES ON EQUIPMENT PADS

A. Formed surfaces of equipment pads shall receive a Type III finish.

B. Top surfaces of equipment pads, except those surfaces subsequently required to receive grout and support equipment bases, shall receive a Type "D" finish, unless otherwise noted. Surfaces which will later receive grout shall, before the concrete takes its final set, be made rough by removing the sand and cement that accumulates on the top to the extent that the aggregate will be exposed with irregular indentations in the surface up to 1/2 inch deep.

3.05 CONCRETE FINISH SCHEDULE

Item	Type of Finish
Concrete surfaces indicated to receive textured coating (as noted on Drawings and in Section 09800, Special Coatings)	I
Inner face of walls of tanks, flow channels, wet wells, perimeter walls, and miscellaneous concrete structures:	
From 1 feet below water surface to bottom of wall	II
From top of wall to 1 feet below water surface	II
Exterior concrete walls below grade	I
Exterior exposed concrete walls, ceilings, beams, manholes, hand holes, miscellaneous structures and columns (including top of wall) to one foot below grade. All other exposed concrete surfaces not specified elsewhere	II
All interior exposed concrete walls and vertical surfaces	III
Interior exposed ceiling, including beams	III
Floors of process equipment tanks or basins, wetwells, flow channels and slabs to receive roofing material or waterproof membranes	B
All interior finish floors of buildings and structures and walking	D

Item	Type of Finish
surfaces which will be continuously or intermittently wet	
All interior finish floors of buildings and structures which are not continuously or intermittently wet	D
Floors to receive tile, resilient flooring, or carpeting	D
Exterior concrete sidewalks, steps, ramps, decks, slabs on grade and landings exposed to weather	E
Garage, storage area floors, and loading docks	G

- END OF SECTION -

SECTION 03370

CONCRETE CURING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Protect all freshly deposited concrete from premature drying and from the weather elements. The concrete shall be maintained with minimal moisture loss at a relatively constant temperature for a period of time necessary for the hydration of the cement and proper hardening of the concrete in accordance with the requirements specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03100 – Concrete Formwork

B. Section 03300 – Cast-In-Place Concrete

C. Section 03350 – Concrete Finishes

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available.

1. ACI 301 – Specifications for Structural Concrete for Buildings

2. ACI 304 – Guide for Measuring, Mixing, Transporting, and Placing Concrete

3. ACI 305 – Hot Weather Concreting

4. ACI 306 – Cold Weather Concreting

5. ACI 308 – Standard Practice for Curing Concrete

6. ASTM C171 – Standard Specifications for Sheet Materials for Curing Concrete

7. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

8. ASTM C1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures.

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1. Proposed procedures for protection of concrete under wet weather placement conditions.

2. Proposed normal procedures for protection and curing of concrete.

3. Proposed special procedures for protection and curing of concrete under hot and cold weather conditions.

4. Proposed method of measuring concrete surface temperature changes.

5. Manufacturer's literature and material certification for proposed curing compounds.

PART 2 -- PRODUCTS

2.01 LIQUID MEMBRANE-FORMING CURING COMPOUND

A. Clear curing and sealing compound shall be a clear styrene acrylate type complying with ASTM C 1315, Type 1, Class A with a minimum solids content of 30%. Moisture loss shall not be greater than 0.40 kg/m^2 when applied at 300 sq.ft./gal. Manufacturer's certification is required. Acceptable products are Super Diamond Clear VOX by the Euclid Chemical Company, MasterKure CC 300 SB by BASF Master Builder Solutions, and Cure & Seal 30 Plus by Symons Corporation.

B. Where specifically approved by Engineer, on slabs to receive subsequent applied finishes, compound shall conform to ASTM C 309. Acceptable products are "Kurez DR VOX" or "Kurez W VOX" by the Euclid Chemical Company. Install in strict accordance with manufacturer's requirements.

2.02 EVAPORATION REDUCER

A. Evaporation reducer shall be BASF, "MasterKure ER 50", or Euclid Chemical "Euco-Bar".

PART 3 -- EXECUTION

3.01 PROTECTION AND CURING

A. All freshly placed concrete shall be protected from the elements, flowing water and from defacement of any nature during construction operations.

B. As soon as the concrete has been placed and horizontal top surfaces have received their required finish, provision shall be made for maintaining the concrete in a moist condition for at least a 5-day period thereafter except for high early strength concrete, for which the period shall be at least the first three days after placement. Horizontal surfaces shall be kept covered, and intermittent, localized drying will not be permitted.

C. Walls that will be exposed on one side with either fluid or earth backfill on the opposite side shall be continuously wet cured for a minimum of five days. Use of a curing compound will not be acceptable for applications of this type.

D. The Design/Builder shall use one of the following methods to insure that the concrete remains in a moist condition for the minimum period stated above.

1. Ponding or continuous fogging or sprinkling.

2. Application of mats or fabric kept continuously wet.

3. Continuous application of steam (under 150°F).

4. Application of sheet materials conforming to ASTM C171.

5. If approved by the Engineer, application of a curing compound in accordance with Article 3.04.

E. The Design/Builder shall keep absorbent wood forms wet until they are removed. After form removal, the concrete shall be cured by one of the methods in paragraph D.

F. Any of the curing procedures used in Paragraph 3.01-D may be replaced by one of the other curing procedures listed in Paragraph 3.01-D after the concrete is one-day old. However, the concrete surface shall not be permitted to become dry at any time.

3.02 CURING CONCRETE UNDER COLD WEATHER CONDITIONS

A. Suitable means shall be provided for a minimum of 72 hours after placing concrete to maintain it at or above the minimum as placed temperatures specified in Section 03300, Cast-In-Place Concrete, for concrete work in cold weather. During the 72-hour period, the concrete surface shall not be exposed to air more than 20°F above the minimum as placed temperatures.

B. Stripping time for forms and supports shall be increased as necessary to allow for retardation in concrete strength caused by colder temperatures. This retardation is magnified when using concrete made with blended cements or containing fly ash or ground granulated blast furnace slag. Therefore, curing times and stripping times shall be further increased as necessary when using these types of concrete.

C. The methods of protecting the concrete shall be approved by the Engineer and shall be such as will prevent local drying. Equipment and materials approved for this purpose shall be on the site in sufficient quantity before the work begins. The Design/Builder shall assist the Engineer by providing holes in the forms and the concrete in which thermometers can be placed to determine the adequacy of heating and protection. All such thermometers shall be furnished by the Design/Builder in quantity and type which the Engineer directs.

D. Curing procedures during cold weather conditions shall conform to the requirements of ACI 306.

3.03 CURING CONCRETE UNDER HOT WEATHER CONDITIONS

A. When air temperatures exceed 85°F, the Design/Builder shall take extra care in placing and finishing techniques to avoid formation of cold joints and plastic shrinkage cracking. If ordered by the Engineer, temporary sun shades and/or windbreakers shall be erected to

guard against such developments, including generous use of wet burlap coverings and fog sprays to prevent drying out of the exposed concrete surfaces.

B. Immediately after screeding, horizontal surfaces shall receive an application of evaporation reducer. Apply in accordance with manufacturer's instructions. Final finish work shall begin as soon as the mix has stiffened sufficiently to support the workmen.

C. Curing and protection of the concrete shall begin immediately after completion of the finishing operation. Continuous moist-curing consisting of method 1 or 2 listed in paragraph 3.01D is mandatory for at least the first 24 hours. Method 2 may be used only if the finished surface is not marred or blemished during contact with the coverings.

D. At the end of the initial 24-hour period, curing and protection of the concrete shall continue for at least six (6) additional days using one of the methods listed in paragraph 3.01D.

E. Curing procedures during hot weather conditions shall conform to the requirements of ACI 305.

3.04 USE OF CURING COMPOUND

A. Curing compound shall be used only where specifically approved by the Engineer. Curing compound shall never be used for curing exposed walls with fluid or earth backfill on the opposite side. A continuous wet cure for a minimum of five days is required for these applications. Curing compound shall not be used on surfaces exposed to water in potable water storage tanks and treatment plants unless curing compound is certified in accordance with ANSI/NSF Standard 61.

B. When permitted, the curing compound shall maintain the concrete in a moist condition for the required time period, and the subsequent appearance of the concrete surface shall not be affected.

C. The compound shall be applied in accordance with the manufacturer's recommendations after water sheen has disappeared from the concrete surface and after finishing operations. Maximum coverage for the curing and sealing compound shall be 300 square feet per gallon for trowel finishes and 200 square feet per gallon for floated or broom surfaces. Maximum coverage for compounds placed where subsequent finishes will be applied shall be 200 square feet per gallon. For rough surfaces, apply in two directions at right angles to each other.

3.05 EARLY TERMINATION OF CURING

A. Moisture retention measures may be terminated earlier than the specified times only when at least one of the following conditions is met:

1. The strength of the concrete reaches 85 percent of the specified 28-day compressive strength in laboratory-cured cylinders representative of the concrete in place, and the temperature of the in-place concrete has been constantly maintained at 50 degrees Fahrenheit or higher.

2. The strength of concrete reaches the specified 28-day compressive strength as determined by accepted nondestructive methods or laboratory-cured cylinder test results.

- END OF SECTION -

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SECTION 03400

PRECAST CONCRETE

PART 1 -- GENERAL

1.01 REQUIREMENTS

A. The Design/Builder shall construct all precast concrete items as required in the Contract Documents, including all appurtenances necessary to make a complete installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02604 - Utility Structures

B. Section 03200 - Reinforcing Steel

C. Section 03300 - Cast-in-Place Concrete

D. Section 03350 - Concrete Finishes

E. Section 03370 - Concrete Curing

F. Section 03600 - Grout

G. Section 05010 - Metal Materials

H. Section 05035 - Galvanizing

I. Section 05050 - Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available.

1. Virginia Uniform Statewide Building Code

2. ACI 318-Building Code Requirements for Structural Concrete

3. PCI Standard MNL-116 - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products

4. PCI Design Handbook

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1.04 SUBMITTALS

A. The Design/Builder shall submit the following for review in accordance with Section 01 33 00, Submittal Procedures.

1. Shop drawings for all precast concrete items showing all dimensions, locations, and type of lifting inserts, and details of reinforcement and joints.

2. A list of the design criteria used by the manufacturer for all manufactured, precast items.

3. Design calculations, showing at least the design loads and stresses on the item, shall be submitted. Calculations shall be signed and sealed by a Professional Engineer registered in the Commonwealth of Virginia.

4. Certified reports for all lifting inserts, indicating allowable design loads.

5. Information on lifting and erection procedures.

1.05 QUALITY ASSURANCE

A. All manufactured precast concrete units shall be produced by an experienced manufacturer regularly engaged in the production of such items. All manufactured precast concrete and site-cast units shall be free of defects, spalls, and cracks. Care shall be taken in the mixing of materials, casting, curing and shipping to avoid any of the above. The Engineer may elect to examine the units at the casting yard or upon arrival of the same at the site. The Engineer shall have the option of rejecting any or all of the precast work if it does not meet with the requirements specified herein or on the Drawings. All rejected work shall be replaced at no additional cost to the Owner.

B. Manufacturer Qualifications

The precast concrete manufacturing plant shall be certified by the Prestressed Concrete Institute, Plant Certification Program, prior to the start of production. Certification is only required for plants providing prestressed structural members such as hollow core planks, double-T members, etc.

C. Plant production and engineering must be under direct supervision and control of an Engineer who possesses a minimum of five years experience in precast concrete work.

PART 2 -- PRODUCTS

2.01 CONCRETE

A. Concrete materials including Portland Cement, aggregates, water, and admixtures shall conform to Section 03300, Cast-in-Place Concrete.

B. For prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 5,000 psi unless otherwise specified. Minimum compressive strength of concrete at transfer of prestressing force shall be 3,500 psi unless otherwise specified.

C. For non-prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 4000 psi unless otherwise specified.

2.02 GROUT

A. Grout for joints between panels shall be a cement grout in conformance with Section 03600, Grout.

B. Minimum compressive strength of grout at 7 days shall be 3,000 psi.

2.03 REINFORCING STEEL

A. Reinforcing steel used for precast concrete construction shall conform to Section 03200, Reinforcing Steel.

2.04 PRESTRESSING STRANDS

A. Prestressing strands shall be 7-wire, stress-relieved, high-strength strands Grade 250K or 270K in conformance with Section 03230, Stressing Tendons.

2.05 STEEL INSERTS

A. Steel inserts shall be in accordance with Section 05010, Metal Materials.

B. All steel inserts protruding from or occurring at the surface of precast units shall be galvanized in accordance with Section 05035, Galvanizing.

2.06 WELDING

A. Welding shall conform to Section 05050, Metal Fastening.

2.07 BEARING PADS

A. Neoprene bearing pads shall conform to Section 05830, Bearing Devices and Anchors.

B. Plastic bearing pads shall be multi-monomer plastic strips which are non-leaching and support construction loads with no visible overall expansion, manufactured specifically for the purpose of bearing precast concrete.

PART 3 -- EXECUTION

3.01 FABRICATION AND CASTING

A. All precast members shall be fabricated and cast to the shapes, dimensions and lengths shown on the Drawings and in compliance with PCI MNL-116. Precast members shall be straight, true and free from dimensional distortions, except for camber and tolerances permitted later in this clause. All integral appurtenances, reinforcing, openings, etc., shall be accurately located and secured in position with the form work system. Form materials shall be steel and the systems free from leakage during the casting operation.

B. All cover of reinforcing shall be the same as detailed on the Drawings.

C. Because of the critical nature of the bond development length in prestressed concrete panel construction, if the transfer of stress is by burning of the fully tensioned strands at the ends of the member, each strand shall first be burned at the ends of the bed and then at each end of each member before proceeding to the next strand in the burning pattern.

D. The Design/Builder shall coordinate the communication of all necessary information concerning openings, sleeves, or inserts to the manufacturer of the precast members.

E. Concrete shall be finished in accordance with Section 03350, Concrete Finishes. Grout all recesses due to cut tendons which will not otherwise be grouted during erection.

F. Curing of precast members shall be in accordance with Section 03370, Concrete Curing. Use of a membrane curing compound will not be allowed.

G. The manufacturer shall provide lifting inserts or other approved means of lifting members.

3.02 HANDLING, TRANSPORTING AND STORING

A. Precast members shall not be transported away from the casting yard until the concrete has reached the minimum required 28 day compressive strength and a period of at least 5 days has elapsed since casting, unless otherwise permitted by the Engineer.

B. No precast member shall be transported from the plant to the job site prior to approval of that member by the plant inspector. This approval will be stamped on the member by the plant inspector.

C. During handling, transporting, and storing, precast concrete members shall be lifted and supported only at the lifting or supporting points as indicated on the shop drawings.

D. All precast members shall be stored on solid, unyielding, storage blocks in a manner to prevent torsion, objectionable bending, and contact with the ground.

E. Precast concrete members shall not be used as storage areas for other materials or equipment.

F. Precast members damaged while being handled or transported will be rejected or shall be repaired in a manner approved by the Engineer.

3.03 ERECTION

A. Erection shall be carried out by the manufacturer or under his supervision using labor, equipment, tools and materials required for proper execution of the work.

B. Design/Builder shall prepare all bearing surfaces to a true and level line prior to erection. All supports of the precast members shall be accurately located and of required size and bearing materials.

C. Installation of the precast members shall be made by leveling the top surface of the assembled units keeping the units tight and at right angles to the bearing surface.

D. Connections which require welding shall be properly made in accordance with Section 05050, Metal Fastening.

E. Grouting between adjacent precast members and along the edges of the assembled precast members shall be accomplished as indicated on the drawings, care being taken to solidly pack such spaces and to prevent leakage or droppings of grout through the assembled precast members. Any grout which seeps through the precast members shall be removed before it hardens.

F. In no case shall concentrated construction loads, or construction loads exceeding the design loads, be placed on the precast members. In no case shall loads be placed on the precast members prior to the welding operations associated with erection, and prior to placing of topping (if required).

G. Design/Builder, Subcontractor or any of his employees shall arbitrarily cut, drill, punch or otherwise tamper with the precast members.

H. Precast members damaged while being erected will be rejected or shall be repaired in a manner approved by the Engineer.

- END OF SECTION -

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SECTION 03600

GROUT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all grout used in concrete work and as bearing surfaces for base plates, in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements of related work are included in Division 1 and Division 2 of these Specifications.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available.

1.	CRD-C 621	Corps of Engineers Specification for Non-shrink Grout
2.	ASTM C 109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm cube Specimens)
3.	ASTM C 531	Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts and Monolithic Surfacings
4.	ASTM C 579	Test Method for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfacings
5.	ASTM C 827	Standard Test Method for Early Volume Change of Cementitious Mixtures
6.	ASTM C 144	Standard Specification for Aggregate for Masonry Mortar
7.	ASTM C 1107	Standard Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink)

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Certified test results verifying the compressive strength and shrinkage and expansion requirements specified herein.

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2. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the work.

1.05 QUALITY ASSURANCE

A. Field Tests

1. Compression test specimens will be taken during construction from the first placement of each type of grout and at intervals thereafter as selected by the Engineer to insure continued compliance with these Specifications. The specimens will be made by the Engineer or its representative.

a. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days, 28 days and any additional time period as appropriate.

b. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C 579, Method B, at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days and any other time period as appropriate.

2. The cost of all laboratory tests on grout will be borne by the Design/Builder, and the Design/Builder shall assist the Engineer in obtaining specimens for testing. The Design/Builder shall supply all materials necessary for fabricating the test specimens, at no additional cost to the Owner.

3. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Cement Grout

1. Cement grout shall be composed of Portland Cement and sand in the proportion specified in the Contract Documents and the minimum amount of water necessary to obtain the desired consistency. If no proportion is indicated, cement grout shall consist of one part Portland Cement to three parts sand. Water amount shall be as required to achieve desired consistency without compromising strength requirements. White Portland Cement shall be mixed with the Portland Cement as required to match color of adjacent concrete.

2. The minimum compressive strength at 28 days shall be 4000 psi.

3. For beds thicker than 1-1/2 inch and/or where free passage of grout will not be obstructed by coarse aggregate, 1-1/2 parts of coarse aggregate having a top size of 3/8 inch should be added. This stipulation does not apply for grout being swept in by a mechanism. These applications shall use a plain cement grout without coarse aggregate regardless of bed thickness.

4. Sand shall conform to the requirements of ASTM C144.

B. Non-Shrink Grout

1. Non-shrink grout shall conform to CRD-C 621 and ASTM C 1107, Grade B or C when tested at a max. fluid consistency of 30 seconds per CDC 611/ASTM C939 at temperature extremes of 45°F and 90°F and an extended working time of 15 minutes. Grout shall have a min. 28-day strength of 7,000 psi. Non-shrink grout shall be, "Euco N-S" by the Euclid Chemical Company, "Sikagrout 212" by Sika Corporation, “Conspec 100 Non-Shrink Non-Metallic Grout” by Conspec, “Masterflow 555 Grout” by BASF Master Builder Solutions.

C. Epoxy Grout

1. Epoxy grout shall be "Sikadur 32 Hi-Mod" by Sika Corporation, "Duralcrete LV" by Tamms Industries, or "Euco #452 Series" by Euclid Chemical, “MasterEmaco ADH 1090 RS” by BASF Master Builder Solutions.

2. Epoxy grout shall be modified as required for each particular application with aggregate per manufacturer's instructions.

D. Epoxy Base Plate Grout

1. Epoxy base plate grout shall be “Sikadur 42, Grout-Pak” by Sika Corporation, or “Masterflow 648” by BASF Master Builder Solutions.

2.02 CURING MATERIALS

A. Curing materials shall be as specified in Section 03370, Concrete Curing for cement grout and as recommended by the manufacturer for prepackaged grouts.

PART 3 -- EXECUTION

3.01 GENERAL

A. The different types of grout shall be used for the applications stated below unless noted otherwise in the Contract Documents. Where grout is called for in the Contract Documents which does not fall under any of the applications stated below, non-shrink grout shall be used unless another type is specifically referenced.

1. Cement grout shall be used for grout toppings and for patching of fresh concrete.

2. Non-shrink grout shall be used for grouting beneath base plates of structural metal framing.

3. Epoxy grout shall be used for bonding new concrete to hardened concrete.

4. Epoxy base plate grout shall be used for precision seating of base plates including base plates for all equipment such as engines, mixers, pumps, vibratory and heavy impact machinery, etc.

B. New concrete surfaces to receive cement grout shall be as specified in Section 03350, Concrete Finishes, and shall be cleaned of all dirt, grease and oil-like films. Existing concrete surfaces shall likewise be cleaned of all similar contamination and debris, including chipping or roughening the surface if a laitance or poor concrete is evident. The finish of the grout surface shall match that of the adjacent concrete. Curing and protection of cement grout shall be as specified in Section 03370, Concrete Curing.

C. All mixing, surface preparation, handling, placing, consolidation, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

D. The Design/Builder, through the manufacturer of a non-shrink grout and epoxy grout, shall provide on-site technical assistance upon request, at no additional cost to the Owner.

3.02 CONSISTENCY

A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow.

3.03 MEASUREMENT OF INGREDIENTS

A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.

B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

3.04 GROUT INSTALLATION

A. Grout shall be placed quickly and continuously, shall completely fill the space to be grouted and be thoroughly compacted and free of air pockets. The grout may be poured in place, pressure grouted by gravity, or pumped. The use of pneumatic pressure or dry-packed grouting requires approval of the Engineer. For grouting beneath base plates, grout shall be poured from one side only and thence flow across to the open side to avoid air-entrapment.

- END OF SECTION -

SECTION 04100

MORTAR AND MASONRY GROUT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on Drawings and specified herein.

B. Principal items of work include:

1. Mortar for unit masonry work.

2. Grout for grouting masonry.

3. Mortar for pointing and touchup.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 04150 - Masonry Accessories

B. Section 04200 - Unit Masonry

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the Specifications, the Work shall conform to the applicable requirements of the following documents:

1.	ASTM C91	Standard Specification for Masonry Cement
2.	ASTM C144	Standard Specification for Aggregate for Masonry Mortar
3.	ASTM C150	Standard Specification for Portland Cement
4.	ASTM C207	Standard Specification for Hydrated Lime for Masonry Purposes
5.	ASTM C270	Standard Specification for Mortar for Unit Masonry
6.	ASTM C476	Standard Specification for Grout for Masonry
7.	ASTM C979	Pigments for Integrally Colored Concrete
8.	ASTM C1019	Standard Methods of Sampling and Testing Grout
9.	ACI 530.1/ASCE 6	Specification for Masonry Structures

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1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Manufacturer's data and mixing instructions for each product.

2. Certificate of compliance with these specifications for each material specified below.

3. Test reports.

4. Samples of colored masonry mortar.

1.05 DELIVERY AND STORAGE

A. Deliver materials in manufacturer's original containers, bearing labels indicating product and manufacturer's name.

B. Store cementitious materials in waterproof locations to prevent damage by elements. Reject containers showing evidence of damage.

C. Store aggregates in separate bins to prevent intrusion of foreign particles. Do not use bottom 6 inches of sand or other aggregate stored in contact with the ground.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications provide products manufactured by one of the following:

1. LaFarge, Reston, VA

2. Lehigh Cement Company, Allentown, PA

3. Holcim, Inc., Dundee, MI

2.02 MATERIALS

A. Mortar and Grout Materials

1. Portland Cement: ASTM C-150, Type I above grade and Type II below grade.

2. Hydrated lime: ASTM C-207, Type "S".

3. Sand: Clean, coarse, free of loam, salt, organic and foreign matter and conforming to ASTM C-144.

4. Coarse and fine aggregates for grout: ASTM C-404.

5. Masonry Cement: ASTM C 91, Type S and meet the following criteria:

   a. Prepackaged masonry cement shall contain Portland Cement, hydrated lime and plasticizing admixtures or hydraulic hydrated lime.

6. Water - clean, fresh, potable and free from injurious amounts of oil, acids, alkalies, salts, organic matter or other deleterious substances.

B. Admixtures

1. Do not use calcium chloride.

2. Do not use admixtures, without written approval of Engineer.

2.03 GROUT AND MORTAR MIXES

A. Masonry mortar shall be Type "S" according to ASTM C-270. Proportions for masonry mortar shall be one of the following:

1. Proportions by volume: 1 part Portland cement to 1/4 - 1/2 parts hydrated lime, and aggregate volume of not less than 2-1/4 or more than 3 times the sum of the volumes of cement and lime.

2. Proportions by volume: 1/2 part Portland cement to 1 part masonry cement, and aggregate volume of not less than 1-1/4 or more than 3 times the sum of the volumes of cement and lime.

B. Proportions for pointing mortar.

1. Proportions by volume: 1 part Portland cement to 1/4 part hydrated lime and 2 parts extra fine sand.

C. Masonry Grout shall conform to the requirements of ASTM C 476 and ACI 530.1/ASCE 6, strength of grout, tested in accordance with ASTM C 1019 shall be equal to f'm as specified in Section 04200, but not less than 2,000 psi.

1. Test grout for every 5,000 square feet of masonry, with a minimum of one test per structure.

PART 3 -- EXECUTION

3.01 FIELD MORTAR MIXING

A. Mixing shall be by mechanically operated batch mixer. Entirely discharge before recharging. Mix sand, lime, cement and admixtures dry for two (2) minutes minimum, add water and mix for three (3) minutes minimum. Control batching procedures by measuring materials by volume. Measurement by shovel count shall not be permitted. Mix mortar with less water than the maximum amount, consistent with workability, to provide near maximum tensile bond strength. Mix only quantity that can be used before initial set, or within the first one-half hour.

B. Mixers, wheel barrows, mortar boards, etc., shall be kept clean.

C. Retempering of mortar will not be permitted and mortar allowed to stand more than one (1) hour shall not be used.

3.02 INSTALLATION

A. Install mortar and grout in accordance with ACI 530.1/ASCE 6.

3.03 REPOINTING MORTAR

A. Prehydrate the mortar by mixing ingredients together dry, and then add only enough water to make a damp, stiff mix that will retain its form when pressed into a ball. After one to two hours, add water to bring it to the proper consistency.

- END OF SECTION -

SECTION 04150

MASONRY ACCESSORIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on Drawings and specified herein.

B. Principal items of work include:

1. Metal joint reinforcement for masonry.

2. Accessories for masonry construction.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 04100 - Mortar and Masonry Grout

B. Section 04200 - Unit Masonry

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of these specifications, Work shall conform to the applicable requirements of the following documents:

1.	ASTM A1064/1064M	Standard Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
2.	ASTM A153	Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware
3.	ASTM A 951	Standard Specification for Steel Wire Masonry Joint Reinforcement
4.	ASTM D1056	Standard Specification for Flexible Cellular Materials - Sponge or Extruded Rubber
5.	ACI 530.1/ASCE 6	Specifications for Masonry Structures

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00, Submittal Procedures, submit the following:

1. Provide manufacturer's complete product data.

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2. Provide manufacturer's certification attesting compliance of material and source of each material specified below.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS FOR MASONRY REINFORCEMENT

A. Subject to compliance with the Specifications, provide products manufactured by the following:

1. AA Wire Products, Company, Chicago, IL

2. Dur-O-Wal, Inc., Arlington Heights, IL

3. Heckmann Building Products, Inc., Chicago, IL.

4. Holman and Barnard, Inc., Hauppauge, NY.

2.02 MATERIALS

A. Single Wythe Joint Reinforcement

Steel ladder type reinforcement conforming to ASTM A 951 with 3/16 inch side rods and 9 gauge continuous cross rods; manufactured with wire conforming to ASTM A1064/1064M, with widths 2-inches less than nominal wall thickness.

B. Anchors: weld to steel.

1. Wire/Strap Anchor - 1/4 inch wire or 12 gauge x 3/4 inch x length required, welded or mechanically attached to back up structure.

C. Top of Wall Anchor

1. Top of wall anchor shall be a 3/8” diameter rod welded to a 3/16” plate with two anchor holes. Provide a plastic tube to allow vertical deflection.

D. Finish

1. Reinforcements, anchorages and ties shall be hot dipped galvanized, Class B-2, after fabrication in accordance with ASTM A153.

2.03 ACCESSORIES

A. Expansion and Joint Filler Material

1. Closed cell neoprene material conforming to ASTM D 1056, with a minimum compressibility of 50%. Horizontal joint filler shall be 1/4 inch thick. Expansion joints shall be a minimum 3/8" thick.

B. Control Joint

1. Wide flange rapid preformed neoprene or PVC gasket.

C. Hardware Cloth

1. Waterproof paper backed with 1/2 inch hardware cloth.

PART 3 -- EXECUTION

3.01 REINFORCEMENT AND ANCHORAGE

A. In masonry wall panels, place horizontal joint reinforcement at a vertical spacing of 16 inches on center, unless otherwise noted.

B. Lap side rods at each end joint a minimum of 6 inches.

C. Install prefabricated corner and tee assemblies at each wall corner and intersection.

D. Mitre and butt end joints are prohibited.

E. Place horizontal joint reinforcement in approximate center of out-to-out wall assembly and assuring a 5/8 inch, minimum.

F. Install horizontal joint reinforcement continuous, terminating only at vertical control joints.

G. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend 24 inches minimum each side of opening.

H. Place joint reinforcement continuous and at 8 inches on center vertically above roof.

I. Place reinforcing bars supported and secured against displacement. Maintain position with ½ inch to true dimension.

J. Coordinate and verify that dowels and anchorages embedded in concrete and attached to structural steel members are properly placed.

K. Provide wall ties for masonry veneer at maximum 16 inches on center vertically and 16 inches on center horizontally. Place at maximum 8 inches on center each way around perimeter of openings, within 12 inches of openings.

L. Masonry adjacent to steel and concrete columns to be attached to the column with masonry anchors at 16 inches on center. Anchors to be attached to each face of the column which is adjacent to a masonry wall, unless otherwise noted.

3.03 BENDING, CUTTING AND SPLICING REINFORCEMENT

A. Make bends and splices in reinforcement only where indicated, or prior-approval by Engineer. Bend reinforcement only when cold, and prior to any placement in construction, forming around a steel pin of diameter at least 6 times the reinforcement size. Cut bars only by approved sawing, shearing or welding methods. Make ends of reinforcement straight,

square, clean and free of defects before splicing. Do not heat or weld bends and splices at points of maximum stress. Clip and bend any tie wires as required to direct the ends away from external surfaces of masonry walls.

B. Where welding is necessary, provide materials and perform welding in accordance with AWS requirements.

C. All lap splices to be 48 bar diameters, unless otherwise noted.

- END OF SECTION -

SECTION 04200

UNIT MASONRY

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on Drawings and specified work.

1. Principal items of work include:

a. Interior masonry wall construction.

b. Installation of masonry reinforcement and accessories.

c. Masonry unit lintels.

d. Installing work required to be built into masonry work.

e. Building into masonry work all anchors, inserts, hangers and the like provided under other Sections.

f. Pointing and cleaning of exposed masonry surfaces.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 04100 – Mortar and Masonry Grout

B. Section 04150 – Masonry Accessories

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the Specifications the Work shall conform to the applicable requirements of the following documents:

1. TMS 402/ACI 530/ASCE 5 Building Code Requirements for Masonry Structures

2. ACI 530.1/ASCE 6 Specifications for Masonry Structures

a) ACI 530.1/ASCE 6, jointly published by the American Concrete Institute and the American Society of Civil Engineers, hereafter referred to as ACI 530.1 shall be considered minimum specifications for all materials, workmanship, methods and techniques for all masonry work.

b) Obtain a copy of the above Specifications prior to beginning any work in this Section.

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3.	ASTM C90	Standard Specification for Load-Bearing Concrete Masonry Units
4.	ASTM C140	Standard Methods for Sampling and Testing Concrete Masonry Units

1.04 TESTING

A. Tests

The Owner reserves the right to test materials for compliance with these specifications. Sampling and testing will be done in accordance with the ASTM standard, by an independent testing agency employed by the Owner. Materials that fail to meet requirements are considered defective. Subsequent tests to establish compliance (of the same or new materials) shall be paid for by the Design/Builder.

1.05 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00, Submittal Procedures, submit the following:

1. Samples of each material to be used showing full range of colors.

2. Manufacturer's specifications and certifications of compliance to the Specifications, including results of tests on masonry units showing such compliance, for each type of masonry. Provide handling, storage, and installation instructions along with protection instructions. Indicate by transmittal that installer has received copies of each instruction.

3. Cold and/or hot weather construction procedures in accordance with ACI 530.1/ASCE 6 sections 2.3.2.2. and 2.3.2.3.

4. Cleaning procedures and cleaner for each masonry type.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in the manufacturer's original unbroken, undamaged and unopened packaging with labels bearing the name of the manufacturer and the product. Masonry units and brick shall be factory packaged and strapped, delivered to the site and stored on skids.

B. Store and handle materials to prevent inclusion of water or foreign matter and to prevent damage of any nature.

C. Distribute materials on floor slabs to prevent overloading. Designated live loads shown for floor shall not be exceeded.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Provide special shape, type or size indicated or for application requiring a form, size or finish which cannot be produced from standard masonry units by sawing.

B. Masonry units for fire-rated walls shall comply with Underwriter's Laboratory requirements for fire rating shown on the Drawings.

2.02 MATERIALS

A. Mortar

1. In accordance with Section 04100 - Mortar and Masonry Grout

C. Concrete Masonry Units

1. Provide units conforming to ACI 530.1 unless otherwise specified.

2. Provide light weight units meeting the requirements of ASTM C90 for hollow and solid load bearing CMU.

3. Manufacture units of Portland Cement, conforming to ASTM C-150 and light weight aggregate conforming to ASTM C331 and ASTM C33. Weight of unit shall not exceed 105 lb. per cu. ft. when measured in accordance with provisions of ASTM C140. Units shall be nominally 8 inches x 16 inches x thicknesses shown or as required. Masonry units shall be manufactured not less than 30 days prior to being used and stored under cover until shipment. All units shall have true, sharp edges and corners, free from cracks or other defects. Provide half special sizes and shapes as required by the Drawings or to meet job conditions.

4. Net area compressive strength of concrete masonry units shall be a minimum of 1,900 psi when tested in accordance with ASTM C140. Compressive strength of masonry (f'm) shall be a minimum of 1,500 psi in accordance with ACI 530.1 when these units are used with the mortar specified in Section 04100.

D. Concrete Masonry Lintels

Specially formed units with reinforcing bars and mortar fill provided where shown and wherever openings in masonry are indicated without structural steel or other supporting lintels.

PART 3 -- EXECUTION

3.01 GENERAL

A. Examine areas and conditions under which masonry is to be installed and notify the Engineer in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

B. Do not wet concrete masonry units.

C. Clean reinforcing, removing loose rust, ice or other coatings from bars, before placement.

D. Build single wythe walls to the actual size of masonry units.

E. Build chases and recesses as shown and as required for the work of other trades.

F. Build other work into masonry work as shown, fitting masonry units around other work and grouting to assure anchorage.

G. Cut masonry units with motor driven saw designed to cut masonry with clean, sharp, unchipped edges. Cut units as required to provide pattern shown or specified, and to fit adjoining work neatly.

H. Cold and hot weather construction.

1. No masonry shall be erected when ambient temperature has dropped below 45°F unless it is rising and at no time when it has dropped below 40°F. Provisions shall be made for heating and drying of materials, and the complete work shall be protected in accordance with the ACI 530.1/ASCE 6 Section 2.3.2.2. Masonry shall not be laid with ice or frost on its surfaces, and no masonry shall be laid on frozen work. Any work which freezes before the mortar has set shall be removed and replaced at the Design/Builder's own expense. Do not use any admixtures or antifreeze in the mortar.

2. When the temperature is above 100°F or 90°F with a wind velocity greater than 8 mph, mortar beds shall be spread no more than 4 feet ahead of masonry and masonry units shall be set within one minute of spreading mortar.

3.02 CONSTRUCTION TOLERANCES

A. Variation from plumb: For vertical lines and surfaces of columns, walls and arises do not exceed 1/4" in 10', or 3/8" in a story height not to exceed 20', nor 1/2" in 40' or more. For external corners, expansion joints, control joints and other conspicuous lines, do not exceed 1/4" in any story or 20' maximum, nor 1/2" in 40' or more. For vertical alignment of head joints do not exceed plus or minus 1/4" in 10', 1/2" maximum.

B. Variation from level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines do not exceed 1/4" in any bay or 20' maximum, nor 1/2" in 40' or more. For top surface of bearing walls do not exceed 1/8" between adjacent floor elements in 10' or 1/16" within width of a single unit.

C. Variation of Linear Building Line: For position shown on plan and related portion of columns, walls, and partitions, do not exceed 1/2" in any bay or 20' maximum, nor 3/4" in 40' or more.

D. Variation in Cross Sectional Dimensions: For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4" nor plus 1/2".

E. Variation in Mortar Joint Thickness: Do not exceed bed joint thickness indicated by more than plus or minus 1/8", with a maximum thickness limited to 1/2". Do not exceed head joint thickness indicated by more than plus or minus 1/8".

3.03 LAYING MASONRY WALLS

A. Layout walls in advance for accurate spacing of surface bond patterns, with uniform joint widths and to properly locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half size units at corners, jambs, and wherever possible at other locations.

B. Lay-up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other work.

C. Pattern Bond: Lay exposed masonry in the bond pattern shown or, if not shown, lay in running bond with vertical joint in each course centered on units in courses above and below.

D. Stopping and Resuming Work: Rack back 1/2 unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly, and remove loose masonry units and mortar prior to laying fresh mortar.

E. Cover top of walls at the end of each day. Protect wall from water infiltration from the top until wall is capped.

F. Built-In Work: As work progresses, build-in items specified under this and other sections of these Specifications. Fill in solidly with masonry around built-in items.

1. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.

2. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of hardware cloth in the joint below and rod grout into core.

3. Fill cores in hollow masonry units with grout 3 courses (24") under bearing plates, beams, lintels, posts and similar items, unless otherwise noted.

4. Seal masonry tight around wall penetrations such as beams, joists, pipes, ducts, and conduit by cutting masonry units to fit as tightly as possible, then closing final gap all around with mortar, or joint filler and caulking as necessary.

3.04 MORTAR BEDDING AND JOINTING

A. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.

B. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells; also bed webs with mortar in starting courses on footing or floors, and where adjacent cells are to be reinforced or filled with grout. For starting courses where cells are not grouted, spread full mortar bed including areas under cells.

C. Maintain joint widths of 3/8", except for minor variations required to maintain bond alignment.

D. Tooling: Joints shall be tooled to a uniform concave joint. Head joints first and then the bed joints.

E. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners and jambs to shift adjacent stretcher units which have been set in position. If adjustments are required, remove units, clean and reset in fresh mortar.

3.05 JOINT REINFORCING

A. Use continuous horizontal joint reinforcement installed in horizontal mortar joints not more than 16" o.c. vertically.

B. Parapets: Use continuous horizontal joint reinforcement installed in horizontal joints at 8" o.c. vertically.

C. Reinforced masonry openings greater than 12" wide, with horizontal joint reinforcing placed in 2 horizontal joints immediately above the lintel and immediately below the sill. Extend reinforcements 2'-0" beyond jambs of the opening except at control joints.

D. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

E. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, pipe enclosures and other special conditions.

F. Intersecting Load-bearing Walls: Provide rigid steel anchors at not more than 2'-0" o.c vertically. Embed ends in mortar-filled cores.

G. Non-loadbearing Interior Partitions: Build full height of story to underside of solid floor or structure above, unless shown otherwise. Fill joint with mortar after dead load deflection of structure above approaches final position.

3.06 CONTROL AND EXPANSION JOINTS

A. General: Provide vertical and horizontal expansion, control and isolation joints in masonry where shown. Where not shown provide vertical control joints in concrete masonry units at 40 feet on center maximum or as recommended by the masonry unit manufacturer. Build-in related items as the masonry work progresses.

3.07 LINTELS

A. Install galvanized steel lintels where indicated.

B. Provide masonry lintels where shown and wherever openings of more than 8" for brick size units and 1'-4" for block size units are shown without structural steel or other supporting lintels. Provide precast or poured-in-place masonry lintels. Cure precast lintels before handling and installation. Temporarily support formed-in-place lintels.

C. For hollow concrete masonry unit walls, use specially formed "U"-shaped lintel units with reinforcement bars placed as shown and filled with grout.

D. Provide minimum bearing of 8" at each jamb.

3.08 REINFORCED UNIT MASONRY

A. Vertical reinforcement shall be held in place by means of frames or other suitable means. Place horizontal joint reinforcement as masonry work progresses. Provide minimum clear distance between longitudinal bars equal to nominal diameter of bar. Minimum thickness of mortar or grout between masonry and reinforcement shall be 1/4", except 6 gage or smaller wires may be laid in 3/8" mortar joints. Collar joints which contain both horizontal and vertical reinforcement shall have a minimum width of 1/2" larger than the diameter of the horizontal and vertical reinforcement.

B. Bar splices shall be contact lap splices. Length of splice shall be a minimum of 24" for #4 bars and 30" for #5 bars.

C. Low lift grouting shall be used when grout space is less than 2" in width. Place grout at maximum intervals of 24" in lifts of 6 to 8 inches as the work progresses. Cores to be grouted shall be clean of mortar, mortar dropping and debris. Agitate grout to assure complete filling and coverage of reinforcement. Hold grout 1-1/2 inches below to top of masonry if work is discontinued for more than an hour.

D. High lift grouting may be used when the grout space is greater than 2". Grout shall not be placed in lifts greater than 4 feet. Grout core shall be kept clean of mortar, mortar dripping and debris. Provide cleanout holes as required for inspection and cleaning. Replace cleanout plugs after inspection and acceptance. Do not place grout until entire wall has been in place a minimum of 3 days. Hold grout 1-1/2 inches below top of masonry if work is discontinued for more than an hour.

E. Forms and shoring shall be substantial and tight to prevent leakage of mortar or grout. Brace and shore forms to maintain position and shape. Do not remove forms or shoring until masonry gains enough strength to sufficiently carry its own weight and any other loads, temporary or permanent, placed on it during construction.

3.09 PROTECTION OF WORK

A. Exposed masonry surfaces shall be protected from staining. Tops of wall shall be covered with nonstaining waterproof coverings when work is not in progress. Installed material shall be secure in high winds.

B. Protection shall be provided for all openings in the walls to prevent damage to sills, jambs, etc., from all causes. Aluminum or steel frames and other finish materials shall be protected from damage during masonry work.

3.10 REPAIR, POINTING AND CLEANING

A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing of Masonry: At the completion of the masonry work, all holes in exposed masonry shall be pointed. Defective joints shall be cut out and tuckpointed solidly with mortar. Pointing and tuckpointing shall be done with a pre-hydrated mortar. The mortar cement shall be controlled so that, after curing of the mortar, no difference in texture or color exists with that of adjacent masonry.

C. Masonry Cleaning: While laying masonry units, good workmanship and job housekeeping practices shall be used so as to minimize the need for cleaning the masonry work. Protect the base of the wall from mud splashes and mortar droppings. The technique for laying masonry shall be such that mortar does not run down the face of the wall or smear onto the face.

1. After the joints are tooled, cut off mortar failings with the trowel and brush excess mortar burrs and dust from the face of the masonry, use a bricklayer's brush made with medium soft hair.

2. Remove all large mortar particles with a hardwood scraper.

3. If, after using the above outlined techniques, additional cleaning of the walls is found necessary, allow the walls to cure one month prior to initiating further cleaning processes.

D. Clean masonry to comply with the masonry manufacturer's directions and as required to accept painting.

- END OF SECTION -

SECTION 05010

METAL MATERIALS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Metal materials not otherwise specified shall conform to the requirements of this Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Requirements for specific products made from the materials specified herein are included in other sections of the Specifications. See the section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. ASTM A36 Standard Specification for Structural Steel

B. ASTM A47 Standard Specification for Malleable Iron Castings

C. ASTM A48 Standard Specification for Gray Iron Castings

D. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

E. ASTM A167 Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

F. ASTM A276 Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes

G. ASTM A307 Standard Specification for Carbon Steel Externally Threaded Standard Fasteners

H. ASTM A446 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) quality

I. ASTM A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

J. ASTM A501 Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

K. ASTM A529 Standard Specification for Structural Steel with 42 000 psi (290 Mpa) Minimum Yield Point (1/2 in. (12.7 mm) Maximum Thickness)

L. ASTM A536 Standard Specification for Ductile Iron Castings

M. ASTM A570 Standard Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality

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N. ASTM A572 Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

O. ASTM A992 Standard Specification for Structural Steel Shapes

P. ASTM A666 Standard Specification for Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications

Q. ASTM A1085 Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)

R. ASTM B26 Standard Specification for Aluminum-Alloy Sand Castings

S. ASTM B85 Standard Specification for Aluminum-Alloy Die Castings

T. ASTM B108 Standard Specification for Aluminum-Alloy Permanent Mold Castings

U. ASTM B138 Standard Specification for Manganese Bronze Rod, Bar, and Shapes

V. ASTM B209 Standard Specification for Aluminum-Alloy Sheet and Plate

W. ASTM B221 Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

X. ASTM B308 Standard Specification for Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded

Y. ASTM B574 Standard Specification for Nickel-Molybdenum-Chromium Alloy Rod

Z. ASTM F468 Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use

aa. ASTM F593 Standard Specification for Stainless Steel Fasteners

1.04 SUBMITTALS

A. Material certifications shall be submitted along with any shop drawings for metal products and fabrications required by other sections of the Specifications.

1.05 QUALITY ASSURANCE

A. Design/Builder may engage the services of a testing agency to test any metal materials for conformance with the material requirements herein. If the material is found to be in conformance with Specifications the cost of testing will be borne by the Design/Builder. If the material does not conform to the Specifications, the cost of testing shall be paid by the Manufacturer and all materials not in conformance as determined by the Design/Builder shall be replaced by the Manufacturer at no additional cost to the Design/Builder. In lieu of replacing materials the Manufacturer may request further

testing to determine conformance, but any such testing shall be paid for by the Manufacturer regardless of outcome of such testing.

PART 2 -- PRODUCTS

2.01 CARBON AND LOW ALLOY STEEL

A. Material types and ASTM designations shall be as listed below:

1.	Steel W Shapes	A992
2.	Steel HP Shapes	A572 Grade 50
3.	Steel M, S, C, and MC shapes and Angles, Bars, and Plates	A36
4.	Rods	F 1554 Grade 36
5.	Pipe - Structural Use	A53 Grade B
6.	Hollow Structural Sections	A500 Grade C or A1085
7.	Cold-Formed Steel Framing	A 653

2.02 STAINLESS STEEL

A. All stainless steel fabrications exposed to underwater service shall be Type 316. All other stainless steel fabrications shall be Type 304, unless noted otherwise.

B. Material types and ASTM designations are listed below:

1.	Plates and Sheets	ASTM A167 or A666 Grade A
2.	Structural Shapes	ASTM A276
3.	Fasteners (Bolts, etc.)	ASTM F593

2.03 ALUMINUM

A. All aluminum shall be alloy 6061-T6, unless otherwise noted or specified herein.

B. Material types and ASTM designations are listed below:

1.	Structural Shapes	ASTM B308
2.	Castings	ASTM B26, B85, or B108
3.	Extruded Bars	ASTM B221 - Alloy 6061
4.	Extruded Rods, Shapes and Tubes	ASTM B221 - Alloy 6063
5.	Plates	ASTM B209 - Alloy 6061
6.	Sheets	ASTM B221 - Alloy 3003

C. All aluminum structural members shall conform to the requirements of Section 05140, Structural Aluminum. (Not applicable for Major Equipment Package)

D. All aluminum shall be provided with mill finish unless otherwise noted.

E. Where bolted connections are indicated, aluminum shall be fastened with stainless steel bolts.

F. Aluminum in contact with dissimilar materials shall be insulated with an approved dielectric.

2.04 CAST IRON

A. Material types and ASTM designations are listed below:

1.	Gray	ASTM A48 Class 30B
2.	Malleable	ASTM A47
3.	Ductile	ASTM A536 Grade 60-40-18

2.05 BRONZE

A. Material types and ASTM designations are listed below:

1.	Rods, Bars and Sheets	ASTM B138 - Alloy B Soft

2.06 HASTELLOY

A. All Hastelloy shall be Alloy C-276.

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 05035

GALVANIZING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Where galvanizing is called for in the Specifications, the galvanizing shall be performed in accordance with the provisions of this Section unless otherwise noted.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Further requirements for galvanizing specific items may be included in other Sections of the Specifications. See section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Virginia Uniform Statewide Building Code

2. ASTM A123 - Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip

3. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

4. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

5. ASTM A780 - Standard Practice of Repair of Damaged Hot-Dip Galvanized Coatings

6. ASTM F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

1.04 SUBMITTALS

A. Certification that the item(s) are galvanized in accordance with the applicable ASTM standards specified herein. This certification may be included as part of any material certification that may be required by other Sections of the Specifications.

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PART 2 -- PRODUCTS

2.01 GALVANIC COATING

A. Material composition of the galvanic coating shall be in accordance with the applicable ASTM standards specified herein.

PART 3 -- EXECUTION

3.01 FABRICATED PRODUCTS

A. Products fabricated from rolled, pressed, and forged steel shapes, plates, bars, and strips, 1/8 inch thick and heavier which are to be galvanized shall be galvanized in accordance with ASTM A123. Products shall be fabricated into the largest unit which is practicable to galvanize before the galvanizing is done. Fabrication shall include all operations necessary to complete the unit such as shearing, cutting, punching, forming, drilling, milling, bending, and welding. Components of bolted or riveted assemblies shall be galvanized separately before assembly. When it is necessary to straighten any sections after galvanizing, such work shall be performed without damage to the zinc coating. The galvanizer shall be a member of American Galvanizers Association.

B. Components with partial surface finishes shall be commercial blast cleaned prior to pickling.

C. Sampling and testing of each lot shall be performed prior to shipment from the galvanizer's facility per ASTM A123.

3.02 HARDWARE

A. Iron and steel hardware which is to be galvanized shall be galvanized in accordance with ASTM A153 and ASTM F2329.

3.03 ASSEMBLED PRODUCTS

A. Assembled steel products which are to be galvanized shall be galvanized in accordance with ASTM A123. All edges of tightly contacting surfaces shall be completely sealed by welding before galvanizing.

3.04 SHEETS

A. Iron or steel sheets which are to be galvanized shall be galvanized in accordance with ASTM A924.

3.05 REPAIR OF GALVANIZING

A. Galvanized surfaces that are abraded or damaged at any time after the application of zinc coating shall be repaired by thoroughly wire brushing the damaged areas and removing all loose and cracked coating, after which the cleaned areas shall be painted with 2 coats of zinc rich paint meeting the requirements of Federal Specification DOD-P-21035A and shall be thoroughly mixed prior to application. Zinc rich paint shall not be tinted. The total

thickness of the 2 coats shall not be less than 6 mils. In lieu of repairing by painting with zinc rich paint, other methods of repairing galvanized surfaces in accordance with ASTM A780 may be used provided the proposed method is acceptable to the Design/Builder.

- END OF SECTION -

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SECTION 05050

METAL FASTENING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all metal welds and fasteners not otherwise specified, in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05010 - Metal Materials

B. Section 05035 - Galvanizing

C. Section 05061 – Stainless Steel

D. Section 05120 - Structural Steel

E. Section 05140 - Structural Aluminum

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available.

1. Virginia Uniform Statewide Building Code

2. AC 193 — Acceptance Criteria for Mechanical Anchors in Concrete Elements

3. AC 308 — Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements

4. ACI 318 — Building Code Requirements for Structural Concrete

5. ACI 355.2 — Qualifications of Post-Installed Mechanical Anchors in Concrete

6. ACI 355.4 — Qualifications of Post-Installed Adhesive Anchors in Concrete

7. AISC 348 — The 2009 RCSC Specification for Structural Joints

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8.	AISC	Code of Standard Practice
9.	AWS D1.1	Structural Welding Code - Steel
10.	AWS D1.2	Structural Welding Code - Aluminum
11.	AWS D1.6	Structural Welding Code – Stainless Steel
12.	Aluminum Association	Specifications for Aluminum Structures
13.	ASTM A572/A572M-94C	Standard Specification for High Strength Low-Alloy Columbium-Vanadium Structural Steel Grade 50
14.	ASTM A36	Standard Specification for Carbon Structural Steel
15.	ASTM A325	Standard Specification for High-Strength Bolts for Structural Steel Joints
16.	ASTM A489	Standard Specification for Eyebolts
17.	ASTM A490	Standard Specification for Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints
18.	ASTM A563	Standard Specifications for Carbon and Alloy Steel Nuts
19.	ASTM D1785	Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe
20.	ASTM E488	Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
21.	ASTM F436	Standard Specification for Hardened Steel Washers
22.	ASTM F467	Standard Specification for Nonferrous Nuts for General Use
23.	ASTM F593	Standard Specification for Stainless Steel Bolts; Hex Cap Screws, and Studs
24.	ASTM F594	Standard Specification for Stainless Steel Nuts
25.	ASTM F1554	Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures.

1. Shop Drawings providing the fastener's manufacturer and type and certification of the fastener's material and capacity.

2. Anchor design calculations sealed by a Professional Engineer currently registered in the Commonwealth of Virginia. Only required if design not shown on Contract Drawings.

3. Manufacturer’s installation instructions.

4. Copy of valid certification for each person who is to perform field welding.

5. Certified weld inspection reports, when required.

6. Welding procedures.

7. Installer qualifications.

8. Certification of Installer Training.

9. Inspection Reports.

10. Results of Anchor Proof Testing.

1.05 QUALITY ASSURANCE

A. Fasteners not manufactured in the United States shall be tested and certification provided with respect to specified quality and strength standards. Certifications of origin shall be submitted for all U.S. fasteners supplied on the project.

B. Installer Qualifications: All concrete anchors shall be installed by an Installer with at least three years of experience performing similar installations. Concrete adhesive anchor installer shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.

C. Installer Training: For concrete adhesive anchors, conduct a thorough training with the manufacturer or the manufacturer’s representative for the Installer on the project. Training shall consist of a review of the complete installation process to include but not be limited to the following:

1. Hole drilling procedure.

2. Hole preparation and cleaning technique.

3. Adhesive injection technique and dispenser training/maintenance.

4. Concrete adhesive anchor preparation and installation.

5. Proof loading/torquing.

D. All steel welding shall be performed by welders certified in accordance with AWS D1.1. All aluminum welding shall be performed by welders certified in accordance with AWS D1.2. All stainless steel welding shall be performed by welders certified in accordance with AWS D1.6. Certifications of field welders shall be submitted prior to performing any field welds.

E. Welds and high strength bolts used in connections of structural steel will be visually inspected in accordance with Article 3.04.

F. The Owner may engage an independent testing agency to perform testing of welded connections and to prepare test reports in accordance with AWS. Inadequate welds shall be corrected or redone and retested to the satisfaction of the Owner and/or an acceptable independent testing laboratory, at no additional cost to the Owner.

G. Provide a welding procedure for each type and thickness of weld. For welds that are not prequalified, include a Performance Qualification Report. The welding procedure shall be given to each welder performing the weld. The welding procedure shall follow the format in Annex E of AWS D1.1 with relevant information presented.

H. Special inspections for concrete adhesive anchors shall be conducted in accordance with the manufacturer's instructions and Specifications Section 01 45 33. Downward installations require periodic inspection and horizontal and overhead installations require continuous inspection.

PART 2 -- PRODUCTS

2.01 ANCHOR RODS (ANCHOR BOLTS)

A. Anchor rods shall conform to ASTM F1554 Grade 36 except where stainless steel or other approved anchor rods are shown on the Drawings. Anchor rods shall have hexagonal heads and shall be supplied with hexagonal nuts meeting the requirements of ASTM A563 Grade A.

B. Where anchor rods are used to anchor galvanized steel or are otherwise specified to be galvanized, anchor rods and nuts shall be hot-dip galvanized in accordance with ASTM F1554.

C. Where pipe sleeves around anchor rods are shown on the Drawings, pipe sleeves shall be cut from Schedule 40 PVC plastic piping meeting the requirements of ASTM D1785.

2.02 HIGH STRENGTH BOLTS

A. High strength bolts and associated nuts and washers shall be in accordance with ASTM A325 or ASTM A490. Bolts, nuts and washers shall meet the requirements of AISC 348 "The 2009 RCSC Specification for Structural Joints".

B. Where high strength bolts are used to connect galvanized steel or are otherwise specified to be galvanized, bolts, nuts, and washers shall be hot-dip galvanized in accordance with ASTM A325.

2.03 STAINLESS STEEL BOLTS

A. Stainless steel bolts shall conform to ASTM F-593. All underwater fasteners, fasteners in confined areas containing fluid, and fasteners in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless steel members not subject to the above conditions shall be Type 304 stainless steel unless otherwise noted.

B. Stainless steel bolts shall have hexagonal heads with a raised letter or symbol on the bolts indicating the manufacturer, and shall be supplied with hexagonal nuts meeting the requirements of ASTM F594. Nuts shall be of the same alloy as the bolts.

2.04 CONCRETE ANCHORS

A. General

1. Where concrete anchors are called for on the Drawings, one of the types listed below shall be used; except, where one of the types listed below is specifically called for on the Drawings, only that type shall be used. The determination of anchors equivalent to those listed below shall be on the basis of test data performed by an approved independent testing laboratory. There are two types used:

    a. Expansion anchors shall be mechanical anchors of the wedge, sleeve, drop-in or undercut type.

    b. Adhesive anchors shall consist of threaded rods or bolts anchored with an adhesive system into hardened concrete. Adhesive anchors shall be two part injection type using the manufacturer's static mixing nozzle and shall be supplied as an entire system.

2. Expansion anchors shall not be used to hang items from above or in any other situations where direct tension forces are induced in anchor.

3. Unless otherwise noted, all concrete anchors which are submerged or are used in hanging items or have direct tension induced upon them, or which are subject to vibration from equipment such as pumps and generators, shall be adhesive anchors.

4. Adhesive anchors shall conform to the requirements of ACI 355.4 or alternately to AC 308. Expansion or mechanical anchors shall conform to the requirements of ACI 355.2 or alternately to AC 193.

5. Fire Resistance: All anchors installed within fire resistant construction shall either be enclosed in a fire resistant envelope, be protected by approved fire-resistive materials, be used to resist wind and earthquake loads only, or anchor non-structural elements.

6. Engineer's approval is required for use of concrete anchors in locations other than those shown on the Drawings.

B. Concrete Anchor Design:

An anchor design consists of specifying anchor size, quantity, spacing, edge distance and embedment to resist all applicable loads. Where an anchor design is indicated on the Drawings, it shall be considered an engineered design and anchors shall be installed to the prescribed size, spacing, embedment depth and edge distance. If all parts of an anchor design are provided on the Drawings except embedment depth, the anchors will be considered an engineered design and the Design/Builder shall provide the embedment depth as indicated in Paragraph B.3 unless otherwise directed by the Engineer. Where an anchor design is not indicated by the Engineer on the Drawings, the Design/Builder shall provide the anchor design per the requirements listed below.

1. Structural Anchors: All concrete anchors shall be considered structural anchors if they transmit load between structural elements; transmit load between non-structural components that make up a portion of the structure and structural elements; or transmit load between life-safety related attachments and structural elements. Examples of structural concrete anchors include but are not limited to column anchor bolts, anchors supporting non-structural walls, sprinkler piping support anchors, anchors supporting heavy, suspended piping or equipment, anchors supporting barrier rails, etc. For structural anchors, the Design/Builder shall submit an engineered design with signed and sealed calculations performed by an Engineer currently registered in the Commonwealth of Virginia. Structural anchors shall be of a type recommended by the anchor manufacturer for use in cracked concrete and shall be designed by the Design/Builder in accordance with ACI 318 Appendix D.

2. Non-Structural Anchors: All other concrete anchors may be considered non-structural concrete anchors. The Design/Builder shall perform an engineered design for non-structural anchors. The Engineer may request the Design/Builder provide anchor design details for review, but submission of a signed, sealed design is not required. Non-structural anchors shall be designed by the Design/Builder for use in uncracked concrete.

3. Embedment Depth

    a. Minimum anchor embedment shall be as indicated on the Drawings or determined by the Design/Builder's engineered design. Although all manufacturers listed are permitted, the embedment depth indicated on the Drawings is based on PE 1000+ by Powers Fasteners. If the Design/Builder submits one of the other concrete adhesive anchors listed, the Engineer shall evaluate the required embedment and the Design/Builder shall provide the required embedment depth stipulated by the Engineer specific to the approved dowel adhesive.

    b. Where the embedment depth is not shown on the Drawings, concrete anchors shall be embedded no less than the manufacturer's standard embedment (expansion or mechanical anchors) or to provide a minimum allowable bond strength equal to the allowable yield capacity of the rod according to the manufacturer (adhesive anchors).

c. The embedment depth shall be determined using the actual concrete compressive strength, a cracked concrete state, maximum long term temperature of 110 degrees F, and maximum short term temperature of 140 degrees F. In no case shall the embedment depth be less than the minimum or more than the maximum stated in the manufacturer's literature.

C. Structural Anchors:

1. Mechanical Anchors:

a. Wedge Anchors: Wedge anchors shall be "Kwik Bolt TZ" by Hilti, Inc., "TruBolt +" by ITW Redhead, "Strong-Bolt 2" by Simpson Strong-Tie Co. or "Powerstud SD-1" or "Powerstud SD-2" by Powers Fasteners.

b. Screw Anchors: Screw anchors shall be "Kwik HUS-EZ" and "KWIK HUS-EZ-I" by Hilti, Inc., "Titen HD" by Simpson Strong-Tie Co., or "Wedge-Bolt +" by Powers Fasteners. Bits specifically provided by manufacturer of chosen system shall be used for installation of anchors.

c. Sleeve Anchors: Sleeve anchors shall be "HSL-3 Heavy Duty Sleeve Anchor" by Hilti, Inc. or "Power-Bolt +" by Powers Fasteners.

d. Undercut Anchors: Undercut anchors shall be "HDA Undercut Anchor" by Hilti, Inc., "Torq-Cut Undercut Anchor" by Simpson Strong-Tie Co., "Atomic + Undercut Anchor" by Powers Fasteners

2. Adhesive Anchors:

a. Adhesive anchors shall be "Epcon C6+ Adhesive Anchoring System" by ITW Redhead, "HIT HY-200 Adhesive Anchoring System" by Hilti, Inc., "AT-XP" or "SET-XP Epoxy Adhesive Anchors" by Simpson Strong-Tie Co., or "PE-1000+ Epoxy Adhesive Anchor System" by Powers Fasteners.

b. Structural adhesive anchor systems shall be IBC compliant and capable of resisting short term wind and seismic loads (Seismic Design Categories A through F) as well as long term and short term sustained static loads in both cracked and uncracked concrete in all Seismic Design Categories. Structural adhesive anchor systems shall comply with the latest revision of ICC-ES Acceptance Criteria AC308, and shall have a valid ICC-ES report in accordance with the applicable building code.

c. **No or equal products will be considered unless prequalified and approved by the Engineer.**

D. Non-Structural Anchors: In addition to the acceptable non-structural anchors listed below, all structural anchors listed above may also be used as non-structural anchors.

1. Mechanical Anchors:

    a. Wedge Anchors: Wedge anchors shall be “Kwik Bolt 3” by Hilti, Inc., “Wedge-All” by Simpson Strong-Tie Co. or “TruBolt” by ITW Redhead.

    b. Screw Anchors: Screw anchors shall be “Kwik HUS” by Hilti, Inc., “Wedge-Bolt” by Powers Fasteners “Large Diameter Tapcon (LDT) Anchor” by ITW Redhead, or “Titen HD” by Simpson Strong-Tie Co. Bits specifically provided by manufacturer of chosen system shall be used for installation of anchors.

    c. Sleeve Anchors: Sleeve anchors shall be “HSL Heavy Duty Sleeve Anchors” by Hilti, Inc. “Power-Bolt” by Powers Fasteners “Dynabolt Sleeve Anchor” by ITW Redhead, or “Sleeve-All” by Simpson Strong-Tie Co.

    d. Drop-In Anchors: Drop-in anchors shall be “Drop-In” by Simpson Strong-Tie Co., “HDI Drop-In Anchor” by Hilti, Inc. or “Multi-Set II Drop-In Anchor” by ITW Redhead.

    e. Undercut Anchors: Undercut anchors shall be “HDA Undercut Anchor” by Hilti, Inc., or “Torq-Cut” by Simpson Strong-Tie Co.

2. Adhesive Anchors:

    a. Adhesive anchors shall be “Epcon A7” or “Epcon C6+ Adhesive Anchoring System” by ITW Redhead, “HIT HY-200 Adhesive Anchoring System” by Hilti, Inc., “SET Epoxy Tie High Strength Anchoring Adhesive” or “AT High Strength Anchoring Adhesive” by Simpson Strong-Tie Co., or “Powers AC 100+ Gold Vinylester Injection Adhesive Anchoring System” or “T308+ Epoxy Adhesive Injection System” by Powers Fasteners.

    b. Non-structural adhesive anchors systems shall be IBC compliant and capable of resisting short term wind and seismic (Seismic Design Categories A and B) as well as long term and short term sustained static loads in uncracked concrete.

    c. Non-structural adhesive anchor embedment depth of the rod shall provide a minimum allowable bond strength that is equal to the allowable yield capacity of the rod unless noted otherwise on the Drawings.

    d. **No or equal products will be considered unless prequalified and approved by the Engineer.**

E. Concrete Anchor Rod Materials:

1. Concrete anchors used to anchor structural steel shall be a threaded steel rod per manufacturer's recommendations for proposed adhesive system, but shall not have a yield strength (fy) less than 58 ksi nor an ultimate strength (fu) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, concrete anchors shall also be galvanized unless otherwise indicated on the Drawings.

2. Concrete anchors used to anchor aluminum, FRP, or stainless steel shall be Type 304 stainless steel unless noted otherwise. All underwater concrete anchors shall be Type 316 stainless steel.

3. Nuts, washers, and other hardware shall be of a material to match the anchors.

2.05 MASONRY ANCHORS

A. Anchors for fastening to solid or grout-filled masonry shall be adhesive anchors as specified above for concrete anchors.

B. Anchors for fastening to hollow masonry or brick shall be adhesive anchors consisting of threaded rods or bolts anchored with an adhesive system dispensed into a screen tube inserted into the masonry. The adhesive system shall use a two-component adhesive mix and shall inject into the screen tube with a static mixing nozzle. Thoroughly clean drill holes of all debris and drill dust with nylon (not wire) brush prior to installation of adhesive and anchor. Design/Builder shall follow manufacturer's installation instructions. The adhesive system shall be "HIT HY-70 System" as manufactured by Hilti, Inc., or "SET-XP Epoxy-Tie or "AT-XP Acrylic-Tie" as manufactured by Simpson Strong-Tie Co.

C. Masonry anchors used to anchor steel shall be a threaded steel rod per manufacturer's recommendations for proposed adhesive system, but shall not have a yield strength (fy) less than 58 ksi nor an ultimate strength (fu) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, masonry anchors shall also be galvanized.

D. Masonry anchors used to anchor aluminum, FRP, or stainless steel shall be Type 304 stainless steel unless noted otherwise. All underwater anchors shall be Type 316 stainless steel.

2.06 WELDS

A. Electrodes for welding structural steel and all ferrous steel shall comply with AWS Code, using E70 series electrodes for shielded metal arc welding (SMAW), or F7 series electrodes for submerged arc welding (SAW).

B. Electrodes for welding aluminum shall comply with the Aluminum Association Specifications and AWS D1.2.

C. Electrodes for welding stainless steel and other metals shall comply with AWS D1.6.

2.07 WELDED STUD CONNECTORS

A. Welded stud connectors shall conform to the requirements of AWS D1.1 Type C.

2.08 EYEBOLTS

A. Eyebolts shall conform to ASTM A489 unless noted otherwise.

2.09 HASTELLOY FASTENERS

A. Hastelloy fasteners and nuts shall be constructed of Hastelloy C-276.

2.10 ANTISEIZE LUBRICANT

A. Antiseize lubricant shall be C5-A Anti-Seize by Loctite Corporation, Molykote P-37 Anti-Seize Paste by Dow Corning, 3M Anti-Seize by 3M, or equal.

PART 3 -- EXECUTION

3.01 MEASUREMENTS

A. The Design/Builder shall verify all dimensions and review the Drawings and shall report any discrepancies to the Engineer for clarification prior to starting fabrication.

3.02 ANCHOR INSTALLATION

A. Anchor Rods, Concrete Anchors, and Masonry Anchors

1. Anchor rods shall be installed in accordance with AISC "Code of Standard Practice" by setting in concrete while it is being placed and positioned by means of a rigidly held template. Overhead adhesive anchors, and base plates or elements they are anchoring, shall be shored as required and securely held in place during anchor setting to prevent movement during anchor installation. Movement of anchors during curing is prohibited.

2. The Design/Builder shall verify that all concrete and masonry anchors have been installed in accordance with the manufacturer's recommendations and that the capacity of the installed anchor meets or exceeds the specified safe holding capacity.

3. Concrete anchors shall not be used in place of anchor rods without Engineer's approval.

4. All stainless steel threads shall be coated with antiseize lubricant.

B. High Strength Bolts

1. All bolted connections for structural steel shall use high strength bolts. High strength bolts shall be installed in accordance with AISC 348 "The 2009 RCSC Specification for Structural Joints". All bolted joints shall be Type N, snug-tight, bearing connections in accordance with AISC Specifications unless noted otherwise on the Drawings.

C. Concrete Anchors

1. Concrete at time of anchor installation shall be a minimum age of 21 days, have a minimum compressive strength of 2500 psi, and shall be at least 50 degrees F.

2. Concrete anchors designed by the Design/Builder shall be classified as structural or non-structural based on the requirements indicated above.

3. Concrete Anchor Testing:

a. At all locations where concrete anchors meet the requirements for structural anchors at least 10% percent of all concrete anchors installed shall be proof tested to the value indicated on the Drawings, with a minimum of one tested anchor per anchor group. If no test value is indicated on the Drawings but the installed anchor meets the requirements for structural anchors, the Design/Builder shall notify the Engineer to allow verification of whether anchor load proof testing is required.

b. Design/Builder shall submit a plan and schedule indicating locations of anchors to be proof tested, load test values and proposed anchor testing procedure (including a diagram of the testing equipment proposed for use) to the Engineer for review prior to conducting any testing. Proof testing of anchors shall be in accordance with ASTM E488 for the static tension test. If additional tests are required, inclusion of these tests shall be as stipulated on Contract Drawings.

c. Where Contract Documents indicate anchorage design to be the Design/Builder's responsibility and the anchors are considered structural per the above criteria, the Design/Builder shall submit a plan and schedule indicating locations of anchors to be proof tested and load test values, sealed by a Professional Engineer currently registered in the Commonwealth of Virginia. The Design/Builder's Engineer shall also submit documentation indicating the Design/Builder's proof testing procedures have been reviewed and the proposed procedures are acceptable. Proof testing procedures shall be in accordance with ASTM E488.

d. Concrete Anchors shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the anchor after loading shall be considered a failure. Anchors exhibiting damage shall be removed and replaced. If more than 5 percent of tested anchors fail, then 100 percent of anchors shall be proof tested.

e. Proof testing of concrete anchors shall be performed by an independent testing laboratory hired directly by the Design/Builder and approved by the Engineer. The Design/Builder shall be responsible for costs of all proof testing, including additional testing required due to previously failed tests.

4. All concrete anchors shall be installed in strict conformance with the manufacturer's printed installation instructions. A representative of the manufacturer shall be on site when required by the Engineer.

5. All holes shall be drilled in accordance with the manufacturer's instructions except that cored holes shall not be allowed unless specifically approved by the Engineer. If cored holes are allowed by the manufacturer and approved by the Engineer, cored holes shall be roughened in accordance with manufacturer requirements. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with the manufacturer's instructions prior to installation of adhesive and threaded rod unless otherwise recommended by the manufacturer. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be either dry or water-saturated. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer. Injection of adhesive into the hole shall be performed to minimize the formation of air pockets in accordance with the manufacturer's instructions. Wipe rod free from oil that may be present from shipping or handling.

D. Other Bolts

1. All dissimilar metal shall be connected with appropriate fasteners and shall be insulated with a dielectric or approved equal.

2. All stainless steel bolts shall be coated with antiseize lubricant.

3.03 WELDING

A. All welding shall comply with AWS Code for procedures, appearance, quality of welds, qualifications of welders and methods used in correcting welded work.

B. Welded stud connectors shall be installed in accordance with AWS D1.1.

3.04 INSPECTION

A. High strength bolting will be visually inspected in accordance with AISC 348 "The 2009 RCSC Specification for Structural Joints". Rejected bolts shall be either replaced or retightened as required.

B. Field welds will be visually inspected in accordance with AWS Codes. Inadequate welds shall be corrected or redone as required in accordance with AWS Codes.

C. Post-installed concrete anchors shall be inspected as required by ACI 318.

3.05 CUTTING OF EMBEDDED REBAR

A. The Design/Builder shall not cut embedded rebar cast into structural concrete during installation of post-installed fasteners without prior approval of the Engineer.

- END OF SECTION -

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SECTION 05061

STAINLESS STEEL

PART 1 -- GENERAL

1.01 SECTION INCLUDES

A. The Design/Builder shall furnish, install and erect the stainless steel work as shown on the Contract Drawings and specified herein.

B. Stainless steel work shall be furnished complete with all accessories, mountings and appurtenances of the type of stainless steel and finish as specified or required for a satisfactory installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 - Submittals

B. Section 05010 - Metal Materials

C. Section 05050 - Metal Fastening

D. Section 05500 - Metal Fabrications

1.03 REFERENCES

A. ASTM A193 - Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.

B. ASTM A194 - Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.

C. ASTM A262 - Practice for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steel.

D. ASTM A276 - Stainless and Heat-Resisting Steel Bars and Shapes.

E. ASTM A314 - Stainless and Heat-Resisting Steel Billets and Bars for Forging.

F. ASTM A380 - Practice for Cleaning and Descaling Stainless Steel Parts, Equipment and Systems.

G. ASTM A473 - Stainless and Heat-Resisting Steel Forgings.

H. ASTM A666 - Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar.

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I. ASTM A774 - Stainless Steel Pipe Fittings

J. ASTM A778 - Stainless Steel Pipe

K. ASTM F593 - Stainless Steel Bolts, Hex Cap Screws and Studs.

L. ASTM F594 - Stainless Steel Nuts.

M. ANSI/ASME B1.1 - Unified Inch Screw Thread (UN and UNR Thread Form).

1.04 TESTS

A. All stainless steel materials including stainless test welds, shall be checked for compliance with tests for susceptibility to intergranular attack. Such tests shall be Practices A, B and E of ASTM A262. Detailed procedures for the tests shall be submitted to the Engineer for approval prior to start of work. Practice A shall be used only for acceptance of materials but not for rejection of materials, and shall be used for screening material intended for testing in Practice B and Practice E. The maximum acceptable corrosion rate under Practice B shall be 0.004 inch per month, rounded off to the third decimal place. If the certified mill report indicates that such test has been satisfactory performed, the fabricator may not be required to repeat the test. Material passing Practice E shall be acceptable.

B. Sample selection for the susceptibility to intergranular attack tests shall be as follows:

1. One (1) sample per heat per heat treatment lot for plates and forgings;

2. One (1) sample per each Welding Procedure Qualification regardless of the joint design;

3. If tests indicate a reduction in corrosion resistance, welding procedure shall be adjusted or heat treatment determined as needed to restore required corrosion resistance.

4. The samples so chosen shall have received all the post-weld heat treatments identical to the finished part.

1.05 SUBMITTALS

A. The Design/Builder shall prepare and submit for approval shop drawings for all stainless steel fabrication in accordance with Section 01 33 00, Submittal Procedures.

B. Submittals shall include, but not be limited to, the following:

1. Certified test reports for susceptibility to intergranular attack.

2. Affidavit of compliance with type of stainless steel shown on the Contract Drawings or specified herein.

3. Certified weld inspection reports.

4. Cleaning and handling of stainless steel in accordance with Paragraph 3.04, Cleaning and Handling.

C. Samples of finish, on each type of stainless steel to be furnished, shall be submitted to the Engineer upon request.

1.06 QUALITY ASSURANCE

A. Shop inspections may be made by the Owner. The Design/Builder shall give ample notice to the Engineer prior to the beginning of any stainless steel fabrication work so that inspection may be provided. The Design/Builder shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the works.

B. Inspectors shall have the authority to reject any materials or work which does not meet the requirements of the Contract Drawings or the Specifications.

C. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the Design/Builder from his responsibility for furnishing proper materials or workmanship.

1.07 HANDLING, STORAGE AND DELIVERY

A. Mechanical damage (e.g., scratches and gouges) to the stainless steel material shall not be permitted and is cause for rejection. Care shall be taken in the material handling since such mechanical damage will result in the passive oxide film being "punctured" leading to a possible lower resistance to the initiation of corrosion than the surrounding chemically-passivated surface.

B. Stainless steel plates and sheets shall be stored vertically in racks and not be dragged out of the racks or over one another. Racks shall be protected to prevent iron contamination.

C. Heavy stainless steel plates shall be carefully separated and chocked with wooden blocks so that the forks of a fork-lift could be inserted between plates without mechanically damaging the surface.

D. Stainless steel plates and sheets laid out for use shall be off the floor and be divided by wooden planks to prevent surface damage and to facilitate subsequent handling.

E. Plate clamps, if used, shall be used with care as the serrated faces can dig in, indent and gouge the surface.

F. Stainless steel fabrications shall be loaded in such a manner that they may be transported and unloaded without being overstressed, deformed or otherwise damaged.

G. Stainless steel fabrications and packaged materials shall be protected from corrosion and deterioration and shall be stored in a dry area. Materials stored outdoors shall be supported above ground surfaces on wood runners and protected with approved effective and durable covers.

H. Stainless steel fabrications shall not be placed in or on a structure in a manner that might cause distortion or damage to the fabrication. The Design/Builder shall repair or replace damaged stainless steel fabrications or materials as directed by the Engineer.

1.08 FIELD MEASUREMENTS

A. The Design/Builder shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of the work.

B. The Design/Builder shall review the Contract Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

PART 2 -- PRODUCTS

2.01 MATERIALS AND FINISHES

A. Stainless steel shall be Type 304 unless it is used for underwater service. Stainless steel for underwater service shall be Type 316. Minimum mechanical finish shall be No. 4 as stated in Table 2 unless otherwise noted on the Contract Drawings.

B. The basic mill forms (sheet, strip, plate and bar) are classified by size as shown on Table 1. Tables 2, 3 and 4 identify finishes and conditions in which sheet, bar and plate are available.

C. Tables 2, 3 and 4 show numbered finishes and conditions for sheet, bar and plate. While there are no specific designations for polished finishes on bar or plate, the sheet finish designations are used to describe the desired effect. This also applies to finishes on ornamental tubing.

D. There are three standard finishes for strip, which are broadly described by the finishing operations employed:

1. No. 1 Strip Finish

   No. 1 strip finish is approximately the same as No. 2D Sheet Finish. It varies in appearance from dull gray matte to a fairly reflective surface, depending largely on alloy composition and amount of cold reduction.

2. No. 2 Strip Finish is approximately the same as a No. 2B sheet finish. It is smoother, more reflective than No. 1, and likewise varies with alloy composition.

3. Bright annealed finish is a highly reflective finish that is retained by final annealing in a controlled atmosphere furnace.

Table 1

Classification of Stainless Steel Product Form

Item	Description	Dimensions		
		Thickness	Width	Diameter or Size
Sheet	Coils and cut length: Mill finishes Nos. 1, 2D and 2B Polished finishes Nos. 3, 4, 6, 7 & 8	 under 3/16" under 3/16"	 24" and over all widths	 -- --
Strip	Cold finished, coils or cut lengths Polished finishes Nos. 3, 4, 6,7 & 8	under 3/16" under 3/16"	under 24" all widths	-- --
Plate	Flat rolled or forged	3/16" and over	over 10"	--
Bar	Hot finished rounds, squares, octagons and hexagons Hot finished flats Cold finished rounds, squares, octagons and hexagons Cold finished flats	-- 1/8" to 8" incl. -- 1/8" to 4-1/2"	-- 1/4" to 10" incl. -- 3/8" to 4-1/2"	1/4" and over -- over 1/8" --
Wire	Cold finishes only: (in coil) Round, square, octagon, hexagon and flat wire	 under 3/16"	 under 3/8"	 --
Pipe & Tubing	Several different classifications, with differing specifications, are available.			
Extrusion	Not considered “standard” shapes. Currently limited in size to approximately 6-1/2" diameter or structurals.			

Table 2

Standard Mechanical Sheet Finishes

Unpolished or Rolled Finishes: No. 1 A rough dull surface which results from hot rolling to the specified thickness followed by annealing and descaling.	No. 4 A polished surface obtained by finishing with a 120-150 mesh abrasive, following initial grinding with coarser abrasives. This is a general purpose bright finish with a visible "grain" which prevents mirror reflection.
No. 2D A dull finish which results from cold rolling followed by annealing and descaling, and may perhaps get a final light roll pass through unpolished rolls. A 2D finish is used where appearance is of no concern.	No. 6 A dull satin finish having lower reflectivity than No. 4 finish. It is produced by Tampico brushing the No. 4 finish in a medium of abrasive and oil. It is used for architectural applications and ornamentation where a high luster is undesirable, and to contrast with brighter finishes.
No. 2B A bright cold-rolled finish resulting in the same manner as No. 2D finish, except that the annealed and descaled sheet receives a final light roll pass through polished rolls. This is the general purpose cold-rolled finish that can be used as is, or as a preliminary step to polishing.	No. 7 A high reflective finish that is obtained by buffing finely ground surfaces but not to the extent of completely removing the "grit" lines. It is used chiefly for architectural and ornamental purposes.
Polished Finishes: No. 3 An intermediate polish surface obtained by finishing with a 100 grit abrasive. Generally used where a semi-finished polished surface is required. A No. 3 finish usually receives additional polishing during fabrication.	No. 8 The most reflective surface, which is obtained by polishing with successively finer abrasives and buffing extensively until all grit lines from preliminary grinding operations are removed. It is used for applications such as mirrors and reflectors.

Table 3

Conditions and Finishes for Bar

Conditions	**Surface Finishes[1]**
Hot worked only	(a) Scale not removed (excluding spot conditioning) (b) Rough turned[2] (c) Pickled or blast cleaned and pickled.
Annealed or otherwise heat treated.	(a) Scale not removed (excluding spot conditioning) (b) Rough turned (c) Pickled or blast cleaned and pickled (d) Cold drawn or cold rolled (e) Centerless ground (f) Polished
Annealed and cold worked to high tensile strength[3]	(d) Cold drawn or cold rolled (e) Centerless ground (f) Polished

1 Surface finishes (b), (e) and (f) are applicable to round bars only.

2 Bars of the 4xx series stainless steels which are highly hardenable, such as Types 414, 420, 420F, 431, 440A, 440B and 440C, are annealed before rough turning. Other hardenable grades, such as Types 403, 410, 416 and 416Se, may also require annealing depending on their composition and size.

3 Produced in Types 302, 303Se, 304 and 316.

Table 4

Conditions and Finishes for Plate

Condition and Finish	Description and Remarks
Hot rolled	Scale not removed. Not heat treated. Plates not recommended for final use in this condition.[4]
Hot rolled, annealed or heat treated	Scale not removed. Use of plates in this condition is generally confined to heat resisting applications. Scale impairs corrosion resistance.[1]
Hot rolled, annealed or heat treated, blast cleaned or pickled	Condition and finish commonly preferred for corrosion resisting and most heat resisting applications.
Hot rolled, annealed, descaled and temper passed	Smoother finish for specialized applications.
Hot rolled, annealed, descaled cold rolled, annealed, descaled, optionally temper passed	Smooth finish with greater freedom from surface imperfection than the above.
Hot rolled, annealed or heat treated, surface cleaned and polished	Polished finishes refer to Table 2.

[4] Surface inspection is not practicable on plates which have not been pickled or otherwise descaled.

PART 3 -- EXECUTION

3.01 FABRICATION

A. Holes for bolts and screws shall be drilled. Fastenings shall be concealed where practicable. Joints exposed to the weather shall be formed to exclude water.

B. As far as practicable, all fabricated units shall be fitted and assembled in the shop, with all cuts and bends made to precision measurements in accordance with details shown on approved shop drawings.

C. Work shall be fabricated so that it is installed in a manner that will provide for expansion and contraction, prevent the shearing of bolts, screws and other fastenings, ensure rigidity, and provide close fitting of sections.

D. All finished and/or machined faces shall be true to line and level. Stainless steel sections shall be well formed to shape and size with sharp lines and angles; curved work shall be sprung evenly to curves.

E. All work shall be fitted together at the shop as far as possible, and delivered complete and ready for erection. Proper care shall be exercised in handling all work so as not to injure the finished surfaces.

3.02 WELDING

A. Welding shall be done in a manner that will prevent buckling and in accordance with Specification 05050 – Metal Fastening, and as modified hereinafter.

B. All welds exposed in the work shall be ground smooth and finished to match the finish of the adjacent stainless steel surfaces.

C. Select weld rods that provide weld filler metal having corrosion resistant properties as nearly identical or better than the base metal to insure preservation of the corrosion-resistant properties. Provide heat treatment at welds where testing of weld procedure indicates it is required to restore the corrosion resistance.

D. Thermal conductivity of stainless steel is about half that of other steels; and the following methods may be used to accommodate this situation:

1. Use lower weld current setting.

2. Use skip-weld techniques to minimize heat concentration.

3. Use back-up chill bars or other cooling techniques to dissipate heat.

E. Edges of the stainless steel to be welded shall be cleaned of contaminants.

3.03 FASTENERS

A. Stainless steel fasteners shall be used for joining stainless steel work.

B. Stainless steel fasteners shall be made of alloys that are equal to or more corrosion resistant than the materials they join.

3.04 CLEANING AND HANDLING

A. All stainless steel surfaces shall be precleaned, descaled, passivated and inspected before, during and after fabrication in accordance with the applicable sections of ASTM A380 and as detailed in the procedures to be submitted to the Engineer for approval prior to start of work. Degreasing and passivation of stainless steel articles shall be conducted as the last step after fabrication.

B. Measures to protect cleaned surfaces shall be taken as soon as final cleaning is completed and shall be maintained during all subsequent handling, storage and shipping.

1. The Design/Builder shall submit for approval specific procedures listing all the steps to be followed in detecting contamination and in descaling, cleaning, passivation and protecting of all stainless steel.

2. Area showing clear indications of contamination shall be recleaned, repassivated and reinspected.

C. At approved stages in the shop operations, contaminants such as scale, embedded iron, rust, dirts, oil, grease and any other foreign matter shall be removed from the metal, as directed or approved by the Engineer. The adequacy of these operations shall be checked by the Engineer. Operations in the shop shall be conducted so as to avoid contamination of the stainless steel and to keep the metal surfaces free from dirt and foreign matter.

D. In order to prevent incipient corrosion during fabrication, special efforts shall be made at all times to keep all stainless steel surfaces from coming in contact with other metals.

1. Stainless steel and stainless steel welds shall be cleaned with clean sand free of iron, stainless steel wool, stainless steel brushes, or other approved means and shall be protected at all times from contamination by any materials, including carbon steel, that shall impair its resistance to corrosion.

2. Approved methods of cutting, grinding and handling shall be used to prevent contamination. If air-arc, or carbon-arc cutting is used, additional metal shall be removed by approved mechanical means so as to provide clean, weldable edges. All grinding of stainless steel shall be performed with aluminum oxide or silicon carbide grinding wheels bonded with resin or rubber. Grinding wheels used on carbon steel shall not be used on stainless steel.

3. Sand, grinding wheels, brushes and other materials used for cleaning stainless steel shall be checked periodically by the Engineer for contaminants. Cleaning aids found to contain contaminants shall not be used on the work.

3.05 INSTALLATION

A. All stainless steel fabrications shall be erected square, plumb and true, accurately fitted, adequately anchored in place, set at proper elevations and positions.

B. All inserts, anchor rods and all other miscellaneous work specified in the Detailed Specifications or shown on the Contract Drawings or required for the proper completion of the work, which are embedded in concrete, shall be properly set and securely held in position in the forms before the concrete is placed.

C. All stainless steel fabrications shall be installed in conformance with details shown on the Contract Drawings or on the approved shop drawings.

-END OF SECTION -

SECTION 05120

STRUCTURAL STEEL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all equipment, labor, materials, and services required to provide all structural steel work in accordance with the Contract Documents. The term "structural steel" shall include items as defined in the AISC "Code of Standard Practice".

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05010 - Metal Materials

B. Section 05035 - Galvanizing

C. Section 05050 - Metal Fastening (Not Applicable for Major Equipment Package)

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents.

1. Virginia Uniform Statewide Building Code

2. AISC - "Code of Standard Practice."

3. AISC - "Specification for Structural Steel Buildings".

4. AISC 348 - "The 2009 RCSC Specification for Structural Joints”.

5. AWS - "Structural Welding Code".

1.04 SUBMITTALS

A. Submit the following.

1. Certified Mill Test Reports

2. Affidavit of Compliance with grade specified

3. Shop Drawings which include the following:

a. Layout drawings indicating all structural shapes, sizes, and dimensions.

b. Beam and column schedules.

c. Detailed drawings indicating jointing, anchoring and connection details.

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4. Structural Steel Survey

5. Summary of fabricator and erector experience

1.05 QUALITY ASSURANCE

A. The erector shall be a qualified installer who participates in the AISC Certification program and is designated an AISC Certified Erector, Category ACSE. Alternatively, an erector that can demonstrate documented, satisfactory experience (a minimum of 5 years) may be acceptable at the discretion of the Engineer.

B. The fabricator shall be a qualified fabricator who participates in the AISC Certification program and is designated an AISC Certified Plant, Category STD. Alternatively, a fabricator that can demonstrate documented, satisfactory experience (a minimum of 5 years) may be acceptable at the discretion of the Engineer.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Structural Steel

1. Structural steel for W shapes shall conform to ASTM A992 unless otherwise indicated.

2. Structural steel for HP shapes shall conform to ASTM A572 Grade 50 unless otherwise indicated.

3. Structural steel for S, M, C, and MC shapes and angles and plates shall conform to ASTM A36 unless otherwise indicated.

4. Steel pipe shall be ASTM A53, Grade B.

5. HSS shall be ASTM A500, Grade C or ASTM A1085. All members shall be furnished full length without splices unless otherwise noted or accepted by the Engineer.

6. All unidentified steel will be rejected and shall be removed from the site and replaced by the Manufacturer, all at the expense of the Manufacturer.

7. Fasteners for structural steel shall be in accordance with Section 05050, Metal Fastening. (Not Applicable for Major Equipment Package)

B. Welds

1. Electrodes for welding shall be in accordance with Section 05050, Metal Fastening. (Not Applicable for Major Equipment Package)

PART 3 -- EXECUTION

3.01 FABRICATION

A. Fabrication shall be in accordance with the AISC "Specification for Structural Steel Buildings and AISC "Code of Standard Practice". Fabrication shall begin only after Shop Drawing approval.

B. Except where otherwise noted on the Drawings or in this Specification, all shop connections shall be welded.

C. All holes in structural steel members required for anchors, anchor rods, bolts, sag rods or other members or for attachment of other work shall be provided by the fabricator and detailed on the Shop Drawings.

D. All materials shall be properly worked and match-marked for field assembly.

E. Where galvanizing of structural steel is required, it shall be done in accordance with Section 05035, Galvanizing.

3.02 DELIVERY, STORAGE AND HANDLING

A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.

B. Structural steel members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that might cause distortion or damage to the members or the supporting structures. The Manufacturer shall repair or replace damaged materials or structures as directed.

3.03 ERECTION

A. The erection of all structural steel shall conform to the applicable requirements of the AISC "Specification for Structural Steel Buildings" and AISC "Code of Standard Practice". All temporary bracing, guys and bolts as may be necessary to ensure the safety of the structure until the permanent connections have been made shall be provided by the Manufacturer.

B. Structural members shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before permanently fastened. A licensed land surveyor shall survey the structural steel during erection and shall provide a final survey indicating elevations and locations of all major members. Necessary adjustments to compensate for discrepancies in elevations and alignments shall be performed.

C. No cutting of structural steel members in the field will be allowed except by the written approval of the Design/Builder.

D. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly.

E. Field welding shall not be permitted unless specifically indicated in the Drawings or approved in writing by the Design/Builder. All field welding shall comply with Section 05050, Metal Fastening (Not Applicable for Major Equipment Package).

F. All bolted connections shall use high strength bolts in accordance with Section 05050, Metal Fastening (Not Applicable for Major Equipment Package). High strength bolts shall be installed in accordance with AISC 348 "The 2009 RCSC Specification for Structural Joints". Bolts specified or noted on the Drawings to be a tension or slip critical "SC" type connection shall be fully pretensioned with proper preparation of the faying surfaces. All other bolts shall be snug tightened unless otherwise noted on the Drawings.

G. All field connections shall be accurately fitted up before being bolted. Drifting shall be only such as will bring the parts into position and shall not be sufficient to enlarge the holes or to distort the metal. All unfair holes shall be drilled or reamed.

H. Misfits at Bolted Connections

1. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins.

2. Where misalignment between anchor rods and rod holes in steel members are encountered, the Design/Builder shall be immediately notified.

I. Grouting of Base Plates and Bearing Plates

1. The bottom surface of the plates shall be cleaned of all foreign materials, and concrete or masonry bearing surface shall be cleaned of all foreign materials and roughened to improve bonding.

2. Accurately set all base and bearing plates to designated levels with steel wedges or leveling plates.

3. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure. Non-shrink grout shall conform to Section 03600, Grout. (Not Applicable for Major Equipment Package)

4. Anchor rods shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its specified strength.

J. Where finishing is required, assembly shall be completed including bolting and welding of units before start of finishing operations.

3.04 PAINTING

A. Painting shall be performed according to Section 09900, Painting and the following additional requirements, or as specified in each Equipment Specification as applicable. This requirement does not apply to the Major Equipment Package.

1. Concrete Encased Steel: Steel members which will be encased in concrete shall be cleaned but not painted prior to encasement.

2. Contact Surfaces: Contact surfaces such as at field connections, shall be cleaned and primed but not painted.

3. Finished Surfaces: Machine finished surfaces shall be protected against corrosion by a rust-inhibiting coating which is easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.

4. Surfaces Adjacent to Field Welds: Surfaces within 2 inches of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

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SECTION 05140

STRUCTURAL ALUMINUM

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all equipment, labor, materials, and services required to provide all structural aluminum work in accordance with the Contract Documents. The term "structural aluminum" shall include items as defined in the Aluminum Association "Specifications for Aluminum Structures".

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05010 - Metal Materials

B. Section 05050 - Metal Fastening

C. Section 09900 - Painting

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available.

1. Virginia Uniform Statewide Building Code

2. Aluminum Association "Specifications for Aluminum Structures"

3. AWS D1.2 - "Structural Welding Code".

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures.

1. Certified Mill Test Reports

2. Affidavit of Compliance with grade specified

3. Shop Drawings which include the following:

a. Layout drawings indicating all structural shapes, sizes, and dimensions.

b. Beam and column schedules.

c. Detailed drawings indicating jointing, anchoring and connection details.

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1.05 QUALITY ASSURANCE

A. Shop inspection may be required by the Owner at his own expense. The Design/Builder shall give ample notice to the Owner prior to the beginning of any fabrication work so that inspection may be provided. The Design/Builder shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the work. Inspectors shall have the authority to reject any materials or work which do not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the Design/Builder from his responsibility for furnishing proper materials or workmanship under this Specification.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Structural aluminum shall comply with Section 05010, Metal Materials.

B. Fasteners for structural aluminum shall be in accordance with Section 05050, Metal Fastening.

C. Electrodes for welding shall be in accordance with Section 05050, Metal Fastening.

PART 3 -- EXECUTION

3.01 MEASUREMENT

A. The Design/Builder shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of work. The Design/Builder shall review the Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

3.02 FABRICATION

A. Fabrication shall be in accordance with the Aluminum Association "Specifications for Aluminum Structures". Fabrication shall begin only after Shop Drawing approval.

B. Except where otherwise noted on the Drawings or in this Specification, all shop connections shall be welded.

C. All holes in structural aluminum members required for anchors, anchor rods, bolts, or other members or for attachment of other work shall be provided by the fabricator and detailed on the Shop Drawings.

D. All materials shall be properly worked and match-marked for field assembly.

3.03 DELIVERY, STORAGE AND HANDLING

A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.

B. Structural aluminum members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that might cause distortion or damage to the members or the supporting structures. The Design/Builder shall repair or replace damaged materials or structures as directed.

3.04 ERECTION

A. All temporary bracing, guys and bolts as may be necessary to ensure the safety of the structure until the permanent connections have been made shall be provided by the Design/Builder.

B. Structural members shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before being permanently fastened. Necessary adjustments to compensate for discrepancies in elevations and alignments shall be performed.

C. No cutting of structural aluminum members in the field will be allowed except by the written approval of the Engineer.

D. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly.

E. Field welding shall not be permitted unless specifically indicated in the Drawings or approved in writing by the Engineer. All field welding shall comply with Section 05050, Metal Fastening.

F. All bolted connections shall comply with Section 05050, Metal Fastening.

G. All field connections shall be accurately fitted up before being bolted. Drifting shall be only such as will bring the parts into position and shall not be sufficient to enlarge the holes or to distort the metal. All unfair holes shall be drilled or reamed.

H. Misfits at Bolted Connections

1. Where misfits in erection bolting are encountered, the Engineer shall be immediately notified. The Design/Builder shall submit a method to remedy the misfit for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member must be refabricated.

2. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. The Design/Builder shall notify the Engineer immediately and shall submit a proposed method of remedy for review by the Engineer.

3. Where misalignment between anchor bolts and bolt holes in aluminum members are encountered, the Engineer shall be immediately notified. The Design/Builder shall submit a method to remedy the misalignment for review by the Engineer.

I. Grouting of Base Plates and Bearing Plates

1. The bottom surface of the plates shall be cleaned of all foreign materials, and concrete or masonry bearing surface shall be cleaned of all foreign materials and roughened to improve bonding.

2. Accurately set all base and bearing plates to designated levels with steel wedges or leveling plates.

3. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure. Non-shrink grout shall conform to Section 03600, Grout.

4. Anchor bolts shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its specified strength.

J. Where finishing is required, assembly shall be completed including bolting and welding of units before start of finishing operations.

3.05 PAINTING

A. Painting shall be performed according to Section 09900, Painting.

B. Aluminum surfaces in contact with concrete or dissimilar metals shall be thoroughly protected with two coats of epoxy paint with a minimum total thickness of 16 mils or other approved isolating material in accordance with the requirements of Section 09900 - Painting.

- END OF SECTION -

SECTION 05210

STEEL JOISTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor and services for the delivery, handling, storing and erecting of steel joists in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05120 - Structural Steel

B. Section 05300 - Metal Decking

C. Section 05500 - Metal Fabrications

1.03 REFERENCE STANDARDS

A. AISC - Specifications for Open Web Steel Joist

B. AWS - Structural Welding Code

C. Standard Specification, Load Tables and Weight Tables for Steel Joist and Joist Girders, published by Steel Joist Institute (SJI)

D. ASTM - Standard Specifications for Materials

E. AISI - Specifications for the Design of Cold-Formed Steel Structural Members.

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, the Design/Builder shall submit the following:

1. Certified mill test reports.

2. Affidavit of compliance with type of grade specified.

3. Joist placement plans showing detailed layouts, design details, connection details, fabrication details, bridging (size, location and connections), deflection criteria and load data.

4. Signed and sealed calculations from the joist manufacturer's registered professional engineer. Manufacturer's professional engineer shall be registered in the Commonwealth of Virginia.

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5. Certified weld inspection reports.

6. Joist manufacturer, at the completion of manufacture, shall provide a certificate of compliance stating that the supplied joists and associated work have been provided in accordance with the approved Contract Documents and with SJI standard specifications.

1.05 QUALITY ASSURANCE

A. All materials, workmanship and production methods shall be in accordance with standards in the industry.

B. Joist manufacturers shall submit a certificate of compliance stating that plant and production methods have met the requirements of all joist specifications, codes and standards.

1.06 QUALIFICATIONS

A. Steel joist manufacturer must be a member of SJI and conform to SJI standards.

B. Manufacturer must specialize in steel joist design and fabrication for a minimum of five (5) years documented experience.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Joists and joist girders shall conform to SJI Standard Specifications.

B. Joist location, spacing and loading shall be as shown on the Contract Documents.

C. Joist sizes shown on the Contract Documents must be evaluated by the manufacturer.

PART 3 -- EXECUTION

3.01 FABRICATION AND DESIGN

A. Joists shall be designed in accordance with SJI standard specifications as simply supported trusses, unless indicated otherwise on the Drawings.

B. All welding shall conform to AWS Standards. No fusion welding is permitted for steel joists.

C. The number of rows of bridging and type of bridging shall be established by the manufacturer for loads shown on the Drawings.

D. Each joist shall be marked and labeled for identification. All joists shall have one coat of primer shop paint.

3.02 DELIVERY AND STORAGE

A. Handle, transport and store joists in a manner to prevent damage affecting their structural integrity. Store all items off the ground in a well drained location protected from the weather and easily accessible for inspection and handling.

B. Any damaged joists shall not be accepted.

3.03 INSTALLATION

A. All bridging and bridging anchors shall be completely installed before roof or floor construction loads are placed on the joists. The ends of all bridging shall be anchored.

B. End anchorage of steel joists shall have a steel bearing plate resting on masonry or concrete, as shown on the Drawings. End anchorage of steel joist resting on steel supports shall be attached with a minimum of two 1/8-inch fillet welds, one inch long, or with 1/2 inch bolts, unless indicated otherwise on the Drawings.

C. The deflection of steel joists due to live load shall not exceed L/360 of span for floors and L/240 of span for roof.

3.04 PAINTING

A. Painting shall conform to Section 09900, Painting.

- END OF SECTION -

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SECTION 05300

METAL DECKING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, equipment, materials and services to install all metal deck complete with all accessories for a complete installation in accordance with the Drawings and as specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05010 - Metal Materials

B. Section 05035 - Galvanizing

C. Section 05050 - Metal Fastening

D. Section 05120 - Structural Steel

E. Section 05210 - Steel Joists

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. AISI - Specification for the Design of Cold-Formed Steel Structural Members

B. SDI - Design Manual for Floor Decks and Roof Decks and Manual of Construction with Steel Deck.

C. ASTM Standards for Test Methods.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures.

1. Complete layout and installation drawings and schedules with clearly marked dimensions.

2. Detail and location drawings for all framing, supports, type and location of all welds and fasteners.

3. Details of all accessories showing welding washers, studs and reinforcing strips.

4. Manufacturer's design calculations or published literature for the structural properties of the metal decking.

5. Qualifications of welders.

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1.05 QUALITY ASSURANCE

A. All materials, workmanship and production methods shall be in accordance with SDI.

B. Manufacturer shall be regularly engaged in the manufacture of metal decking.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Steel sheet shall be flat rolled carbon steel sheets meeting the requirements of ASTM A653.

B. Steel shall be galvanized in accordance with Section 05035, Galvanizing.

C. Mechanical fasteners used for sidelap connections shall be SDI standard.

PART 3 -- EXECUTION

3.01 FABRICATION AND DESIGN

A. Design, fabrication and erection of decking shall comply with references listed in Section 1.03 and manufacturer's recommendations.

B. Deck units shall conform to the SDI standard type and gage shown on the Drawings.

3.02 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be delivered in unbroken, undamaged, original packages bearing manufacturer's labels.

B. Metal decking shall be stored off the ground with one end elevated for drainage and covered with water-proof material in accordance with decking manufacturer's recommendations.

C. Decking shall be handled so as to preclude damage from any source.

D. Metal decking units may not be used for any purpose (such as scaffold decking) prior to incorporation in the work. Any units which have been so used will be rejected.

3.03 INSPECTION

A. Verify correct layout and alignment of supporting members and clean all support surfaces of debris. All defects shall be corrected prior to installation of metal decking.

3.04 INSTALLATION

A. Install deck units and accessories in accordance with shop drawings and manufacturer's recommendations. Deck units shall be installed where called for on the Drawings.

B. Position deck units on supporting steel framework and adjust to final position with ends bearing on supporting members and accurately aligned end to end before being permanently fastened. Extend deck units over three or more supports unless shown otherwise on the Drawings. Lap ends not less than 2 inches. Place deck units flat and square, secured to adjacent framing without warp or deflection.

C. Secure deck units to supporting members as shown on the Drawings. Weld pattern shall be as indicated on the Drawings in accordance with SDI. The Design/Builder may use an equivalent pattern of mechanical fasteners in lieu of welded fastening.

D. Attach deck at sidelaps with screws as indicated on the Drawings or as recommended by the manufacturer.

E. Cut and fit deck units around openings. Deck manufacturer shall approve openings larger than 6" diameter prior to cutting.

3.05 REPAIR OF GALVANIZING

A. Galvanizing shall be repaired at all welds, scarred areas, and rust spots in accordance with Section 05035, Galvanizing.

3.06 CONSTRUCTION GUIDELINES

A. Do not use deck units as a working platform or storage area until units are permanently attached in position.

B. Construction loads shall not exceed the load carrying capacity of the deck.

C. All units damaged during construction shall be repaired or replaced by the Design/Builder.

- END OF SECTION -

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SECTION 05500

METAL FABRICATIONS

PART 1 -- GENERAL

1.01 REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all metal fabrications not specifically included in other Sections, complete and in accordance with the requirements of the Contract Documents.

B. Work shall include but may not be limited to lintels and guard posts.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 – Submittal Procedures

B. Section 05010 - Metal Materials

C. Section 05050 - Metal Fastening

D. Section 05035 - Galvanizing

E. Certain specific items are included in other Sections of the Specifications. See the section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available.

1. Virginia Uniform Statewide Building Code

2. AISC - Specification for Structural Steel Buildings

3. AISI - Specifications for the Design of Cold-Formed Steel Structural Members

4. Aluminum Association Specifications for Aluminum Structures

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures.

1. Complete fabrication and erection drawings of all metalwork specified herein.

2. Other submittals as required in accordance with Section 05010, Metal Materials, and Section 05050, Metal Fastening.

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PART 2 -- PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used in metal fabrications shall conform to Section 05010, Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used in metal fabrication shall conform to Section 05050, Metal Fastening, unless noted otherwise.

2.03 LINTELS

A. Provide lintels as shown on the Drawings and specified herein with 8 inches minimum bearing each side unless noted otherwise.

B. All lintels shall be steel in accordance with Section 05120, Structural Steel, and shall be galvanized in accordance with Section 05035, Galvanizing, unless noted otherwise.

2.04 GUARD POSTS (BOLLARDS)

A. Guard posts shall be 6-inch diameter Schedule 40 galvanized steel pipe in accordance with ASTM A53.

B. Guard posts shall be concrete filled and crowned, as detailed in the Drawings.

PART 3 -- EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Design/Builder prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05050, Metal Fastening. All fastenings shall be concealed where practicable.

G. Fabricated items shall be shop painted when specified in Section 09900, Painting.

3.02 INSTALLATION

A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions

C. Metal work shall be field painted when as specified in accordance with Section 09900, Painting.

- END OF SECTION -

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SECTION 05510

METAL STAIRS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all metal stairs in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05010 - Metal Materials

B. Section 05035 - Galvanizing

C. Section 05050 - Metal Fastening

D. Section 05120 - Structural Steel

E. Section 05140 - Structural Aluminum

F. Section 05520 - Handrails and Railings

G. Section 05531 - Gratings, Access Hatches, and Access Doors

H. Section 05550 - Stair Treads and Nosings

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available.

1. Virginia Uniform Statewide Building Code

2. AISC Specification for Structural Steel Buildings

3. AISI Specification for the Design of Cold-Formed Steel Structural Members

4. Aluminum Association Specifications for Aluminum Structures

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

1. Complete fabrication and erection drawings of all metal work specified herein.

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2. Other submittals as required in accordance with Section 05010 - Metal Materials, and Section 05050 - Metal Fastening.

3. Design calculations for pan stairs and alternating tread stairs shall be submitted. Design calculations for metal stairs shall be submitted where member sizes are not indicated on the Contract Drawings. Calculations shall be signed and sealed by a Professional Engineer registered in the Commonwealth of Virginia.

PART 2 -- PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for metal stairs shall conform to Section 05010, Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used in metal stairs shall conform to Section 05050, Metal Fastening, unless noted otherwise.

2.03 METAL STAIRS AND LANDINGS

A. Stair stringers and structural framing of landings shall be fabricated from steel or aluminum as indicated on the Drawings.

1. Steel stairs shall be fabricated from steel in accordance with Section 05120, Structural Steel.

2. Aluminum stairs shall be fabricated from aluminum alloy 6061-T6 in accordance with Section 05140, Structural Aluminum.

B. Regardless of material of stringers, all stair treads shall be aluminum in accordance with Section 05550, Stair Treads and Nosings.

C. Where metal landings are required as indicated on the Drawings, gratings at landings shall conform to Section 05531, Gratings, Access Hatches, and Access Doors.

D. Handrails for metal stairs shall conform to Section 05520, Handrails and Railings. Design/Builder shall coordinate attachment of handrails to metal stairs.

E. All clips, anchors, and necessary appurtenances shall be provided for a complete and rigid installation.

F. Closure plates shall be provided for all exposed ends of stringers.

G. All exposed connections shall be welded and ground smooth, unless otherwise indicated on the Drawings.

H. Stairs and landings shall be designed to support a 100 psf live load, minimum, unless otherwise indicated on the Drawings.

2.04 STEEL PAN STAIRS

A. General

1. All steel stairs and landings with concrete filled steel pan risers and treads shall meet all applicable OSHA, ANSI, and NFPA codes.

2. Stair assemblies shall conform to the dimensions and arrangements shown on the Drawings.

3. Stair assemblies shall be designed to support a minimum 100 psf live load unless otherwise indicated on the Drawings.

4. Steel framing, hangers, columns, struts, clips, brackets, bearing plates, and other necessary appurtenances shall be provided for support of stairs and platforms as shown on the Drawings.

5. Exposed portions of steel pans, platforms, framing system stringers, and portions of aluminum nosings in contact with concrete, steel, or masonry shall be painted in accordance with Section 09900, Painting.

6. Concrete fill shall be 3-inches thick for platforms and 1-1/2 inches thick for pan treads.

7. Cast-in-place safety stair nosings in accordance with Section 05550, Stair Treads and Nosings, shall be provided for treads and platforms.

8. Metal pan treads, platforms, and risers shall be fabricated from 0.1084-inch thick (12 gauge minimum), galvanized structural steel sheets.

9. Risers and treads shall be supported by steel angle brackets welded to the stringers. Metal pans shall be secured to the brackets with welds.

10. Closure pieces shall be provided for ends of stringers.

B. Connections

1. All connections shall be welded unless otherwise shown on the Drawings or specified herein. All welds shall be continuous and ground smooth where exposed. Welding shall conform to Section 05050, Metal Fastening.

2. Assemblies shall be fabricated such that bolts and other fastenings do not appear on finished surfaces.

3. All joints shall be true and tight, and connections between parts shall be light-proof tight.

C. Handrails for steel pan stairs shall conform to Section 05520, Handrails and Railings. Design/Builder shall coordinate connection of handrails to stairs.

2.05 ALTERNATING TREAD STAIRS

A. Stairs, landings, and platforms shall be designed to carry a live load of 100 lbs. per square foot, unless noted otherwise on the Drawings.

B. The stairs shall be welded, alternating tread type stairs having a center spine and a cast integrally welded combination mounting plate and top landing, flush with the upper floor level. Handrails shall be custom formed and contoured to provide close body support and shall be welded on to the balusters which extend directly from the treads. All risers shall be equal, including the first and last risers, and treads shall have anti-skid surfaces. The stringer bottoms shall be bent and/or cut and welded to a floor plate. All exposed connections shall be welded and ground smooth.

C. Treads, floor plate castings, and landing shall be aluminum alloy AAF356F. Half treads shall be at least 9-inches wide and 10-inches deep. The central stringer shall be aluminum alloy 6063-T52, 1-3/4-inches x 4 inches x 1/8-inch box shape. Handrails shall be aluminum alloy 6061-T4. Finish shall be Aluminum Association M12C22A41.

D. The alternating tread type stairs shall be Model 68AL, as manufactured by Lapeyre Stair, Harahan, Louisiana.

PART 3 -- EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Design/Builder prior to fabrication. Such verification shall include coordination with all adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05050, Metal Fastening. All fastenings shall be concealed where practicable.

G. Fabricated items shall be shop painted when specified in accordance with Section 09900, Painting.

3.02 INSTALLATION

A. Assembly and installation of metal stairs shall be performed in strict accordance with manufacturer's recommendations.

B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

C. Metal stairs shall field painted when specified in accordance with Section 09900, Painting.

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SECTION 05515

LADDERS

PART 1 -- GENERAL

1.01 REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all ladders in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05010 - Metal Materials

B. Section 05050 - Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents.

1. Virginia Uniform Statewide Building Code

2. Aluminum Association Specifications for Aluminum Structures

3. Occupational Safety and Health Administration (OSHA) Regulations

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures.

1. Complete fabrication and erection drawings of all metalwork specified herein.

2. Other submittals as required in accordance with Section 05010, Metal Materials, and Section 05050, Metal Fastening.

PART 2 -- PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for ladders shall conform to Section 05010, Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used for ladders shall conform to Section 05050, Metal Fastening, unless noted otherwise.

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2.03 LADDERS

A. Ladders shall be furnished with all mounting brackets, baseplates, fasteners, and necessary appurtenances for a complete and rigid installation.

B. All ladders shall be aluminum alloy 6061-T6 or 6063-T5, with a clear, anodized finish, Aluminum Association M12C22A41.

C. All ladders shall conform to dimensions indicated on the Drawings and shall comply with OSHA requirements.

D. Side rails shall be 1-1/2 inch diameter Schedule 80 pipe, minimum.

E. Rungs shall be serrated 3/4 inch diameter, minimum.

F. All exposed connections shall be welded and ground smooth.

G. Ladders shall be as manufactured by Thompson Fabricating Company, or equal.

2.04 FALL PREVENTION SYSTEM

A. Ladders shall be installed with a fall prevention system, unless indicated otherwise on the drawings. For all ladders with an uninterrupted length exceeding 20 ft. between landings or floors, fall prevention system is mandatory.

B. Fall prevention system shall comply with OSHA requirements.

C. Fall prevention system shall include all necessary components to provide a fully operational system, including one full body safety harness with a 310 lb. weight capacity for each fall prevention system. System shall have a fall locking device, impact attenuator, and rail system. Rail extension with dismounting system, which allows detachment from the system while not standing on the ladder, shall be provided for ladders accessed thru hatch openings. All components shall be stainless steel with a non-metallic cable guide.

D. Fall Prevention Systems shall be RTC 2000 Climb-Rite System, Research and Trading Corporation, or Saf-T-Climb Fall Prevention System, Norton by Honeywell.

PART 3 -- EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Design/Builder prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05050, Metal Fastening. All fastenings shall be concealed where practicable.

G. Fabricated items shall be shop painted when specified in accordance with Section 09900, Painting.

3.02 INSTALLATION

A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

C. Metalwork shall be field painted when specified in accordance with Section 09900, Painting.

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SECTION 05520

HANDRAILS AND RAILINGS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all handrails and railings in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05010 - Metal Materials

B. Section 05050 - Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available.

1. Virginia Uniform Statewide Building Code

2. Aluminum Association Specifications for Aluminum Structures

3. Occupational Safety and Health Administration (OSHA) Regulations

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures.

1. Complete fabrication and erection drawings of all metal work specified herein.

2. Other submittals as required in accordance with Section 05010, Metal Materials and Section 05050, Metal Fastening.

PART 2 -- PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for handrails and railings shall conform to Section 05010, Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used in handrails and railings shall conform to Section 05050, Metal Fastening, unless noted otherwise.

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2.03 HANDRAILS AND RAILINGS

A. General - Handrail systems shall consist of all railings, posts, toeboards, baseplates, anchors, and accessories required for a complete and rigid installation.

1. All handrail systems shall be fabricated from extruded aluminum alloy 6061-T6 or 6105-T5, with Aluminum Association M12C22A41 finish, unless otherwise noted.

2. Metal railings shall be fabricated from 1-1/2 inch Schedule 40 pipe. Metal railing support posts shall be fabricated from 1-1/2 inch Schedule 80 pipe.

3. The centerline of the top guard rail shall be 42 inches above the walking surface for level rail. For stair rail, the centerline of the top guard rail shall be 42 inches above the leading edge of the tread nosing. Stair handrail shall be 34 inches above the leading edge of the tread nosing.

4. Posts

   a. Maximum horizontal spacing between posts for level rail shall be six feet.

   b. Maximum horizontal spacing between posts for stair rail shall be five feet.

5. All rail joints shall be finished flush and shall occur only at supports. Posts shall not interrupt the continuation of the top rail at any point along the railing, including corners and end terminations. The top surface of the top railing shall be smooth and shall not be interrupted by projecting fittings.

6. Toeboards

   a. Toeboards shall project 4-inches above the walking surface and shall not infringe on the minimum required walkway width.

   b. Aluminum toeboards shall be extruded from aluminum alloy 6063-T6 unless otherwise noted.

   c. Toeboards shall have a minimum thickness of 1/8" at any point. Geometry of toeboard shall closely resemble geometry shown on Drawings.

7. Expansion joint splices shall be provided at 30 foot maximum spacing and at all expansion joints in the structure supporting the handrail.

8. The handrail system shall be designed to resist the design loads specified by both OSHA and the Virginia Uniform Statewide Building Code.

9. Provide handrail extensions at top and bottom of stairs and ramps in accordance with the Virginia Uniform Statewide Building Code.

B. For metal handrail, the Design/Builder shall have the option of providing a handrail system of either an all welded type construction or a component type construction.

1. With both the all welded or component type construction, the baseplates and toeboards shall be furnished as shown on the Drawings.

2. Component Type System

   a. All fittings and brackets shall be designed for stainless steel concealed set screws with internal tyne type connectors.

   b. Exposed fittings shall be cast or extruded aluminum, or stainless steel to match ladder material, except where corrosion-resistant steel is employed as a standard fabricator's item for use.

   c. Component type handrail shall be as manufactured by Thompson Fabricating Company, Inc., Golden Railings, Inc., Hollaender Manufacturing Company, Inc or approved equal.

3. Welded handrail may be field assembled using component type fittings as described herein.

C. Handrail shall be either Type I or Type II handrail as shown on the Drawings. If no type is indicated on Drawings, handrail shall be Type I.

1. Type I handrail shall be a two-rail system. The centerline of the intermediate rail shall be 21 inches above the walking surface.

2. Type II handrail shall be a three-rail system with vertical posts spanning between the two intermediate rails.

   a. The centerline of the lower intermediate rail shall be 7 inches above the walking surface.

   b. The centerline of the upper intermediate rail shall be 5-3/4" below the centerline of the top rail.

   c. Vertical posts spanning between the intermediate rails shall be 1/2" diameter schedule 40 pipe or fiberglass rod.

   d. Spacing of vertical posts shall be as required to prevent passage of a 4-inch sphere at any point.

D. Where gates are required in handrails as shown on the Drawings, they shall be self-closing and shall be provided by the same manufacturer as the handrail. Gates shall swing away from the opening being protected by the handrail.

E. Where safety chains are required in handrails as shown on the Drawings, chains shall be constructed of Type 304 stainless steel. Chains shall be straight link style, 3/16-inch diameter, with at least twelve links per foot, and with snap hooks on each end. Snap hooks shall be boat type and eye bolts for attachment of chains shall be 3/8-inch bolts with 3/4-inch eye diameter welded to the railing posts. Two (2) chains, four inches longer than the anchorage spacing shall be supplied for each guarded area.

2.04 FREE STANDING RAILING SYSTEM

A. Free standing railing system shall be installed on roof ledges where accessible equipment is provided on roof and roof does not have a perimeter parapet wall of a minimum height of 42 inches. Free standing railing system shall be Safety Rail 2000 Guardrail System by BlueWater Mfg., Inc. or approved equal.

B. Toe Board brackets shall be used when the parapet wall is less than 3-1/2” in height.

C. Performance Characteristics: Shall meet and exceed OSHA (Standards - 29 CFR) 1926.502 (b).

1. Railing System shall be designed to withstand a minimum 200 pounds of test load in any direction.

2. Railing System shall consist of a top rail and rail at mid height between top rail and walking surface.

3. Railing system shall extend to a height of at least 42" from the finished roof deck.

4. Railing system shall be free of sharp edges and snag points.

D. Railing and Base

1. Rail shall be 1 5/8” O.D. Hot Rolled Pickled Electric Weld Tubing

2. Each support post shall have a free standing base cast from Class 30 Gray Iron material.

3. Each base shall have four (4) receiver posts for accepting the rails.

4. The receiver posts shall have a positive locking system. A friction locking system will not be acceptable.

5. The receiver posts shall have a slot to enable the rails to be mounted in any direction.

E. Hardware

1. The securing pins shall be made from 1010 carbon steel. The pins shall be zinc plated and yellow chromate dipped. The pins shall consist of a collared pin and a lanyard that connects to a lynch pin.

2. For Gate Assemblies Only. Bolts and washers shall be 3/8" x 3 ½" and 3/8" x 3" grade 5, zinc plated.

3. Finish: Rails: Specify factory finish Safety Yellow Powder Coat Paint, Hot Dipped Galvanized or a color to match the building.

Bases: Specify factory finish Safety Yellow Powder Coat Paint, Hot Dipped Galvanized or a color to match the building.

PART 3 -- EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Design/Builder prior to fabrication. Such verification shall include coordination with all adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. Concrete anchors and bolts for attachment of handrail baseplates to supporting members shall conform to Section 05050, Metal Fastening.

G. All fabricated items shall be shop painted in accordance with Section 09900, Painting.

3.02 INSTALLATION

A. Assembly and installation of handrails and railings shall be performed in strict accordance with manufacturer's recommendations.

B. All handrails and railings shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

- END OF SECTION -

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SECTION 05531

GRATINGS, ACCESS HATCHES, AND ACCESS DOORS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all gratings, floor plates, and hatches in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05010 - Metal Materials

B. Section 05035 - Galvanizing

C. Section 05050 - Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available.

1. Virginia Uniform Statewide Building Code

2. Aluminum Association Specifications for Aluminum Structures

3. Occupational Safety and Health Administration (OSHA) Regulations

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures.

1. Complete fabrication and erection Drawings of all gratings, access hatches, and access doors specified herein.

2. Other submittals as required in accordance with Section 05010, Metal Materials, and Section 05050, Metal Fastening.

PART 2 -- PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for gratings, floor plates, and hatches shall conform to Section 05010, Metal Materials, unless noted otherwise.

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2.02 METAL FASTENING

A. All welds and fasteners used for gratings, floor plates, and hatches shall conform to Section 05050, Metal Fastening, unless noted otherwise.

2.03 GRATING

A. General - Grating, including support frames, fastenings, and all necessary appurtenances for a complete installation, shall be furnished as indicated on the Drawings.

1. All exposed bearing ends of grating shall be enclosed in a perimeter band of the same dimensions and material as the main bars, including ends at all cutouts.

2. Grating shall be fabricated into easily removable sections and shall be fastened at each corner and as required with fasteners provided by the grating manufacturer. No fasteners shall be permitted to project above the walking surface.

3. Grating shall be designed for a loading of 150 psf unless otherwise required by the Drawings. Grating deflection shall not exceed 1/4 inch under a uniform load of 100 psf. Minimum grating depth shall be 1-1/2 inches, unless structural requirements based on clear span require more depth.

4. Grating installed in cast-in-place concrete shall be provided with embedded support frames on all perimeter and bearing edges. Support frames shall include anchor straps or headed studs at a maximum of 18” on-center, a minimum of two each side. Support frames shall be fabricated from the same material as the grating.

B. Aluminum Grating

1. Aluminum grating shall be of I-bar type and shall consist of extruded bearing bars positioned and locked by crossbars. All supports, cross members, etc. shall be aluminum. Plank clips for grating holddowns or other required attachments, shall be aluminum or stainless steel. Bolts shall be stainless steel. Provide embedded aluminum support frames for cast-in-place concrete installations.

2. Grating shall be “IB” by Harsco Industrial IKG, “I-Bar 19SGI4", by Ohio Grating Inc., or “I-Bar” by Thompson Fabricating LLC.

C. Aluminum Plank Grating

1. Aluminum plank grating shall be unpunched planks of extruded aluminum welded together to form panels. Panel ends shall have an extruded aluminum end bar welded in place. All support members shall be aluminum. Plank clips for grating holddowns or other required attachments, shall be aluminum or stainless steel. Bolts shall be stainless steel. Provide embedded aluminum support frames for cast-in-place concrete installations.

2. Aluminum plank grating shall be HD-P manufactured by Harsco Industrial IKG., Heavy Duty Series manufactured by Ohio Gratings, Inc., or Unpunched Duo-Grip Extruded Series manufactured by Alabama Metal Industries Corporation (AMICO).

D. Aluminum Close Mesh Grating

1. Aluminmum close mesh grating shall conform to the requirements of Aluminum Grating. Additionally, aluminum close mesh grating shall conform to ADA Accessibility Guidelines.

2. Grating shall be CM series by Harsco Industrial IKG, SG series, by Ohio Grating Inc., or Close Mesh by McNichols.

E. Heavy Duty Steel Grating

1. Heavy duty steel grating shall be galvanized according to Section 05035, Galvanizing.

2. Main bearing bars shall conform to ASTM A36. Cross bars shall be flush with the top of the grating. Provide embedded galvanized steel support frames for cast-in-place concrete installations.

3. Grating span shall be 36 inches maximum and shall satisfy AASHTO loading for H-20 truck.

4. Grating shall be manufactured by Harsco Industrial IKG, Alabama Metal Industries Corporation (AMICO), and Ohio Gratings, Inc.

2.04 ACCESS HATCHES

A. Access hatches shall be aluminum unless noted otherwise.

B. All access hatches shall be checker plate with an approved raised pattern, non-skid surface.

C. Access hatches shall be designed to carry a minimum live load of 150 psf, or a concentrated load of 300 pounds at the center, whichever produces the greatest stress.

D. Access hatches shall not exceed an allowable fiber stress of 16,000 psi. Live load deflection shall be limited to L/240 of the span, but not more than 1/4-inch.

E. All access hatches shall be fabricated from 1/4" plate, minimum and shall be stiffened as required to maintain allowable stress and deflection requirements specified herein. Stiffeners shall consist of angles or bars welded to the bottom of the plate.

F. Hinges, where indicated on the Drawings, shall be insulated, heavy-duty, cadmium plated bronze with stainless steel pins and fasteners.

G. All access hatches as indicated on the Drawings shall be provided with recessed handles. Handle material shall be as shown on the Contract Drawings.

H. Air-tight and water-tight access hatches shall be provided with a 1/8 inch thick neoprene gasket between the checkered plate and the support frame. Gasket material shall be bonded to the support frame and access hatches shall be bolted to the structural support frame with countersunk stainless steel flathead screws.

2.05 ACCESS DOORS

A. General

1. Door opening sizes, number and direction of swing of door leaves, and locations shall be as shown on the Drawings. The Drawings shall indicate the clear opening dimensions.

2. All doors shall be aluminum unless otherwise noted.

3. Openings larger than 42 inches in either direction shall have double leaf doors.

4. Doors shall be designed for flush mounting and for easy opening from both inside and outside.

5. All doors shall be provided with an automatic hold-open arm with release handle.

6. Double leaf doors shall be provided with safety bars to go across the open sides of the door, when in the open position. Brackets shall be provided on the underside of the doors to hold the safety bars when not in use.

7. All hardware, including but not limited to, all parts of the latch and lifting mechanism assemblies, hold open arms and guides, brackets, hinges, springs, pins, and fasteners shall be stainless steel.

8. All doors shall be watertight with a continuous gasket. All single door applications shall include a continuous EPDM odor reduction gasket.

9. Door frames shall be extruded and equipped with a 1-1/2 inch minimum drain pipe located by the manufacturer. The drain pipe shall be provided by the Design/Builder and shall extend to the nearest point of discharge acceptable to the Engineer.

B. Floor, Wet Well and Dry Pit Access Doors

1. Door leaves shall be 1/4 inch, minimum, diamond pattern plate with an approved raised pattern, non-skid surface. Plate shall be stiffened as required to maintain allowable stress and deflection requirements. Stiffeners shall consist of angles or bars welded to the bottom of plate.

2. Doors shall be designed for a 300 psf live load minimum, unless noted otherwise.

3. Doors shall be designed for flush mounting and for easy opening from both inside and outside.

4. All doors shall have an enclosed compression spring assist and open to 90 degrees.

5. Exterior doors shall be Type "J-AL" or "JD-AL", by Bilco Company, Type ”W1S” or “W2S” by Halliday Products Inc., Type "TPS" or "TPD", by U.S.F. Fabrication Inc., Type "THG" or "THG-D", by Thompson Fabricating LLC.

6. Interior doors shall be Type "K" or "KD", by Bilco Company, Type "S1S" or "S2S" by Halliday Products Inc., Type "APS300" or "APD300", by U.S.F. Fabrication Inc., Type "TH" or "TH-D", by Thompson Fabricating LLC.

7. Doors rated for H-20 traffic loading shall be "JAL-HD" or "JDAL-HD" by the Bilco Company, Type "H1C" or "H2C" by Halliday Products, Inc., or Type "THS" or "THD" by U.S.F. Fabrication Inc.

C. Roof Access Hatch

1. Doors shall be designed for 50 psf live load unless noted otherwise.

2. Doors for ladder access shall be Bilco Type S. Coordinate installation with standing seam metal roof system.

D. Fixed Ladders

1. Where the Contract Documents indicate fixed ladders are required under access doors, they shall be provided with "LadderUp, Model LU-4" by Bilco Company, "L1E Ladder Extension" by Halliday Products Inc., or "Ladder Climb-out Device" by Thompson Fabricating.

2. The safety posts shall be manufactured of the same material as the access door with telescoping tubular sections that lock automatically when fully extended.

3. Upward and downward movement shall be controlled by a stainless steel balancing mechanism.

4. Safety posts shall be assembled in strict accordance with manufacturer's recommendations.

2.06 FALL THROUGH PREVENTION SYSTEM

A. All access hatches and access doors covering openings measuring 12 inches or more in its least dimension through which persons may fall shall be equipped with a fall through prevention system, except where noted on the Contract Drawings. Access hatches and access doors shall be provided with a permanent installed fall through prevention grate system that provides continuous safety assurance in both its closed and open positions. The grate system shall be made with 6061-T6 aluminum or FRP and be designed for a 300 psf minimum liveload, unless noted otherwise.

PART 3 -- EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Design/Builder prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05050, Metal Fastening. All fastenings shall be concealed where practicable.

3.02 INSTALLATION

A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

B. All gratings, access hatches, and access doors shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions. Embedded support frames shall be set level and square.

C. Grating shall not be field cut or modified unless approved by Engineer.

D. Grating shall not be used for equipment support or anchorage.

- END OF SECTION -

SECTION 05540

CASTINGS

PART 1 -- GENERAL

1.01 REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all castings in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02604 – Utility Structures

B. Section 05010 - Metal Materials

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available.

1. International Building Code
2. HRSD Standards and Preferences for Engineered Construction Projects
3. VDOT Road and Bridge Standards

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures.

1. Complete fabrication and erection drawings of all castings specified herein.

2. Other submittals as required in accordance with Section 05010, Metal Materials, and Section 05050, Metal Fastening.

PART 2 -- PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for castings shall conform to Section 05010, Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

A. All welds and fasteners used for castings shall conform to Section 05050, Metal Fastening, unless noted otherwise.

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2.03 IRON CASTINGS

A. General - Iron Castings shall include, but not be limited to frames, covers, valve boxes, and risers, grates for trench drains, catch basins, and inlets/.

1. Castings shall be of gray iron of uniform quality, free from defects, smooth and well cleaned by shotblasting.

2. Castings for drainage structures shall conform to VDOT standards.

3. Manhole Frames and Covers, Air Vent Frames and Covers, and Valve Boxes and Risers Shall conform to HRSD Standards and Preferences for Engineered Construction Projects.

3. Castings shall be as manufactured by Dewey Brothers, Neenah Foundry Company or equal.

B. Covers and Grates

1. Covers and grates shall be provided with matching frames. Cover shall fit flush with the surrounding finished surface. The cover shall not rock or rattle when loading is applied.

2. Round covers and frames shall have machined bearing surfaces.

3. Design loadings:

a. Where located within a structure, a minimum design loading of 300 psf shall be used, unless noted otherwise.

b. At all locations not within a structure, the design loading shall be a standard AASHTO H-20 truck loading, unless otherwise noted.

C. Watertight gasketing, bolting, locking devices, patterns, lettering, pickholes, vents, or self-sealing features shall be as detailed on the Drawings.

PART 3 -- EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Design/Builder prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

C. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

3.02 INSTALLATION

A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

B. All castings shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

- END OF SECTION -

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SECTION 05550

STAIR TREADS AND NOSINGS

PART 1 -- GENERAL

1.01 REQUIREMENT

A. Furnish all materials, labor, and equipment required to provide all stair treads and nosings in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05010 - Metal Materials

B. Section 05050 - Metal Fastening

C. Section 05510 - Metal Stairs

D. Section 06610 - Glass Fiber and Resin Fabrications

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue.

1. Virginia Uniform Statewide Building Code

2. Aluminum Association Specifications for Aluminum Structures.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, Submittal Procedures.

1. Complete fabrication and erection drawings of all work specified herein.

2. Other submittals as required in accordance with Section 05010, Metal Materials, and Section 05050, Metal Fastening.

PART 2 -- PRODUCTS

2.01 METAL MATERIALS

A. Metal materials used for stair treads and nosings shall conform to Section 05010, Metal Materials, unless noted otherwise.

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2.02 METAL FASTENING

A. All welds and fasteners used for stair treads and nosings shall conform to Section 05050, Metal Fastening, unless noted otherwise.

2.03 SAFETY STAIR NOSINGS

A. Abrasive cast aluminum, safety stair nosings shall be provided on all concrete or concrete filled steel pan stairs, including the top stair of metal stairs that attach to concrete, and as shown on the Drawings unless noted otherwise.

B. Nosing shall be 3 inches wide and shall extend the full width of the stairway minus 3 inches on either side. Nosing shall be cast into the concrete and held in place with butterfly type extruded anchors.

C. The nosing shall be "Style 231-A", by Amstep Products, “Alumogrit Type 101", by Wooster Products, Inc., "Type AX", by Safe-T-Metal Company. For steel pan concrete filled stairs, nosing shall be "Type 101-SP", Wooster Products, Inc., or "Type AXPE", by Safe-T-Metal Company. For pan stairs, nosing shall be continuous over corner of stair treads to fully protect corner of treads from abrasion. All exposed fasteners shall be Type 304 stainless steel.

2.04 STAIR TREADS

A. Stair treads shall be aluminum with an abrasive nosing as shown on the Drawings.

B. Stair treads shall be designed for the live load specified in Section 05510, Metal Stairs.

C. Stair treads shall be as manufactured by IKG Industries, or Safe-T-Metal Company.

2.05 FRP STAIR NOSINGS

A. FRP stair nosings shall be provided on all concrete stairs as indicated on the Drawings.

B. FRP stair nosings shall conform to Section 06610, Glass Fiber and Resin Fabrications as indicated on the Drawings.

C. FRP stair nosings shall be manufactured from vinyl ester resin.

2.06 FRP STAIR TREADS

A. FRP stair treads shall be provided for FRP stairs in sodium hypochlorite areas and as indicated on the Drawings.

B. FRP stair treads shall conform to Section 06610, Glass Fiber and Resin Fabrications.

PART 3 -- EXECUTION

3.01 FABRICATION

A. All measurements and dimensions shall be based on field conditions and shall be verified by the Design/Builder prior to fabrication. Such verification shall include coordination with adjoining work.

B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, connections, brackets, and other details necessary for a complete installation shall be provided.

C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

D. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.

E. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05050, Metal Fastening. All fastenings shall be concealed where practicable.

3.02 INSTALLATION

A. Assembly and installation of stair treads and nosings shall be performed in strict accordance with manufacturer's recommendations.

B. All stair treads and nosings shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

- END OF SECTION -

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SECTION 06100

ROUGH CARPENTRY

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on the Drawings and specified herein.

B. Principal items of work include:

1. Wood blocking, nailers, grounds, furring, ties, centering, etc., necessary or required for attachment or support of work under this Section, and other Sections.

2. Fasteners, including nails, screws, bolts, anchors and other fastenings, required to secure work under this Section.

3. Temporary enclosures and protective boarding.

4. Wood preservative treatment for all wood members in contact with roofing, masonry, concrete, and exposed to the elements.

5. Source wood products from verifiable sustainable sources.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of these specifications Work shall conform to the applicable requirements of the following documents:

1. AWPA-CA Preservative Standards, Lumber and Plywood.

2. AWPA-C20 Structural Lumber Fire-Retardant Treatment by Pressure Process.

3. AWPC-C27 Plywood Fire-Retardant Treatment by Pressure Process.

4. AWPA-M4 Standards for Care of Preservative Treated Wood Products.

5. APA Guide to Plywood Grades.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 30 00 Submittal Procedures, submit the following:

1. Certifications of Preservative and Fire Retardant Treatment.

2. Warranty of treatment manufacturer.

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3. Certification of type and grade of lumber to be used.

4. Certification of type, rating and conformance to APA Standards.

5. Certificates for a recognized national organization showing that wood is sourced from sustainable sources.

1.04 DELIVERY AND STORAGE

A. Take all measures necessary to protect products against damage during delivery and storage.

B. Store lumber in enclosed places in such a manner to provide ventilation and protection from the weather.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Blocking, nailers, grounds and the like: Southern Yellow Pine, Eastern Spruce, or Douglas Fir - No. 3 Dimension Lumber or Construction Grade, with a moisture content not to exceed 19%.

B. Plates, blocking, and nailers in contact with masonry: Pressure treated southern yellow pine.

C. Plywood: Identified with APA Grade trademarks of the American Plywood Association, in thickness as shown on the Drawings.

1. Exterior: AC-EXT-APA where exposed to view or a finish is required, CD-EXT-APA where concealed.

2. Interior: AC-INT-APA where exposed to view or a finish is required, CD-INT-APA where concealed.

D. Structural Framing Lumber: Douglas Fir No.1 grade with fb = 1,500 pounds per square inch and E = 1,700,000 pounds per square inch, 19 percent moisture content.

E. Fasteners: Provide clamps, connectors, straps, nails, bolts, screws, anchors, ties and other accessories and fasteners shown or required to properly secure all rough carpentry. Fasteners and accessories shall be stainless steel, galvanized, or other noncorrosive metal recommended for use.

F. Wood Preservative Treatment: Pressure treatment in conformance with the American Wood Preservers' Association Standard P5. Retention shall be in accordance with AWPA Standards and be a minimum of 0.40 pounds per cubic foot. Stamp each piece of treated wood with a trademark identifying the classification of the treatment or a certificate from the processor for each shipment.

G. Fire Retardant Treatment: Fire-retardant lumber and plywood must have an Underwriters Laboratories stamp signifying a FR-S rating and certifying a 25 or less flame spread and smoke developed value, when tested in accordance to UL 723, ASTM E 84, and NFPA 255 "Tunnel Test", and when the test is extended for 20 additional minutes. Treatment formulation shall contain no halogens, sulfates, chlorides or ammonium phosphate. Smoke toxicity shall be no more than that of untreated wood.

PART 3 -- EXECUTION

3.01 COORDINATION

A. Coordinate with all trades as to nailers, blocking, grounds and the like required for the attachment of their work and other items requiring same. Carry out all work as required to cooperate work of other trades.

3.02 INSTALLATION

A. Perform work in conformance manufacturer's recommendations and specifications, industry, national and local standards and codes.

B. Layout, cut, fit and erect rough blocking, nailers, furring and other rough carpentry. Do cutting work in connection with carpentry and finish for other trades. Brace plumb and level all members in true alignment and rigidly secure in place with sufficient nails, spikes, screws and bolts. Defects which render any piece or part unable to serve its intended purpose shall be discarded or, cut out and replaced.

C. Provide all bracing, supports and shoring required to support construction.

D. Protect all masonry including edges of concrete platforms and similar items. Remove protective covering when directed. Take special precautions at masonry openings and corners of the building.

E. Set all rough hardware, such as plates, spikes, bolts, nails, lag screws, lagging bolts, anchors, etc., as required to hold woodwork together or to anchor or secure it to other materials and construction.

F. Provide wood grounds, nailing strips and similar items wherever necessary or required throughout the project for the support, proper erection or installation of the work and support of mirrors, cabinets, shelf cleats, base and similar items. Thoroughly secure in place by approved means.

G. Secure wood grounds, nailing strips and similar items to metal plugs set in masonry, toggle or expansion bolts. Give the mason all necessary information to enable him to lay out correctly the location for metal wall plugs. Wood plugs will not be accepted.

H. Construct joints to support dead loads, live loads, snow loads, wind loads, or combinations in conformance with "National Design Specifications for Stress Grade Lumber and its Fastenings", recommended by National Forest Products Association.

I. Nailers and Blocking: Provide and secure wood nailers, blocking, for the reception of roof curbs, roofing, etc.

1. Provide nailers of sizes, shapes and profiles indicated on the Drawings or as required. Provide with anchors as indicated, recommended or required for secure attachment.

3.03 TEMPORARY PROTECTION

A. Provide and install all temporary protection in accordance with applicable provisions of the Contract Documents, OSHA regulations, and as follows:

1. Temporary protection shall include wood doors, railings, protection of floor or roof openings, temporary partitions, and the like; adequately maintained in good repair during the life of the Contract.

2. Furnish and set temporary partitions with wood doors at all exterior doorways, exterior openings or in locations exposed to weather. Substantially build and hang, with proper hinges, locks and other necessary hardware, and remove and reset whenever required to accommodate the Work and keep in good repair.

3. Provide substantial temporary wood covering or guards for openings left in floor or roof slabs for ducts, shafts, etc., using rough planking at least 2 inch thick, cleated together and otherwise made sufficiently strong and put in place wherever required immediately after the forms have been removed.

3.04 JOB CONDITIONS

A. If the installation of metal frames and glass does not promptly follow the completion of the exterior enclosures, and if the absence of enclosures would cause damage, close in all such openings temporarily by the use of heavy polyethylene plastic sheeting, or canvas stretched over and nailed to frames of 1 inch x 2 inch or heavier strips.

3.05 REMOVAL OF TEMPORARY WORK

A. Remove all temporary protection when so directed, or prior to acceptance of this project.

- END OF SECTION -

SECTION 06200

FINISH CARPENTRY

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

A. Furnish all labor, materials, equipment and appliances required for the complete execution of Work as shown on the Drawings and specified herein.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Architectural Woodwork Institute (AWI) -"Architectural Woodwork Quality Standards."

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 30 00 Submittal Procedures, submit the following:

1. Manufacturer's product data of hardware and plastic laminate.

2. Certification that woodwork manufacturer's work complies with the quality grades and other requirements indicated.

3. Solid surface materials. Each countertop may have a unique color as selected by Owner.

4. Provide plans, section, and elevations, drawn to scale, of architectural casework shop drawings showing the construction of all materials, dimensions, construction types, and plastic laminate types.

5. Provide certifications that wood is sourced from nationally recognized sustainable sources and that wood materials used do not use added urea-formaldehyde.

1.04 SHIPPING, HANDLING AND STORAGE

A. Protect finish carpentry during transit, delivery, storage, and handling to prevent damage, soiling, and deterioration.

B. Do not deliver woodwork, until painting, wet work, sanding, and other similar operations have been completed.

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PART 2 -- PRODUCTS

2.01 SOLID SURFACES

A. Acceptable Products and Manufacturers

1. Formica Solid Surfacing by Formica Corporation

2. Corian by DuPont Surfaces

3. Gibralter Solid Surfacing by Wilsonart International

4. Swanstone Solid Surface by Swann Corporation

B. Color and pattern shall be selected from manufacturer's standard color and patterns with a minimum of 32 choices.

C. Provide manufacturer's recommended low VOC adhesives and fillers.

D. Shop fabricate components to greatest extent possible. Form joints between components in accordance with manufacturer's recommendations with inconspicuous joints. Cut and finish component edges clean and sharp shapes shown on Drawings. Coordinate and provide all support required for complete and secure installation.

2.02 WOOD PRODUCTS

A. Particleboard: ANSI A-208.1, mat-formed, Grade 1-M-2 with minimum density of 45 pounds per cubic foot, internal bond of 60 psi; and a minimum screw holding capacity of 225 pounds on facades and 200 pounds on edges.

B. Plywood: APA INT with "A" face for all exposed surfaces.

C. Standing and Running Trim: Southern Yellow Pine, Grade clear.

D. Wood products shall be urea-formaldehyde free.

2.03 FASTENERS AND ANCHORAGES

A. Provide nails, screws, and other anchoring devices of the type, size, material, and finish required for the application indicated to provide secure attachment, concealed where possible, and complying with applicable standards and codes.

2.04 HARDWARE

A. Hinges: Concealed, 165 degree swing, self closing.

B. Pulls: 4", minimum, stainless steel. Finish to be US32D.

C. Drawer slides: Full extension, ball bearing, 100 pound capacity.

D. Shelf standards: Surface mounted, Model # 255 by K&V. Shelf clips, Model #256 by K&V.

2.05 CASEWORK

A. Construction Style: Flush Overlay.

B. Construction: Wood faced cabinets complying with AWI Section 400, and its Division 400A "Wood Cabinets", custom grade, with a clear maple with multi-coat water based polyurethane finish.

2.06 COUNTERTOPS

A. Exposed surfacing material: Solid Surfacing

B. Exposed surfacing material: Material shall be warrantied for a minimum of ten years against material defects. Each countertop may be selected with a unique color and pattern

C. Provide minimum 1" thickness. Edge shall be eased or profiles shown on drawings.

D. Coordinate installation with casework to ensure proper support. Coordinate all openings required with plumbing fixtures.

E. Provide steel supports, angles, and hardware required to support solid surfacing in accordance with manufacturer's requirements.

2.07 FINISHES

A. Exposed surfaces, including interior of cabinets and drawers, bottom and edges of shelves, etc. shall be filled and stained, sealed, and then two finish coats of clear varnish or polyurethane. Products shall comply with Federal, State and Local regulations for Volatile Organic Compounds (VOC) and Hazardous Air Pollutants (HAP) emissions limitations per the EPA Clean Air Act.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Use only sound, thoroughly seasoned, well manufactured materials of the congest practical lengths and sizes to minimize jointing. Use materials free from warp which cannot be easily corrected by anchoring and attachment. Sort out and discard warped material and material with either defects which would impair the quality of the work.

B. Securely attach carpentry to substrates by anchoring and fastening as shown, and as required by recognized standards.

C. Provide washers under bolt heads and nuts in contact with wood.

D. Nail plywood to comply with the recommendations of the American Plywood Association.

E. Countersink nail heads on exposed carpentry work and fill holes.

F. Set carpentry work accurately to required levels and lines with members plumb and true and accurately cut and fitted.

G. Shim with metal for full bearing on concrete, steel, or masonry substrates.

3.02 CASEWORK CONSTRUCTION

A. Construct casework without face frames and of hardwood plywood and edging. No exposed plywood edges will be accepted. All joinery and fastenings shall be concealed from view and meet accepted standards as endorsed by the Architectural Woodwork Institute.

B. Assembly casework square and install plumb, level, and true to the building structure. Scribe casework, as required to fit around columns, chases and other conditions.

C. Protect from damage before, during, and after installation. Damaged casework shall be removed and replaced with equivalent.

- END OF SECTION -

SECTION 06610

GLASS FIBER AND RESIN FABRICATIONS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Design/Builder shall furnish and install all fiberglass items as specified herein and as shown on the Drawings. The Design/Builder shall be responsible for the coordination with related work specified elsewhere and to provide all hardware, accessories and appurtenances required for a complete installation, including all fabrication and mounting hardware.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05050, Metal Fastening

B. Section 07900, Joint Fillers, Sealants, and Caulking

C. Section 09900, Painting

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available.

1. ASTM D2996 – Specification for Filament Sound Reinforced Thermosetting Resin Pipe

2. ASTM D3647 - Standard Practice for Classifying Reinforced Plastic Pultruded Shapes According to Composition

3. ASTM D3917 - Standard Specification for Dimensional Tolerances of Thermosetting Glass - Reinforced Plastic Pultruded Shapes

4. ASTM D4385 - Standard Practice for Classifying Visual Defects in Thermosetting Reinforced Plastic Pultruded Products

1.04 SUBMITTALS

A. The Design/Builder shall submit shop drawings showing fabrication details and a Performance Affidavit for all items specified herein in accordance with Section 01 30 00 Submittal Procedures and Section 11000, Equipment General Provisions.

B. Certification of compliance with ASTM Standards.

C. Where specifically requested, design calculations sealed by a currently Registered Professional Engineer in the Commonwealth of Virginia.

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1.05 QUALITY ASSURANCE

A. All fiberglass items of the same type provided shall be the products of a single manufacturer for compatibility.

B. It shall be the Design/Builder's responsibility to ensure that the fiberglass items and appurtenances furnished shall be compatible and have the necessary operating clearances with the structural elements and equipment shown on the Drawings.

C. Manufacturer shall provide a one (1) year warranty on all FRP products against defect in material and workmanship.

PART 2 -- MATERIALS

2.01 GENERAL

A. The manufacturer shall maintain a continuous quality control program and shall, upon request, furnish the Engineer with certified test reports consisting of physical tests of samples.

B. Ultraviolet light resistive resins shall be used for all exterior locations and where specified.

C. All FRP resins shall be flame resistant and shall meet the requirements of ASTM D 635 and ASTM E 84, Class 1 with a maximum flame spread rating of 25.

D. All edges shall be sealed in the mold where possible. Machined or cut edges shall be sealed with a compatible resin system.

2.02 GRATING AND TREADS

A. Fiberglass grating and treads shall be furnished and installed in areas shown on the Drawings including all FRP angle supports, fasteners and accessories. Gratings and treads shall consist of extruded bearing bars positioned and locked by crossbars. Grating and treads shall be installed in accordance with the manufacturer's recommendations.

B. Grating shall be fabricated into easily removable sections as large as possible up to 150 lbs. per section.

C. Fasteners shall not project above the walking surface.

D. Fiberglass grating and treads shall be manufactured of vinyl ester resin. Grating and treads shall be produced by IKG Industries, Fibergrate, Inc., IMCO Reinforced Plastics, Inc., or equal.

E. Grating shall be designed for a uniform loading of 100 PSF over the gross projected area with deflection limited to 0.375” or grating span/240 whichever is less. Fiberglass or PVC support beams shall be provided as required to meet deflection criteria.

F. The grating and tread supplier shall supply all shelf support angles, embedded angles with anchors, concrete anchors and necessary 316 stainless steel grating clips coated with epoxy paint per Section 09900, Painting, for a complete system.

G. Treads shall be designed for a 300 lb. concentrated load at midspan. Treads shall be furnished with integral nosing.

2.03 FIXED LADDERS

A. The Design/Builder shall provide fixed ladder systems with all safety cages, landings, mounting clips, fasteners, and necessary appurtenances for a complete and rigid installation.

B. The ladder systems shall be designed to meet or exceed all OSHA requirements.

C. Ladders and cages shall be fabricated from pultruded shapes conforming to vinyl ester resin. Shapes shall be manufactured by Strongwell, Inc., or equal.

D. Ladder side rails shall be fabricated from channel members or 1-3/4 inch minimum square tube.

E. Side rails shall be anchored with FRP standoff clips manufactured of vinyl ester resin. Clips shall be placed at the top and bottom of the ladder and at 6 foot maximum vertical centers.

F. Rungs

1. Rungs shall be 18 inches long, serrated and covered with a silica grit to produce and ant-skid surface.

2. Rungs shall be uniformly spaced at 12 inches on center.

3. Rungs shall be designed to support a 1,200 pound vertical load applied at midspan.

4. Rungs shall be both mechanically attached and epoxy bonded to the side rails.

G. Fall prevention system and anti-climb guard shall be as specified in Section 05515, Ladders.

2.04 CONNECTIONS

A. All connections shall be non-corrosive, non-staining, and concealed where practicable, as detailed on the Drawings or specified herein.

B. Fiberglass fasteners shall be "Fibrebolt", as manufactured by Strongwell, Inc., or equal.

C. All metal fasteners shall be Type 316 stainless steel, except for sodium hypochlorite applications, Hastelloy C-276 shall be used unless noted otherwise.

D. Holes for bolts and screws shall be drilled.

E. Joints exposed to weather shall be formed to exclude water.

F. Design and installation of fiberglass items shall provide for expansion and contraction, prevent shearing of bolts, screws and other fastenings, and provide close fitting of sections.

2.05 STRUCTURAL SHAPES AND FLAT SHEETS

A. Shapes shall conform to sizes indicated on Drawings and shall be vinyl ester resin . Shapes shall be manufactured by Strongwell, Inc., or equal.

B. Metal bolted connections shall be made with stainless steel bolts except for sodium hypochlorite applications where Hastelloy C bolts shall be used. Bolts shall conform to Section 05050, Metal Fastening.

C. Adhesive bonded connections shall be made with a compatible epoxy adhesive following manufacturer's instructions. Adhesive bonded connections shall only be used where bolted connections are not feasible.

2.06 FRP HANDRAIL

A. Fiberglass reinforced plastic (FRP) handrail system shall be designed by the Design/Builder to meet or exceed OSHA requirements with a minimum safety factor equal to 2, and shall be furnished and installed as shown on the Contract Drawings. All rails, posts, kick plates, base plates, fasteners, and necessary appurtenances for a complete and rigid installation shall be provided and installed per manufacturer's recommendations. Handrail systems shall be manufactured by Strongwell, Inc., Bristol, VA, R.W. Fowler Company, Atlantic Beach, FL, IMCO Reinforced Plastics, Inc., Moorestown, NJ, or equal.

B. The handrail system shall consist of pultruded fiberglass shapes of vinyl ester resin manufactured with the following minimum properties:

Properties	Test Method	Value
Tensile Stress	ASTM D638	30,000 psi
Tensile Modulus	ASTM D638	2.5×10^6 psi
Compressive Strength	ASTM D695	30,000 psi
Compressive Modulus	ASTM D695	2.5×10^6 psi
Flexural Stress	ASTM D790	30,000 psi
Flexural Modulus	ASTM D790	2.0×10^6 psi
Shear Stress	ASTM D2344	4,500 psi
Density	ASTM D792	.070 lbs/in^3
24 hr. Water Absorption	ASTM D570	0.6% max
Coeff. of Thermal Expansion	ASTM D696	6×10^6 in/in/EF
Barcol Hardness		50

C. The handrail system shall have two (2) rails, unless otherwise noted on the Contract Drawings, with the top rail located 42 inches above the walking surface. Rails shall be 1-3/4" minimum square tubing and posts shall be 2" minimum square tubing with internal fittings for all connections. Kick plates shall be provided where required by OSHA. All rail and kick plate corner joints shall be mitered at a 45° angle and securely fastened to posts. Maximum horizontal spacing between posts shall be 4 feet. For stair rail, the top rail shall be not less than 34 inches nor more than 38 inches above the leading edge of the stair tread.

D. Handrails shall be erected with true horizontal and vertical alignment and shall be smooth and free of surface defects. All cut edges and holes shall be sealed with a compatible resin system.

PART 3 -- EXECUTION

3.01 FABRICATION

A. All cut edges and holes shall be sealed with a compatible resin.

B. All FRP items shall conform to the dimensions indicated on the Drawings.

C. All fiberglass items described in this Section shall be supplied by a manufacturer that normally fabricates such items so that appearance and quality control are first class.

3.02 HANDLING, TRANSPORTING, AND STORING

A. All FRP items shall be properly packed, labeled and stored in accordance with Divisions 1 and 11.

3.03 INSTALLATION

A. Installation of all items shall be according to manufacturer's instructions, unless otherwise noted.

B. Exposed threads of FRP bolts shall be sealed with a compatible resin after installation of the bolts. Where bolts are attaching removable items, the exposed threads shall be sealed with a light coat of polyurethane sprayed onto the threads.

- END OF SECTION -

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SECTION 07100

WATERPROOFING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, materials, equipment and appliances required for the complete execution of the Work as shown on the Drawings and specified herein.

B. Principal items of work include:

1. Crystalline waterproofing vertical walls below grade where interior is dry including trenches and containment areas and the valve vault of the GAC and Drain Pump Station.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03300 - Cast-in-Place Concrete

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 30 00 Submittal Procedures, submit the following:

1. Manufacturers product literature, specification data sheets and installation instructions.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's unopened containers identified with name, brand, type, grade, class and all other qualifying information.

B. Store materials in dry location, in such manner as to prevent damage or intrusion of foreign matter. Conspicuously mark "Rejected" on materials which have been damaged and remove from the job site.

PART 2 -- PRODUCTS

2.01 CRYSTALLINE WATERPROOFING

A. Crystalline Waterproofing: Concrete waterproofing material of the cementitious crystalline type that chemically and permanently fixes non-soluble crystalline growth throughout the capillary voids of the concrete. Apply at a rate of 2 lbs./sq. yd. Apply second coat while first coat is still green. Crystalline waterproofing shall be as manufactured by Xypex Chemical Corporation, Vandex, HEY'DI K11 by Tamms, or equal.

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PART 3 -- EXECUTION

3.01 EXAMINATION OF SURFACES

A. Examine all surfaces and installation of work done by other trades.

B. Coordinate all work under this Section with contiguous work of other trades.

3.02 APPLICATION

A. Crystalline waterproofing shall be applied to "green" or existing concrete which has been thoroughly saturated with clean water. Prepare surfaces in strict accordance with manufacturer's recommendations and instructions. Mix and apply in accordance with manufacturer's literature.

- END OF SECTION -

SECTION 07190

VAPOR BARRIER

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, material, equipment and appliances required for complete execution of Work.

B. Principal items of work include:

1. Vapor barrier below structural slabs on grade.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03300 - Cast-in-Place Concrete

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 30 00 Submittal Procedures, submit the following:

1. Manufacturer's data and installation instructions.

PART 2 -- PRODUCTS

2.01 VAPOR BARRIER

A. Vapor Barrier: A reinforced laminate membrane with a minimum tensile strength of 75 lbs/in. in accordance with ASTM D-882, vapor transmission rating of 0.02 perms in accordance with E-96, and a puncture resistance of 25 lbs in accordance with ASTM D-4833.

B. Adhesive/Tape: Type approved by the Manufacturer of the vapor material.

C. Penetration sealing: Provide manufacturer’s recommended penetration seals at all pipe, conduit, and similar penetrations.

2.02 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:

1. Viper Vapercheck 10 by Insulation Solutions, Inc.

2. Griffolyn Type-85, by Reef Industries, Inc.

3. Or Equal

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PART 3 -- EXECUTION

3.01 VAPOR BARRIER

A. Vapor barrier shall be placed on top of 4 inches minimum of compacted structural fill stone, free of debris and protrusions for structural slabs.

B. Lap edges 12 inches and seal with adhesive tape. Lay with seams perpendicular to and lapped in the direction of placement. Do not penetrate vapor barrier.

C. Protect from damage until concrete is placed. Punctures and tears in vapor barrier shall be repaired using patches of the material which overlaps puncture or tear a minimum of 12 inches; seal with tape or adhesive.

D. Penetrations through vapor barrier, such as pipe, drains, conduits and similar penetrations, shall be sealed in strict accordance with manufacturer's recommended instructions.

- END OF SECTION -

SECTION 07210

BUILDING INSULATION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for complete execution of Work as shown on Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03300 - Cast-in-Place Concrete

B. Section 09260 - Gypsum Drywall Systems

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of these specifications Work shall conform to applicable requirements of the following documents:

1.	HH-I-526C	Insulation Board, Thermal (Mineral Fiber).
2.	HH-I-1972/1	Insulation Board, Thermal, Polyurethane or Polyisocyanurate, Faced with Aluminum Foil On one side.
3.	TT-S-001657	Sealing Compound Single Component, Butyl Rubber Based, Solvent Release Type (For Buildings and other Types of Construction).
4.	ASTM C 665	Specification for Mineral fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 30 00 Submittal Procedures, submit the following:

1. Manufacturer's literature, specifications, installation instructions, technical data, and general recommendations.

2. Samples of each type of insulation specified.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in unopened, undamaged original packaging with bearing the manufacturer's name.

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B. Store materials in clean, dry, protected areas. Do not leave materials exposed to the weather or sunlight, except to the extent necessary to perform the work.

C. Protect against ignition.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the requirements, provide products as manufactured by the following:

1. Manufacturers of Extruded Polystyrene Board Insulation

    a. Amoco Foam Products Company

    b. Dow Chemical U.S.A.

    c. UC Industries

2. Manufacturers of Glass Fiber Insulation

    a. CertainTeed Corporation

    b. Manville Corporation

    c. Owens-Corning Fiberglass Corporation

3. Manufacturers of Polyisocyanurate Foam Insulation

    a. Apache Products Company.

    b. Atlas Energy Products.

    c. The Celotex Corporation.

4. Manufacturers of Sprayed Polyurethane Foam (Gap Sealant):

    a. The Dow Company
    b. Or approved equal

2.02 MATERIALS

A. Acoustical Batt Insulation: Unfaced faced, fiberglass acoustical insulation depth of metal studs. Provide batts friction fit between walls of office adjoining offices, bathroom walls, and lobby walls.

B. Under Slab and Foundation Wall Insulation: Expanded polystyrene extruded into 2 inch thick boards as indicated on Drawings. Provide insulation conforming to the requirements of ASTM C 578, Type IV; with a 5 year aged R-value of 5.

C. Roof Insulation: Provide a minimum of 5" polyisocyanurate insulation. Provide a minimum of two staggered layers, unless otherwise indicated. Provide tapered insulation where roof structure does not slope. Roof insulation shall be approved by roofing manufacturer in accordance with the requirements of the roofing warranty. Roof insulation shall meet the requirements of a UL Class A and FM Class 1 roof. Insulation shall have an aged R-value of 5 per inch. Secure insulation as required by the roofing manufacturer to resist wind speeds as indicated in the roofing specification. Install ½" glass faced gypsum board where insulation is installed over metal deck.

D. Mineral Wool Batt Insulation: Semi-rigid boards for use as fire stop. Materials shall conform to requirements of UL penetration systems. Mineral wool material shall meet the requirements of ASTM E-136.

E. Adhesive and Fasteners: Type compatible with insulation, masonry, concrete, or other substrate and as recommended or produced by the insulation manufacturer.

F. Sealer and Tape: Type recommended by insulation manufacturer and having perm rating and fire resistance characteristics similar to that of the insulation.

G. Gap Sealant: General Purpose Type: single-component polyurethane sealant. Gun-applied and Straw-applied products, Thermal Value R3.5 per inch. Provide GREATSTUFF PRO™ Gaps & Cracks Insulating Foam Sealant as manufactured by The Dow Chemical Company or approved equal. Provide Substrate Cleaner as recommended by foam sealer manufacturer.

PART 3 -- EXECUTION

3.01 GENERAL

A. Insulation shall be provided in walls, slabs and ceilings and where shown on Drawings.

3.02 INSTALLATION OF INSULATION

A. Install in accordance with the manufacturer's printed installation instructions to provide maximum sound and thermal benefits for material specified. Install to fill or cover voids. Cut neatly to snugly fit angles, corners and irregular areas and carefully wrapped around pipes, conduits, outlets, switches, beams, etc., to maintain continuity of insulation. Avoid gaps or bridges.

B. Foundation and Under-Slab Insulation

1. On vertical surfaces, set units in adhesive applied in accordance with manufacturer's instructions. Stagger vertical joints, except ends over line of expansion joints.

2. On horizontal surfaces, set units level, unless otherwise noted.

C. Acoustical Batt Insulation: Friction fit between metal studs. Follow manufacturer's recommendations and instructions.

D. Roofing Insulation: Install roofing insulation in accordance with insulation and roofing manufacturer printed instructions and recommendations.

E. Mineral Wool Batt Insulation: Install insulation in accordance with UL design requirements and in accordance with manufacturer's recommendations. Provide at edge of second floor slab and metal wall panels.

F. Gap Sealant: Seal all gaps at perimeter of walls and penetrations and openings. Install in strict accordance with manufacturer's recommendations. Provide pre-finished sheet metal cover where exposed. Color shall match adjacent surfaces. Cut smooth and cover. Gap sealant shall not be exposed.

3.03 ADJUSTMENT AND CLEANING

A. Adequately protect Work from damage resulting from subsequent construction operations. Replace damaged or soiled Work.

- END OF SECTION -

SECTION 07270

FIRESTOPPING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, materials and equipment required to complete the installation of troweled or gun applied firestopping as indicated on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Division 15 - Mechanical

B. Division 16 - Electrical

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of these specifications Work shall conform to the applicable requirements of the following documents:

1.	ASTM E84	Test Method for Surface Burning Characteristics of Building Materials.
2.	ASTM E119	Method for Fire Tests of Building Construction and Materials.
3.	ASTM E814	Test Method of Fire Tests of Through- Penetration Firestops.
4.	ASTM E 1966	Standard Test Method for Five Resistive Joint Systems.
5.	UL-01	Building Materials Directory.
6.	Ul-1479	Fire Test of Through-Penetration Firestops
7.	UL-2079	Tests for Fire Resistance of Building Joint Systems.

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 30 00 Submittal Procedures, submit the following:

1. Product data on characteristics, performance, and limitation criteria.

2. Manufacturer's installation instructions.

3. Certification that products meet or exceed requirements.

4. Detail Drawings.

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1.05 QUALITY ASSURANCE

A. A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate Design/Builder personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.

B. Firestop System installation must meet requirements of ASTM E-814, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated.

C. Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.

D. Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.

E. Engage an installer with a minimum of 5 years experience and who is certified, licensed, or otherwise qualified by firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL label where applicable.

B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.

C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements, including temperature restrictions.

D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.

E. Do not use damaged or expired materials.

1.07 PROJECT CONDITIONS

A. Do not use materials that contain flammable solvents.

B. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

C. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

D. Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.

E. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications provide products manufactured by one of the following:

1. Hilti, Inc.

2. 3M Corp.

3. Specified Technologies, Inc.

2.02 MATERIALS

A. Provide firestopping materials of commercially manufactured products complying with the following minimum requirements and as listed in Underwriters Laboratories, Inc. -Building Materials Directory.

1. ASTM E84 or UL 723 with a flame spread of 25 or less; smoke development rating of 50 or less; fuel contribution of 50 or less.

2. Non-toxic and non-corrosive during each stage of application and during fire conditions.

3. Penetrations: ASTM E814 or UL 1479 with 2 hour ratings or as shown on Drawings.

4. Joints: UL 2079 2 hour rating or as shown on Drawings.

5. Non-combustible when tested in accordance with ASTM E136.

6. Materials shall impede the passage of smoke and gases.

B. Backing Material: Unfaced non-combustible mineral wool, or manufacturer pre-fabricated backer rod, as per Underwriters Laboratories, Inc. Building Materials Data.

C. Accessories: Collars, fasteners, straps, and other accessories shall be manufacturer's standard products approved for UL through penetrations.

PART 3 -- EXECUTION

3.01 SURFACE PREPARATION

A. Perform preparation and cleaning procedures in compliance with manufacturer's instructions.

3.02 INSTALLATION

A. Install firestopping as shown on the Drawings, as specified, and as required by UL-system. Firestop the following:

1. Duct, conduit, and pipe penetrations through below-grade floors and time-rated partitions.

2. Penetrations of vertical shafts.

3. Gaps between fire rated partitions and structure above, or exterior walls.

B. Install firestopping in strict accordance with UL through-penetrations systems requirements.

C. Cure finished work as recommended by the manufacturer to avoid shrinkage cracks.

3.03 MIXING

A. Mix and prepare materials in compliance with the manufacturer's directions.

B. Store materials in tightly covered containers. Maintain containers used in storage, mixing, and application of firestopping in a clean condition, free of foreign materials and residue.

C. Mix materials to produce a uniform density and as required for application of the materials.

3.04 INSPECTION

A. Examine the substrates to receive firestopping and the conditions under which the work is to be performed and notify the Engineer in writing of any conditions detrimental to the proper and timely completion of the work and performance of the firestopping. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the material manufacturer and Engineer.

B. Commencement of firestopping work shall be interpreted as proof of acceptability of the substrates, by the applicator and the applicator's acceptance of responsibility for any failure of bond between installation of firestopping and substrate in any particular area.

C. Do not apply materials over incompatible steel primers, dirt, rust, grease, moisture or other conditions unacceptable according to the manufacturer's instructions.

3.05 FIELD QUALITY CONTROL

A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.

B. Keep areas of work accessible until inspection by applicable code authorities.

C. Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, “Standard Practice for On-Site Inspection of Installed Fire Stops” or other recognized standard.

D. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

3.06 ADJUSTMENT AND CLEANING

A. Upon completion of work, clean spattered surfaces. Remove spattered materials by methods of washing and scraping, using care not to scratch or otherwise damage finish surfaces. Clean with manufactures recommended solution.

B. Protect work of other trades, whether to be coated or not, against damage by the work. Correct damage by cleaning, repairing or replacing and recoating. Leave all work in undamaged condition.

C. Take precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of firestopping.

- END OF SECTION -

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SECTION 07410

METAL WALL PANELS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for complete execution of work shown on Drawings and specified herein.

B. Work includes:

1. Provide support angles as required to support and transfer design loads from metal wall panels to structural systems.

2. Prefinished galvanized steel, foamed-in-place, insulated wall panels as indicated on the Drawings.

3. Cut panels as required to fit around piping, conduits and other existing items that penetrate the wall. Field cut panels shall have field cuts coated to prevent corrosion. Provide trim and seals for a watertight installation.

4. Provide fasteners, flashing, and other accessories required to support the wall system and provide a weathertight installation.

5. Provide window systems, sunshade, and louver systems specifically designed to integrate with metal wall panel system.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 07900 – Joint Fillers, Sealants and Caulking

B. Section 08400 – Aluminum Storefront

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. ASTM E-72 – Strength Test of Panels for Building Construction

B. ASTM E-283 – Rate of Air Leakage through Exterior Windows, Curtain Walls and Doors

C. ASTM E-331 – Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 30 00 Submittal Procedures, submit the following:

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1. Drawings of proposed work, including all details required for construction including at a minimum fastener type and spacing, wall panels, support framing, flashing, extruded trim, and accessory details.

2. Manufacturer's product data, specifications and installation instructions.

3. Submit certification that installer is authorized by manufacturer.

4. Structural design data and calculations signed by a Professional Engineer registered in the Commonwealth of Virginia.

5. Drawing showing spacing of fasteners and supports.

6. Sample warranties.

7. Provide samples of wall panels for color, profile and texture verification. Sample panels shall be 36”long by full height. Sample panel shall be provided to Owner.

8. Provide window system product data and installation instructions.

9. Provide louver systems product data and installation instructions.

10. Provide integrated Sun-Shade product data and installation instructions.

1.05 DESIGN CRITERIA

A. Use the following standards and criteria where applicable in the structural design of the wall support system:

1. Statewide Building Code of Virginia.

2. “Manual of Steel Construction”, American Institute of Steel Construction

3. “Cold Formed Steel Design Manual”, American Iron and Steel Institute

B. Design Loads

1. Design loads include live, snow, wind, earthquake and dead loads. See Structural Drawing sheets for loading requirements.

2. Loads and combination of loads shall be as prescribed and recommended in the standards and codes listed above.

3. Design wall to withstand a maximum positive wall pressures as required by the Building Code.

4. Thermal expansion and contraction expected for this location.

1.06 WARRANTY

A. Wall Panels

1. Exterior finish shall be warranted by the manufacturer for twenty five (25) years against blistering, peeling, cracking, flaking, checking and chipping in a marine environment.

2. Color change and chalking shall be warranted for twenty five (25) years. Color change shall not exceed 5 NBS units per ASTM D 224. Chalking shall be not less than a rating of 8 per ASTM D 659.

B. Weathertightness

1. Warrant wall system, wall panels, trim flashing, penetrations, and other materials integral to the wall system, against leaks for a period of five years.

2. Liability will be limited to cost of installed wall system.

C. Provide all materials required by wall panel manufacturer to obtain specified warranty whether or not specifically indicated.

1.07 QUALITY ASSURANCE

A. Manufacturer shall have been regularly engaged in the fabrication of preformed wall panel systems for at least five years.

B. Installer shall be authorized by the Manufacturer as trained and qualified to erect the Manufacturer's product.

C. Metal wall panel system manufacturer's representative will observe the installation of the wall system at the start of the project and as required by the manufacturer to ensure warranty provisions are adhered to.

PART 2 -- PRODUCTS

2.01 BASIS OF DESIGN

A. The following metal wall panels form the basis of design:

1. 3" Designwall 2000/4000 by Kingspan, Dimension Series Horizontal Smooth Wall Panels.

2. 3" Designwall R series by Kingspan, 4" Rib spacing Horizontal Wall Panels

3. Integrated Window System by Kingspan. Including extruded head, sill, jamb, mullion, vertical girt trim, and other accessories.

4. Integrated louver system and coordinated with Kingspan Wall Panels. Provide integrate Kingspan blank off panels.

5. Sunshade with airfoil blades by and coordinated with Kingspan. Color shall closely match color of wall panels.

2.02 PERFORMANCE TEST

A. Thermal Properties

Wall	ASTM C-518	R15 (minimum)
B. Air Filtration:	ASTM E-1680	<.06 cfm per sq.ft. @ 1.56 psf
C. Water Penetration:	ASTM E-1646	No water penetration @ 6.24 psf
D. Wind Uplift:	FM Standard	I-90
E. Building Corner:	FM Standard	Approved Class 1 4880
F. Flame Spread:	ASTM E84	25 or less
G. Smoke Developed:	ASTM E84	450 or less
H. Panel Classification:	FM Standard	4880, Class 1

2.03 PRODUCTS

A. Wall Panel System

1. Wall panels shall be configured as shown on Contract Drawings.

2. Panel units shall consist of roll formed steel face and liner elements chemically bonded to a continuously foamed-in-place urethane modified isocyanurate core.

3. Panel edges shall be double tongue and groove design with factory applied vapor seal. Structural fasteners and clips shall be concealed within the side joint, mechanically engage both face and liner elements and be designed to prevent crushing of the foam core during fastener installation.

4. Panel exterior skin shall be ASTM A653, Grade 37, G90 galvanized steel smooth or profiled panel in 22 gauge, minimum.

5. Panel interior skin shall be ASTM A653, Grade 37, G90 galvanized steel, in 24 gauge, minimum.

6. Panel exterior finish shall consist of a 0.8 mil primer with a 0.8 mil Kynar 500 color coat and a 0.8 mil 70% Kynar 500 clear coat in a color. Three colors shall be selected.

8. Panel interior finish shall consist of a 0.2 mil epoxy primer with a 2.7 mil Versacor epoxy barrier coat and a 1.5 mil urethane coat. Color shall be selected by the Owner.

9. Urethane modified isocyanurate core shall be poured in place between the steel face and liner to fill all voids in the panel and have the following minimum physical properties:

a.	Density	-	2.7 pcf
	Shear stress	-	20 psi
	Compressive strength	-	20 psi
	Tensile strength	-	20 psi

2.04 PANEL SUPPORT AND ANCHORAGE SYSTEM

A. Metal Wall Panel manufacturer shall review vertical girts as shown on Contract Drawings. Coordinate and provide additional girt members or supports of adequate size and thickness to meet the design loading. Supports shall be designed per AISC, AISI, or the Aluminum Association stress requirements. Provide for adjustable connections or anchorages to accommodate building movements or deflections.

B. Connections and anchorages shall be designed to provide adjustability for final alignment in accordance with the latest addition of AISC Manual for Steel Construction.

C. Girts supplied without adjustable connections shall be erected within these tolerances. Maximum allowable girt plane is ± 1/2 inch. In any twenty feet length, horizontally or vertically this deviation cannot vary more than 3/8 inch. Transition areas such as corners and soffits shall have girt steel within ± 1/8 inch of the theoretical girt plane.

D. Support and anchorage systems shall be designed to resist live and dead loads required by the Virginia Statewide Building Code and as shown.

PART 3 -- EXECUTION

3.01 INSPECTION

A. Manufacturer shall inspect conditions of structural system. Notify the Engineer and Owner if any structural members are not acceptable for proposed wall system. Do not begin work until structural system has been verified and corrected as required.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions and approved shop drawings.

B. Replace damaged or defective items.

C. Minimize field cuts. Where field cuts cannot be avoided cut surfaces shall be coated with paint system provided by manufacture. Clean drips from face that will not be covered by flashing.

- END OF SECTION -

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SECTION 07415

STANDING SEAM METAL ROOFING AND WALL PANELS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for complete execution of work shown on Drawings and specified herein.

B. Work includes:

1. Standing seam metal roofing, wall panels, trim, flashing and accessories associated with a complete and weathertight roofing system and as indicated on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 05531 – Gratings, Access Hatches, and Access Doors

B. Section 07210 - Building Insulation

C. Section 07700 - Roof Specialties and Accessories

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 30 00 Submittal Procedures, submit the following:

1. Drawings of proposed work, including fastener type and spacing, roof panels, support framing, flashing, snow retention system, and accessory details.

2. Manufacturer's product data, specifications and installation instructions.

3. Submit calculations signed by a professional engineer indicating loads, uplifts, spacing of clips, fasteners, snow retention system, and accessories. Calculations shall be project specific in accordance with ASCE 7.

4. Submit certification that installer is authorized by manufacturer.

5. Drawing showing spacing of fasteners and supports.

6. Letter verifying that panels are factory roll formed.

7. Finish sample warranties.

8. Copy of 25-year Manufacturer’s total roof warranty.

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1.04 DESIGN CRITERIA

A. Use the following standards and criteria where applicable in the structural design of the roof support system:

1. Virginia Statewide Building Code

2. “Steel Construction Manual”, American Institute of Steel Construction

3. “Cold Formed Steel Design Manual”, American Iron and Steel Institute

4. ASCE 7 - Minimum Design Loads for Buildings and Other Structures

B. Design Loads

1. Design loads include live, snow, wind, earthquake and dead loads.

2. Loads and combination of loads shall be as prescribed and recommended in the standards and codes listed above.

3. Design roof to withstand 100 mph winds.

4. Thermal expansion and contraction expected for this location.

1.05 WARRANTY

A. Roof Panels and exposed trim:

1. Exterior finish shall be warranted by the manufacturer for twenty years against blistering, peeling, cracking, flaking, checking and chipping.

2. Color change and chalking shall be warranted for twenty years. Color change shall not exceed 5 NBS units per ASTM D 224. Chalking shall be not less than a rating of 8 per ASTM D 4214.

B. Weathertightness

1. **Single Source** manufacturer’s roof system warranty including roof panels, fascia, trim flashing, penetrations, and other materials integral to the roof system, against leaks for a period of twenty five years. Warranties shall cover workmanship and materials. Manufacturer shall be sole responsible party within warranty. Warranties limit manufacturer’s responsibility and include performance by installer shall not be acceptable.

2. No dollar limit.

C. Provide all materials required by roofing manufacturer to obtain specified warranty whether or not specifically indicated.

1.06 QUALITY ASSURANCE

A. Manufacturer shall have been regularly engaged in the fabrication of metal standing seam roof systems for at least ten years.

B. Installer shall be authorized by the Manufacturer as trained and qualified to erect the Manufacturer's product.

C. Conduct a preroofing conference with the following attendees; Design/Builder, metal-roofing Design/Builder, metal roofing systems manufacturer's representative, all sub-Design/Builders whose work penetrates the roof, the Owner and Engineer.

D. Metal roofing system manufacturer's representative will observe the installation of the roof system at the start of the project and as required by the manufacturer to ensure warranty provisions are adhered to. The manufacturer's representative will produce a report based on observations of the roofing system that indicates that the roofing system, trim, accessories have been installed in accordance with all requirements of the manufacturer. If any deficiencies in materials or installation are found during this inspection the deficiencies shall be corrected.

E. System shall be tested in accordance with UL 580 or ASTM E 1592.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications provide products from one of the following:

1. IMETCO, Series 300

2. Centria, SRS 3

3. The Garland Company, R MER SPAN

4. Dimensional Metals Incorporated, TL25

2.02 PRODUCTS

A. Standing Seam Roof Panels

1. Smooth finished 0.040 Aluminum sheets factory finished with two coat, baked-on full-strength (70% resin) fluorocarbon coating system. Color shall be selected by the Owner from colors with a minimum SRI of 78.

2. Panels shall be 16" or 18" wide by length required to cover roof to minimize end laps.

B. Roof System

1. Structural standing seam incorporating with continuous “T” batten and secured to concealed anchor clips allowing unlimited thermal movement, and of configurations that will prevent entrance or passage of water.

2. Fastening system shall allow the roof covering to move independently of any differential thermal movement by the framing system.

3. Provide interlocking batten cap with a plant applied, and non-hardening sealant. Mechanically lock or crimp seams during installation.

4. Seal panel termination and perimeter flashing with sealant approved by manufacturer.

5. Provide metal closures matching roof profile at ridge, headwall, rake, jamb and hip conditions.

6. Panels length shall be full length from factory. Field formed panels will not be allowed.

7. Coordinate structural support locations for wall and roof panels. Provide additional structural support, if required by panel manufacturer to resist required design loads.

8. Roof and wall panels shall be furnished in continuous lengths from ridge to eave of top of wall to bottom of wall panel.

9. Seam height will be a minimum of 2-3/8”.

C. Trim System

1. Design trim to provide for expected movement of roof panels due to thermal expansion.

2. Use manufacturer's standard trim pieces, except where field formed pieces are recommended by the manufacturer.

3. Use .032 or.040 Aluminum trim with factory finish to match roof panels.

4. Concealed fasteners shall be used to the greatest extent possible. Where exposed fasteners are used, they shall be installed neatly and aligned with other fasteners in straight rows and lines and finished to match roof panels.

D. Roof Accessories

1. Use silicone roof jacks with aluminum sealing ring for openings 12 inches in diameter or less. Do not use roof jacks where ribs are altered.

2. Provide .032 or .040 gutters and downspouts with a 20 year factory applied fluorocarbon finish. Color shall match roof panels.

3. Snow Retention System: Provide clamps with stainless steel fasteners that mechanically attach to standing seams without penetrating the roof system. Snow retention system shall include cross members to retain snow with snow and ice clips. Snow retention system shall be specifically manufactured for profile of standing seam metal roofing. Snow retention system manufacturer shall design system for local conditions and provide multiple rows as required by the manufacturer's design to resist sliding snow. Snow retention system shall be approved for use by standing seam roofing system manufacturer and not void or limit warranty. Color to match standing seam roofing system and color warranty. Provide S-5 Colorguard by Metal Roof Innovations, Ltd., or SnoBar/ColorBar by SnoBlox-Snojax; or approved equal.

4. Underlayment: Provide underlayment over entire roof area. Underlayment shall be 40 mil self adhesive membrane. Underlayment may not be shown on drawings. Underlayment shall lap over the PVC membrane.

E. Internal Gutter

1. 20" wide ¼" galvanized bent plate. Welds required shall be continuous and ground smooth. Coat with zinc rich paint. Install an epoxy grout sloping 1/8" per foot from cent to a point 16'-0" to the east and west. Cover gutter with fully adhered 60 mil PVC membrane roofing with water tight joints in accordance with manufacturer's requirements. Configuration shall be as shown on Drawing. Provide screen to prevent clogging of internal gutter. Downspout shall be 12" diameter pipe welded to gutter and founded at the ground. Pipe shall be galvanized and fully welded where joined to gutter and joined in field. Grind welds smooth and paint.

PART 3 -- EXECUTION

3.01 INSPECTION

A. Manufacturer shall inspect conditions of structural system and work below. Verify that work is complete to a point where this work can commence and installation can be performed in accordance with the manufacturer's recommendations and instructions.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions and approved shop drawings.

B. Replace damaged or defective items.

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SECTION 07540

SINGLE PLY MEMBRANE ROOFING (PVC OR KEE)

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on Drawings and specified herein.

B. Principal items of work include:

1. Preparation of roof deck to receive new roofing materials.

2. Application of insulation, and accessories.

3. Fully adhered roofing system.

4. Twenty year "Total Roofing System Warranty".

5. Removal and cleanup of excess materials and debris.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. ASTM Designations; Stipulated under PART 2 - PRODUCTS.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 30 00, submit the following:

1. Manufacturer's Data.

2. Manufacturer's Installation Instructions.

3. Total System Warranty.

4. Dimensioned shop drawings which shall include:

a. Outline of roof with roof size and elevations shown.

b. Profile details of flashing methods for penetrations.

c. Technical acceptance from Sarnafil.

5. Certification that all materials submitted are acceptable for warranty coverage indicated.

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1.04 QUALITY ASSURANCE

A. The installer must be skilled and experienced and approved by roofing membrane manufacturer for type of roofing and associated work required, and equipped to perform workmanship in accordance with recognized standards.

B. Provide periodic inspections by an official manufacturer's technical representative on all roofing and flashing. Inspections to be made at the beginning of the job and a minimum of one more while the roofing and/or flashing work is in progress to insure workmanship is in accordance with the manufacturer's specifications.

1.05 CODE REQUIREMENTS

A. Installed system shall meet all State and local codes, approved and listed to meet the following: UL class A and FM 1-90.

B. Inform all personnel working on roof of fall protection requirements. Provide all necessary equipment and training for proper use to comply.

1.06 GUARANTEE

1. Furnish to the Owner a twenty (20) year written Manufacturer's Warranty covering materials and workmanship for the entire "Roofing System", including repair and replacement of roofing components which are deemed faulty or in disrepair during the guarantee period. Such items in disrepair shall be repaired at no cost to the Owner. Cover both labor and materials necessary to effect watertightness, including that required to repair roof leaks caused by standing water, defective material or workmanship, without limit as to amount required to effect watertightness.

1.07 JOB CONDITIONS

A. Roofing products shall be installed in accordance with manufacturer’s recommended job conditions including environmental and physical.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's unopened containers identified with name, type, grade, class and all other qualifying information, including UL and other specified insurance agency's labels.

B. Store materials in a dry location, in such manner as to prevent damage or intrusion of foreign matter. Conspicuously mark "Rejected" on materials which have once been wet or damaged and remove from the job site.

PART 2 -- PRODUCTS

2.01 MEMBRANE

A. Membrane shall conform to ASTM D4434-96 (or latest revision), "Standard for Polyvinyl Chloride Sheet Roofing". Classification: Type II, Grade I.

1. Basis of Design: Sarnafil $_{6}$G410-15 feltback, 59 mil (1.5 mm), thermoplastic membrane with fiberglass reinforcement and a factory applied 9 oz geotextile felt backing.

B. Color of Membrane

1. White with a Solar Reflectance Index of 78 or greater.

2.02 FLASHING MATERIALS

A. Provide flashing approved for use with manufacturer's system warranty and in accordance with manufacturer's details.

2.03 INSULATION/OVERLAYMENT/RECOVER BOARD

A. Polyisocyanurate Insulation

A rigid isocyanurate foam insulation with black mat facers.

2.04 UNDERLAYMENTS

A. Provide Dens-Deck, a siliconized gypsum, fire-tested hard board with glass mat facers or equal.

2.05 VAPOR BARRIER

A. Two layers of bituminous vapor retarder as recommended by manufacturer.

2.06 ATTACHMENT COMPONENTS

A. Membrane and Underlayment Adhesive

1. Use manufacturer's recommended adhesives for materials and substrates to be fastened.

B. Insulation Board Adhesive

1. Type III hot asphalt or other adhesive recommended by manufacturer.

C. Fasteners

1. Use manufacturer's recommended fasteners for materials and substrates to be fastened.

2.07 MISCELLANEOUS ACCESSORIES

A. Provide all accessories recommended by the manufacturer to provide a watertight system.

2.08 RELATED MATERIALS

A. Wood Nailer

Treated wood nailers shall be installed at the perimeter of the entire roof and around such other roof projections and penetrations as specified on Project Drawings. Thickness of nailers must match the insulation thickness to achieve a smooth transition. Wood nailers shall be treated and be #2 quality or better lumber. Creosote, CCA, or asphalt-treated wood is not acceptable. Wood nailers shall conform to Factory Mutual Loss Prevention Data Sheet 1-49. All wood shall have a maximum moisture content of 19% by weight on a dry-weight basis.

PART 3 -- EXECUTION

3.01 SURFACE PREPARATION

A. Installer shall notify Design/Builder, in writing, of defects in the substrate, and work shall not proceed until defects have been corrected. The starting of work implies the acceptance of such surfaces.

B. Construction work on the roof shall be complete before the roofing operations commence. The roof surfaces shall be clean, smooth, dry, and free from loose and foreign materials, dirt, oil, grease, and holes.

C. Surface joints (including walls and substrate) shall be 1/4-inch or less in width. Repair all joints wider than 1/4-inch with approved joint filler before proceeding with installation.

D. Vents and all other projections through the roof shall be secured in position before roofing is commenced.

3.02 INSTALLATION

A. Roofing shall be furnished and installed in compliance with U.L. Class "A" requirements. Manufacturer's instructions for the installation of such roofing system shall be strictly adhered to. All accessories necessary to complete the installation shall be provided.

B. The roofing shall be applied and finished in one area in a continuous operation. Care shall be taken to insure that water does not flow beneath any completed sections of roof. Loose edges of membrane shall be temporarily sealed with an approved night seal when the weather is threatening. When work is resumed, the sheet shall be pulled free before continuing installation.

C. Roofing and flashing installation at the junction of all parapet walls, curbs, and other roof openings shall be in accordance with the roof membrane manufacturer's standard details unless shown otherwise on the Drawings. Typical details of all actual roof conditions shall be submitted for approval prior to membrane installation.

3.03 WOOD NAILER INSTALLATION

A. Install continuous wood nailers at the perimeter of the entire roof and around roof projections and penetrations as shown on the Detail Drawings.

B. Nailers shall be anchored to resist a minimum force of 300 pounds per lineal foot in any direction. Individual nailer lengths shall not be less than 3 feet long. Fasteners shall be staggered 1/3 the nailer width and installed within 6 inches of each end. Two fasteners shall be installed at ends of nailer lengths. Nailer attachment shall meet this requirement and that of the current Factory Mutual Loss Prevention Data Sheet 1-49.

3.04 INSULATION INSTALLATION

A. Insulation shall be installed according to insulation manufacturer's instructions.

B. Insulation shall be neatly cut to fit around penetrations and projections.

C. Install tapered insulation in accordance with insulation manufacturer's shop drawings.

D. Do not install more insulation board than can be covered by the roofing membrane by the end of the day or the onset of inclement weather.

3.05 INSTALLATION OF SARNAFIL MEMBRANE

A. Inspect the surface of insulation prior to install of the roof membrane. The substrate shall be clean, dry, free from debris and smooth with no surface roughness or contamination. Broken, delaminated, wet or damaged insulation boards shall be removed and replaced.

B. Apply adhesive and membrane in strict accordance to roofing manufacturer’s instructions and recommendations. Membrane shall be applied with no air pockets or wrinkles.

C. Mechanically fasten roof system 4’-0” from all roof edges along the entire perimeter using Sarnabar fastened 12” o.c. and with a welded cover strip.

3.06 HOT-AIR WELDING OF SEAM OVERLAPS

A. Welding: All seams shall be hot-air welded. Seam overlaps should be 3 inches (75 mm) wide when automatic machine-welding and 4 inches (100 mm) wide when hand-welding, except for certain details. All membrane to be welded shall be clean and dry. Welding shall be accomplished in strict accordance with manufacturer’s recommendations.

B. Quality Control of Welded Seams: Applicator shall check all welded seams for continuity using a rounded screwdriver. Visible evidence that welding is proceeding correctly is smoke during the welding operation, shiny membrane surfaces, and an uninterrupted flow of dark grey material from the underside of the top membrane. On-site evaluation of welded seams shall be made daily by the applicator including taking one inch (25 mm) wide cross-section samples of welded seams. Correct welds display failure from shearing of the membrane prior to separation of the weld. Each test cut shall be patched by the Applicator at no extra cost to the Owner.

3.07 MEMBRANE FLASHINGS

A. All flashings shall be installed concurrently with the roof membrane as the job progresses. No temporary flashings shall be allowed without the prior written approval of the Owner's Representative and Sarnafil. Approval shall only be for specific locations on specific dates. If any water is allowed to enter under the newly completed roofing, the affected area shall be removed and replaced at no expense to the Owner. Flashing shall be adhered to compatible, dry, smooth, and solvent-resistant surfaces. Use caution to ensure adhesive fumes are not drawn into the building. Apply flashing in strict accordance with manufacturer's instructions.

B. All flashings shall extend a minimum of 8 inches (0.2 m) above roofing level.

C. All flashing membranes shall be consistently adhered to substrates. All interior and exterior corners and miters shall be cut and hot-air welded into place. No bitumen shall be in contact with the Sarnafil membrane.

3.08 METAL FLASHINGS

A. Metal details, fabrication practices and installation methods shall conform to the applicable requirements of the following:

1. Factory Mutual Loss Prevention Data Sheet 1-49 (latest issue).

2. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) - latest issue.

B. Complete all metal work in conjunction with roofing and flashings so that a watertight condition exists daily.

C. Metal shall be installed to provide adequate resistance to bending to allow for normal thermal expansion and contraction.

D. Metal joints shall be watertight.

E. Metal flashings shall be securely fastened into solid wood blocking. Fasteners shall penetrate the wood nailer a minimum of 1 inch (25 mm).

F. Hook strips shall extend past wood nailers over wall surfaces by 1½ inch (38 mm) minimum and shall be securely sealed from air entry.

3.09 COMPLETION

A. The Owner and Sarnafil representative shall review the work at completion. All defects noted and non-compliances with the Specifications or the recommendations of Sarnafil shall be itemized in a punch list. These items must be corrected immediately by the Installer to the satisfaction of the Owner and Sarnafil. All work shall comply with warranty including necessary reviews prior to installation.

- END OF SECTION -

SECTION 07600

FLASHING AND SHEET METAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on Drawings and specified herein.

B. Flashing and trim related to wall and roof systems shall be provided by roofing and wall panel manufacturers.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 04200 - Unit Masonry

B. Section 07415 – Standing Seam Metal Roofing

C. Section 07410 – Metal Wall Panels

C. Section 07700 – Roof Specialties and Accessories

D. Section 07900 - Joint Fillers, Sealants and Caulking

1.03 REFERENCES SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of these specifications Work shall conform to the applicable requirements of the following documents:

1.	OF-506C	Flux, Soldering, Paste, and Liquid
2.	ASTM A176	Stainless and Heat-Resisting Chromium Steel Plate, Sheet and Strip
3.	ASTM B32	Specifications for Solder Metal
4.	ASTM D1187	Test Method for Asphalt-Base Emulsions for use as Protective Coatings for Metal
5.	"Architectural Sheet Metal Manual" by Sheet Metal and Air Conditioning Contractors National Association.	

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 30 00 Submittal Procedures, submit the following:

1. Manufacturer's literature and installation instructions.

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2. Complete layout and installation Drawings and schedules with clearly indicated dimensions.

3. Color samples.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store materials in a clean dry protected area in such manner to preclude damage by denting, warping, or other distortion.

PART 2 -- MATERIALS

2.01 MATERIALS

A. Metal Flashing

1. Exposed to View: Provide prefinished 0.050 inches aluminum. Provide a full-strength Kynar 500 baked-on paint finish with a 20 year warranty. Colors shall be selected to match adjacent colors.

2. Concealed from View: Provide a minimum of stainless steel sheet, or mill-finished aluminum sheet.

B. Nails, screws, rivets, bolts and other fasteners: same material as sheet metal being attached. Nails shall be 18 gauge diameter shank, 1/4 inch diameter flat head, annular-thread, diamond point, long enough to penetrate backing by at least 1 inch. Nails shall be spaced 3 inches on center unless other spacing is indicated. Exposed fasteners shall match finish of metal being fastened.

C. Reglets shall be formed of 300 series stainless steel, minimum of 0.020 inch. Reglets shall be Model CO for insertion in concrete, MA-4 for insertion in masonry as manufactured by FRY Reglet Corporation. Corners shall be factory made, mitered and sealed. Furnish reglets to proper trade in sufficient time to be incorporated into the masonry or concrete work.

D. Plastic cement shall conform to ASTM D2822.

E. Sealants shall be silicone type.

F. Sealer tape shall be polyisobutylene tape specifically manufactured for setting flanges on bituminous roofing such as Morrison and Company CL-50.

PART 3 -- EXECUTION

3.01 FABRICATION

A. Shop fabricate Work to greatest extent possible. Comply with details shown and applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry standards. Fabricate for waterproof and weather resistant performance; with expansion

provisions for running work, sufficient to permanently prevent leakage, and damage or deterioration of the work. Comply with material manufacturer's instructions and recommendations for forming material. Form exposed work without excessive oil-canning, buckling and tool marks, true to line and levels as indicated, with exposed edges folded back to form hems.

B. Roof penetration sheet metal work shall be provided and coordinated with the roofing system. The design and details shall conform to SMACNA "Architectural Sheet Metal Manual". Sheet metal items shall be built into roofing in strict accordance with the instructions of the roofing manufacturer.

- END OF SECTION -

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SECTION 07700

ROOF SPECIALTIES AND ACCESSORIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, materials, equipment and appliances required for the complete execution of Work shown on Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 06100 – Rough Carpentry

B. Section 07415 – Standing Seam Metal Roofing and Wall Panels

C. Section 07600 - Flashing and Sheet Metal

D. Section 07900 - Joint Fillers, Sealants and Caulking

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of these specifications Work shall conform to the applicable requirements of the following documents:

1. TT-P-641 (1) Primer Coating, Zinc Dust - Zinc Oxide (for galvanized surfaces

2. ASTM A 525 Specification for General Requirements for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process.

3. ASTM A 526 Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process, Commercial Quality.

4. ASTM B 209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

5. Sheet Metal and Air Conditioning Design/Builders National Association "Architectural Sheet Metal Manual" (ASMM).

6. The Aluminum Association "Specification for Aluminum Sheet Metal Work in Building Construction."

7. American Welding Society (AWS).

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1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 30 00, Submittal Procedures, submit the following:

1. Manufacturers literature and installation instructions.

2. Samples, of each material listed.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in factory packed unopened cartons and crating bearing the manufacturer's labels.

B. Store materials in clean, dry protected area in such manner to preclude damage of any nature.

C. Handle all materials with proper care to avoid denting, marring, warping or other distortions during delivery, storage and handling.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. General: Provide roof specialties and accessories of design and construction compatible and approved for use with roofing manufacturer.

B. Fasteners: Provide all fasteners and attachments required to secure item to substrate and support loads required by applicable Building Code. Use only non-corrosive fasteners which are compatible with materials being joined.

C. Colors: Colors shall be selected by Owner.

2.02 EXTERIOR GUTTERS AND DOWNSPOUTS

A. Material: 0.050 inch aluminum.

B. Design: Manufacture gutters tapered and notched to provide telescoping joint. Design gutters and downspouts to accommodate expected thermal movement.

C. Supports and Fasteners: Provide manufacturers' standard straps, brackets and fasteners. Place supports and fasteners at 36 inches on center or as recommended by the manufacturer. Finish of supports, brackets and fasteners shall match gutter and downspout.

D. Accessories: Provide end caps, flashing, trim, and other items required for a complete installation.

E. Finish: Baked on Kynar, with 20 year warranty. Color shall match wall panels.

F. See Drawings and Specifications 07415 for internal gutter.

2.03 ROOF CURBS

A. Material: 18 gauge, G-90 galvanized steel, 12 inches high with mitered and continuous welded corners and seams, factory installed pressure treated wood nailers, and rigid fiberglass insulation.

B. Design: Provide roof curb units manufactured to fit manufactured roof panels. Provide integral water diverter. Design roof curb to support weight of equipment. Coordinate roof curb unit with roof panel manufacturer to ensure proper fit. Roof curb shall be approved for use by manufacturer.

C. Accessories: Provide interior liner, flashing, trim and other items required for a complete installation.

PART 3 -- EXECUTION

3.01 INSTALLATION - GENERAL

A. Install roof accessories and specialties in accordance with the manufacturer's instructions. Provide a complete watertight and weatherproof installation. Install with provision for expansion and contraction.

3.02 DAMAGED MATERIAL

A. Repair or replace materials damaged during installation.

3.03 ADJUSTING AND CLEANING

A. Check levels and adjust as necessary after roofing and flashing is complete.

B. Protect materials from damage by other trades. Remove protective coatings at completion of project.

- END OF SECTION -

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SECTION 07900

JOINT FILLERS, SEALANTS AND CAULKING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for the complete execution of Work shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03250 - Concrete Accessories

B. Section 03290 - Joints in Concrete

C. Section 08800 - Glass and Glazing

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available.

1. ASTM C-920 Elastomeric Joint Sealants

2. ASTM D-1056 Flexible Cellular Materials - Sponge or Expanded Rubber

3. SWRI Sealant and Caulking Guide Specification

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 30 00 Submittal Procedures, submit the following:

1. Manufacturers literature and installation instructions.

2. Color samples of each type of sealant.

1.05 QUALITY ASSURANCE

A. Applicator shall be a company specializing in the installation of sealants with a minimum of five years experience.

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1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in unopened labeled packages.

B. Store materials in location protected from freezing or damages.

C. Reject and remove from the site materials within broken or damaged packaging.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Sealants

1. Type 1: Multi-component, non-sag, low-modulus polyurethane rubber sealant meeting ASTM C-920, Type M, Grade NS, Class 25, use NT, M, A, and O. Capable of withstanding 50% in extension or compression such as Sikaflex-2C NS/SL, Sika Corporation, or Sonolastic NP-2, Sonneborn, or DynaTrol II by Pecora Corporation.

2. Type 2: Single component polyurethane sealant meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, A, and O. Capable of withstanding 25% in extension or compression such as Sikaflex 1A by Sika Corporation, DynaTrol 1-XL by Pecora Corporation, or Sonolastic NP-1 by BASF Construction Chemicals.

3. Type 3: Single component, low-modulus moisture curing silicone meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, G, and A. Capable of withstanding 50% extension and compression. Pecora 890 by Pecora Corporation, Sonolastic Omni Seal by BASF Construction Chemicals.

4. Type 4: Single component, mildew resistant, moisture-curing silicone meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, G, and A. Pecora 898 by Pecora Corporation, Sonolastic Omni Plus by BASF Construction Chemicals.

5. Type 5: Single component, acrylic latex meeting ASTM C-834. AC-20+ Silicone by Pecora Corporation, Sonneborn Sonolac by BASF Construction Chemicals.

6. Type 6: High grade butyl sealant meeting Federal Specification TT-S-00-1657. BC-158 by Pecora Corporation or equal.

7. Type 7: Multi-component chemical resistant polysulfide sealant conforming to ASTM C-920, Type M, Grade NS, Class 25 such as Deck-O-Seal by W.R. Meadows, Tammsflex by DuraJoint Concrete Accessories, or Synthacalk GC2+ by Pecora Corporation.

8. Type 8: Nonsag, Multi Component, traffic grade polyurethane sealant meeting ASTM C920, Type 19, Grade NS, Class 25, use T, M, A, and O. DynaTread by Pecora Corporation, Sonolastic Ultra by BASF Construction Chemicals.

B. Primer: Non-staining primer recommended by sealant manufacturer for the substrates on this project.

C. Backer Rod: Closed cell foam, nonreactive with caulking materials, non-oily, and approved by the sealant manufacturer. Minimum density shall be 2.00 pounds per cubic foot. Use no asphalt or bitumen-impregnated fiber with sealants.

D. Joint Cleaner: Recommended by sealant or caulking compound manufacturer.

E. Bond breaker: Either polyethylene film or plastic tape as recommended by the sealant manufacturer.

F. Color: Where manufacturer's standard colors do not closely match materials being sealed, provide a custom color.

PART 3 -- EXECUTION

3.01 QUALITY CONTROL

A. Coordinate work with details shown on approved shop drawings prepared by other trades.

B. Verify conditions in the field.

C. Schedule work to follow closely the installation of other trades.

D. Apply sealants and related items in temperatures and dry conditions recommended by the manufacturers.

E. Do not paint sealant, unless recommended by sealant and paint manufacturer.

3.02 PREPARATION

A. Protect finished surfaces adjoining by using masking tape or other suitable materials.

B. Clean and prime joints before starting any caulking or sealing work.

C. Thoroughly clean joints and spaces of mortar and other foreign materials. Cleaning agent shall be Xylol or similar non-contaminating solvent to remove any film from metal surfaces. Masonry or concrete surfaces shall be brushed or air jet cleaned.

D. Joint Requirements

1. All joints and spaces to be sealed in exterior work shall be less than 1/2 inch deep and not less than 1/4 inch wide. If joints in masonry are less than that specified herein, the mortar shall be cut out to the required width and depth. All joints and spaces to receive sealant shall be completely prepared and thoroughly dry before installation of sealant.

2. Unless otherwise specified, joints and spaces which are open to a depth of 1/2 inch or greater shall be solidly filled with back-up material to within 1/4 inch of the surface. Back-up material shall be packed tightly and made continuous throughout the length of the joints. Bond breaker shall be applied as required. If joints are less than 1/4 inch deep, the back-up material may be omitted, a bond breaker substituted and the joint completely filled with sealant. The back-up material shall not project beyond the 1/4 inch depth of the open space in any joint. The following width-to-depth ratio table shall be adhered to, unless otherwise recommended by manufacturer.

Joint Width	Sealant Depth	
	Minimum	Maximum
¼ inch	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
Over 1/2 inch to 1 inch	1/2 inch	Equal to width
Over 1 inch to 2 inch	1/2 inch	1/2 of width

3.03 APPLICATION

A. Exercise care before, during, and after installation so as not to damage any material by tearing or puncturing. All finished work shall be approved before covering with any other material or construction.

B. Apply sealant by an approved type of gun except where the use of a gun is not practicable, suitable hand tools shall be used. Avoid applying the compound to any surface outside of the joints or spaces to be sealed. Mask areas where required to prevent overlapping of sealant.

C. All joints shall be waterproof and weathertight.

D. Point sealed joints to make a slightly concave joint, the edges of which are flush with the surrounding surfaces. Exposed joints in the interior side of the door and other frames shall be neatly pointed flush or to match adjacent jointing work.

E. Adjacent materials which have been soiled shall be cleaned immediately and the work left in neat and clean condition.

F. Comply with sealant manufacturer's written instructions except where more stringent requirements are shown or specified and except where manufacturer's technical representative directs otherwise.

3.04 ADJUSTMENT AND CLEANING

A. Remove misplaced sealant compounds promptly using methods and materials recommended by the manufacturer, as the work progresses.

B. Allow sealants to cure and remove protective edging, of doors, louvers, saddles windows etc. as directed by the Engineer.

3.05 SCHEDULE

Schedule of Sealants

Application	**Sealant**	**Color**
Vertical and horizontal expansion and construction joints in concrete structures unless noted otherwise herein or on Drawings.	Type 1	To closely match adjacent surfaces or mortar and as selected by the Owner.
Vertical and horizontal joints bordered on both sides by masonry, precast concrete, natural stone or other porous building material, unless noted otherwise herein or on Drawings.	Type 2	To closely match adjacent surfaces or mortar and as selected by the Owner.

Application	Sealant	Color
Vertical and horizontal joints bordered on both sides by painted metals, anodized aluminum, mill finished aluminum, PVC, glass or other non-porous building material. See Note 5.	Type 3	To closely match adjacent surfaces and as selected by the Owner.
Masonry expansion and control joints less than 1¼" wide. See Note 2	Type 2	To closely match adjacent surfaces and as selected by the Owner.
Masonry expansion and control joints equal or greater than 1¼ inches wide and not to exceed 2". See Note 2.	Type 1	To closely match adjacent surfaces and as selected by the Owner.
Interior – wood trim and finish joints.	Type 5	Color to be selected by Owner
Sanitary areas, joints in ceramic tile, around plumbing fixtures, countertops, and back splashes. See Note 1.	Type 4	To closely match adjacent surfaces and as selected by the Owner.
Perimeter sealing of doors, windows, louvers, piping, ducts, and electrical conduit. See Note 2.	Type 2 OR Type 3	To closely match adjacent surfaces and as selected by the Owner.
Below thresholds.	Type 6	Manufacturer's standard
Submerged in liquids. See Note 4.	Type 1	Manufacturer's standard
Submerged in liquids with high concentration of chlorine (> 2 ppm).	Type 7	Manufacturer's standard
Horizontal Joints exposed to vehicular or pedestrian traffic.	Type 8	To closely match adjacent surfaces.
Other joints indicated on the drawings or customarily sealed but not listed.	Type recommended by manufacturer	To closely match adjacent surfaces and as selected by the Owner.

Note 1. Sealant for Laboratory Countertop shall be as recommended by countertop manufacturer.

Note 2. Provide UL approved sealants for penetrations thru fire-rated walls shall be as specified in Section 07270.

Note 3. Sealants which will come in contact with potable water shall meet the requirements of NSF 61.

Note 4. Where sealant will be immersed in liquid chemicals verify compatibility prior to installation of sealant.

Note 5. – Where sealants are incorporated into metal wall panel system, sealant shall be as required by metal wall panel manufacturer. See Specification 07410.

- END OF SECTION -

SECTION 08110

STEEL DOORS AND FRAMES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, material, equipment and appliances required for complete execution of Work shown on Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 04200 - Unit Masonry

B. Section 07410 – Metal Wall Panels

C. Section 08710 - Finish Hardware

D. Section 08800 - Glass and Glazing

E. Section 09260 – Gypsum Drywall Systems

F. Section 09900 - Painting

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of these specifications, the work shall conform to the applicable requirements of the following documents:

1.	ANSI/DHI A115	Series Specifications for Steel Door and Frame Preparation for Hardware
2.	ANSI/SDI 100	Recommended Specifications: Standard Steel Doors and Frames
3.	ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
4.	ASTM A366/A 366M	Standard Specification for Steel, Sheet, Carbon, Cold-Rolled Commercial Quality
5.	ASTM A525	Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
6.	ASTM E152	Standard Methods of Fire Tests of Door Assemblies
7.	NFPA 80	Standard for Fire Doors and Windows

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1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 Submittal Procedures, submit the following:

1. Manufacturer's product data.

2. Complete layout and installation drawings and schedules with clearly marked dimensions. Indicate details of construction, profiles, gauges, reinforcing and location of doors and frames.

3. Certify that shop applied primer is compatible with finish coats specified in Section 09900, Painting.

1.05 QUALITY ASSURANCE

A. Comply with ANSI/SDI 100.

B. Locations where fire-rated door and frame assemblies are required, provide assemblies which comply with NFPA 80 and have been tested and labeled in accordance with ASTM E152 by agency acceptable to governing authorities.

C. Provide certificate or label for fire-rated doors which exceed sizes tested from a independent testing and inspection agency. Certificate or label shall indicate that door and frame assembly conforms to the requirements of the design.

D. Provide stairwell doors which have temperature rise rating of 450 degrees F maximum in 30 minutes of fire exposure.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver products boxed or crated suitable for storage.

B. Store products under cover, raised above ground level, and stacked to prevent warping and damage.

C. Replace items damaged during delivery, storage, or handling.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:

1. Curries Company, Mason City, Iowa

2. Amweld Building Products, Inc.

3. Steelcraft, Cincinnati, Ohio

2.02 MATERIALS

A. Steel Sheets: Commercial quality hot or cold rolled. Galvanize sheet steel in accordance with ASTM A525, commercial quality, A60 zinc coating, mill phosphatized.

B. Anchorages: Galvanized steel, minimum 18 gauge.

C. Fasteners and Inserts: Galvanized units standard with manufacturer.

D. Primer: Rust-inhibitive coating, suitable to receive finish coatings specified in Section 09900, Painting.

2.03 FABRICATION, GENERAL

A. Shop-fabricate assemblies to greatest extent possible.

B. Fabricate exterior and interior doors, frames and louvers from hot-dip galvanized steel.

C. Where exposed screws and fasteners are used, provide countersunk, flat Phillips-head fasteners.

D. Fabricate exterior, vestibule and other doors indicated to be insulated in the schedule with foam in place insulation. Door and frame assembly shall have a maximum calculated core U-Value of 0.10 BTU per hour per square foot per degree F in accordance with ASTM C518.

E. Comply with ANSI/DHI A115 series specifications for door and frame hardware preparation. Prepare door and frame using final hardware schedule and templates from hardware supplier.

F. Shop Painting

1. Clean surfaces thoroughly before beginning painting operations, removing rust, scale, oil, grease and other contaminants.

2. Apply primer evenly to provide full protection of all exposed surfaces.

2.04 STEEL (HOLLOW METAL) DOORS

A. Provide doors of size and style indicated.

1. Exterior Doors: SDI-100, Grade III, extra heavy-duty, Model 4, seamless, 16 gauge for doors less than four feet wide and 14 gauge for doors greater than four feet wide.

2. Interior Doors: SDI 100, Grade II, heavy-duty, Model 3, seamless, 18 gauge for doors less than four feet wide and 16 gauge for doors greater than four feet wide.

B. Top and bottom closures on all doors and a weather tight cap on all exterior doors.

C. Where indicated, provide doors with sightproof and weatherproof louvers formed of 24 gauge galvanized steel. Provide louvers with 50% free area, Exterior doors indicated to have louvers shall include an 18x14 aluminum insect screen.

D. Glass lite kits shall be provided to accommodate glass shown or specified. Fame material shall be 20 gauge (minimum) cold rolled steel with mitered corners.

2.05 STEEL (HOLLOW METAL) DOOR FRAMES

A. Fabricate door frames with mitered and welded corners in masonry and exterior openings. Wrap around frames shall be used in metal stud and gypsum board walls. Wrap around frames shall be field assembled with mitered corners that interlock rigidly.

B. Provide concealed fastenings, unless otherwise indicated.

C. Provide galvanized plaster guards or mortar boxes at back of finish hardware cutouts.

D. Drill frames to receive three silencers on strike jamb of side swinging doors, and two silencers on heads of double doors, unless doors are to receive weatherstripping.

E. Provide a minimum of three jamb anchors per jamb for doors 96 inches or less in height and one additional anchor for each additional 24 inches of height.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. All doors and frames specified herein shall be neatly installed in designated locations indicated on Drawings.

B. Install frames in accordance with SDI-105 and as herein specified.

C. Install doors in accordance with SDI-100 and as herein specified.

D. Install fire-rated doors and frames in accordance with NFPA 80.

3.02 PROTECTION AND CLEANING

A. Provide protection against stains, dirt or damage to the finished installation. Adjust doors for proper operation.

B. Immediately after erection and prior to finish painting, remove rusted or damaged prime coat and apply touch-up primer compatible with original primer and final coats.

- END OF SECTION -

SECTION 08210

WOOD DOORS

PART 1 -- GENERAL

1.01 REQUIREMENT

A. Furnish all labor, materials, equipment and appliances required to complete installation of wood doors and hollow metal door frames as indicated on the drawings and as specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 06100 - Rough Carpentry

B. Section 08110 – Steel Doors and Frames

C. Section 08710 - Door Hardware

D. Section 08800 - Glass and Glazing

E. Section 09900 - Painting

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Architectural Woodwork Institute (AWI).

B. ANSI/NWMA I.S.1 - Industry Standard for Wood Flush Doors.

C. NFPA 80 - Fire Doors and Windows.

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 Submittal Procedures and Division 1, submit the following:

1. Product Data

2. Shop Drawings showing layout and installation drawings, details of construction, profiles, reinforcing and schedules.

1.06 DELIVERY, STORAGE AND HANDLING

A. Package materials to protect during shipment from the factory. Protect all hardware which may be attached.

B. Protect products against damage during delivery, storage, and handling. If site storage is necessary, stack materials on blocking clear of ground, tilted to permit water drainage and protected from corrosion and construction abuse.

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C. Protect frames and doors after being set.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Heavy duty solid core doors five ply stave core construction: 1-3/4 inches thick with lifetime guaranteed core. Where fire rated assemblies are required, doors shall be 1-3/4 inches mineral core with lifetime guarantee. Face veneer species shall be premium grade Red Oak, quarter sliced, 1/8 inch thickness. Size doors as indicated and detailed on the drawings. Provide five inch minimum depth top and bottom rails. Provide 10 inch wide stiles blocks for mortise hardware applications.

B. Finish: 4 coat system; filler/stain, sealer, and two clear finish coats. Color to be selected by Owner.

C. Provide fire rated doors with metal frames conforming to UL requirements, as specified in Section 08110.

2.02 ACCEPTABLE MANUFACTURERS

A. Marshfield- Algoma.

B. Eggers Industries

C. Mohawk Flush Doors

D. ASSA ABLOY Wood Doors

PART 3 -- EXECUTION

3.01 GENERAL

A. Provide light openings, flush transoms, undercuts, and glass beads (square edge type). Premachine doors for hardware, as specified under Section 08710. Provide wide stiles and rails as required to accept specified hardware.

B. Factory match doors for color, graining and other characteristics. Where pair of doors occur, provide book match veneer on both faces of doors. Provide doors with 1/2 inch thick edge strips of wood species to match face veneer.

C. Remove and replace all work showing any defects or blemishes.

3.02 INSTALLATION

A. Install doors in strict accordance with all pertinent codes and regulations, manufacturer's recommendations and instructions. Hang square, plumb and straight and firmly anchored in position. Maximum diagonal distortion shall not exceed 1/16 inch measured with a straight edge from corner to corner.

B. Provide fire rated doors with fire rating label attached to door edge. At fire rated walls and vertical shafts.

C. Provide approved edges for fire rating of meeting stiles for fire rated double door assemblies. Provide fire retardant stiles for 20 minute doors in order to preclude use of astragal or metal edges.

3.03 ADJUST AND CLEAN

A. Replace or rehang doors that are hingebound and do not operate freely.

B. Replace doors that do not fit within the allowed clearance.

C. Replace doors that are warped.

3.04 GUARANTEE

A. Manufacturer to submit lifetime guarantee for wood doors installed under this Contract.

- END OF SECTION -

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SECTION 08225

FIBERGLASS DOORS AND FRAMES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, materials, equipment and appliances required for the complete execution of the Work as shown on Drawings and specified herein.

B. Principal Items of work include:

1. Fiberglass frames and doors.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 04200 - Unit Masonry

B. Section 08710 - Finish Hardware

C. Section 08800 - Glass and Glazing

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 Submittal Procedures, submit the following:

1. Samples shall include:

a. Corner sections of frames and trim.

b. Corner sections of doors.

c. Finish and color charts.

2. Shop Drawings shall include, but not be limited to:

a. Complete layout and installation drawings and schedules with clearly marked dimensions. Indicate details of construction, profiles, gauges, reinforcing and location of all doors and frames.

3. Manufacturer's literature.

1.04 WARRANTY

A. The Manufacturer shall unconditionally guarantee the fiberglass reinforced-plastic doors and frames for five (5) years against failure due to corrosion by environmental conditions. Under this guarantee a new door will be offered replacement or the original factory price will be refunded at the discretion of the manufacturer.

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1.05 DELIVERY, STORAGE AND HANDLING

A. All materials shall be boxed or crated and suitably protected prior to shipment from the factory. Protect all hardware which may be attached.

B. Protect products against damage during delivery, storage, and handling. Stack materials on blocking clear of ground, tilted to permit water drainage and protected from corrosion and construction abuse.

C. Frames and doors, after being set shall be protected with heavy Kraft paper or other approved means in such manner to prevent damage. Protection shall be maintained until such time as directed by the Engineer.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, provide products from one of the following manufacturers:

1. Tiger Doors by Overly

2. FIB-R-Door Systems

3. Chem Pruf Door Company

2.02 MATERIALS

A. Provide doors and frames from the same manufacturer.

B. Fiberglass reinforced plastic doors and frames shall be resin transfer molded (RTM). The doors shall be molded in one piece with gel-coat, fiberglass reinforcement, resin and core material molded together. Window openings, door hardware openings and flush hinge recesses shall be molded in. Secondary cutting and coating will not be allowed. Continuous stainless steel bars shall be molded in during the initial molding. The steel plates shall be pretapped to receive screws for attachment of hardware. Door hardware shall be stainless steel.

C. Fiberglass reinforcement shall consist of a surfacing mat followed by continuous stand mat wrapped around rigid closed cell polyurethane foam core material. The outer surface shall consist of 30 mils of high quality commercial grade polyester gel-coat. Fiberglass laminate shall be a minimum of 1/8 inch on all sides and edges. The outer surface of the finished door and frame shall have a matte finish and be free of pits, porosity, blisters, wrinkles, dry glass, cracks or crazing.

D. The fiberglass laminate shall have the following minimum physical properties using the applicable ASTM Standards.

Tensile strength	9,000 psi	ASTM D638
Flexural strength	20,000 psi	ASTM D790
Flexural modulus	$1.0x10^6$	ASTM D790
Impact, Notched Izod foot pound per inch	15.0	ASTM D256
Barcol hardness	40 min. average	ASTM D2583
Water Absorption, degrees 24 hours	0.1 percent	ASTM D570
Average coefficient of thermal expansion inch per inch per degree fahrenheit	$10.5x10^6$	ASTM D696
Flame Spread	25 or less	ASTM E84

2.03 FIBERGLASS REINFORCED PLASTIC DOOR FRAMES

A. FRP frames shall be solid fiberglass. The stop and frame will be molded in one piece. The frame shall be integrally gel-coated to the Owner's color when molded.

B Hardware Preparations/Internal Reinforcement: Doors shall be reinforced and mortised for hardware with a minimum of 1-1/2 inches x 1-1/2 inches of solid fiberglass to allow application of hinges and locks, in accordance with the hardware schedule, hardware manufacturer's instructions and templates. Reinforcement Blocking: Non-swelling polymer or firestop blocking will be used for all lockset, surface mounted hardware and thru-bolted hardware blocking.

C. The jamb shall be flat on the backside (against the opening) and uniform in thickness as to provide a solids, uniform surface against the wall opening. No wood blocks or spacers are permitted.

D. Frame shall meet the industry accepted design details of a standard frame profile which is 5-3/4 inches overall jamb depth with a two inch face, 5/8 inch stop and 5/8 inch return for both wrap around or butt mounting.

E. The gel-coat shall be of .025 thick resin rich surface of an isolphthalic or chemical-resistant polyester resin which is resistant to moisture, ultra violet sunlight and many industrial acids, alkalies and solvents and protects the glass reinforcements from degradation.

2.04 DOORS

A. Fiberglass doors shall be flush type of 1-3/4 inch thickness. Doors shall be constructed with a gel-coat surface of 0.25 resin rich surface of an isophthalic or chemical resistant to moisture, ultra violet sunlight and many industrial acids, alkalies and solvents and protects the glass reinforcement from degradation. The Fiberglass laminate of 1/8 inch thickness shall be the primary structural component of the door. Color shall be selected from manufacturer's standard colors.

B. The core shall be continuously bonded to the laminate for structural support and rigidity. To enhance this bond, the core shall be perforated so that resin posts are formed during the molding process which additionally ties the outer laminates together.

C. The fiberglass door shall be formed to size to produce a totally seamless door.

D. The fiberglass door shall have continuous steel reinforcement for hinge mounting. The lock edge of the door shall be the same steel reinforcement, except it will be interrupted at the lock location for lock installation. The manufacturer shall provide a 1/8 inch thick, 5-inch high x 18 inch long steel reinforcement for closer mounting. Totally encapsulated reinforcements in fiberglass.

1. The door shall be prepared for hardware specified in Section 08710 - Finish Hardware.

2.05 FIRE RETARDANT

A. The doors and frame shall be "Fire Resistant" and will not support combustion.

2.06 ANCHORS

A. Jamb anchors shall be 14 gauge galvanized, flat, "T" anchors to suit frame size with legs not less than three inches by 10 inches. Set anchors at every three masonry courses, a minimum of three per jamb.

B. For cast-in-place concrete, anchor frame jambs with 3/8 inches minimum counter-sunk stainless steel bolts into expansion shield or inserts, with crush-proof sleeves. Provide a minimum of three per jamb.

C. Floor anchors at doors shall be 16 gauge galvanized sheet steel at each jamb. Clip type anchors with two holes to receive fasteners.

PART 3 -- EXECUTION

3.01 FRAME INSTALLATION

A. Install plumb, level and true to line, rigidly secured in openings. Set frames in masonry walls prior to beginning masonry work.

3.02 DOOR INSTALLATION

A. Install plumb, level and true to line. Apply and adjust hardware to achieve quiet and smooth operation.

B. Doors shall fit snugly and close without forcing or binding. Door clearances shall not exceed 1/8 inch at jambs and heads and meeting stiles at pairs of doors. Clearance between bottom of door and finished floor material or threshold shall not exceed 1/4 inch. Frames shall be manufactured and machined to within 1/32 inch for all dimensions.

3.03 PROTECTION

A. Protect installation from damage and touch up scratched areas with same paint used for shop coats. Damaged work shall be repaired or replaced.

- END OF SECTION -

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SECTION 08334

SECTIONAL OVERHEAD DOORS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on Drawings and specified herein.

B. Complete sectional glazed overhead door assemblies with door sections, tracks and appurtenances sized and arranged to suit opening sizes, conditions, and clearance limitations indicated on the Drawings. Coordinate electrical motor requirements.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Electrical connections for motors and accessories are specified in Division 16.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 Submittal Procedures, submit the following:

1. Manufacturer's literature and installation instructions.

2. Drawings showing details of the products, connections to adjoining materials, and schedules showing sizes and types.

3. Finish and color samples.

4. Wind performance data confirming doors are designed to withstand negative and positive wind load pressures in accordance with the Virginia Statewide Building Code.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver products in original and unbroken packages, containers, or bundles bearing the name of the manufacturer.

B. Store materials carefully in an area that is protected from the elements, and in a manner that will prevent damage or marring of the door.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with these specifications provide products from one of the following manufacturer:

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1. Wayne Dalton Corporation.

2. Clopay Building Products Company.

3. Overhead Door Corporation.

2.02 MATERIALS

A. Full View Aluminum Doors

1. Provide heavy duty aluminum door panels with interlocking sections designed to meet 25 psf minimum windload.

2. Panels shall be fabricated from extruded 6053-T5 aluminum with integral reinforcements. Enclosed top and bottom rails shall be minimum of 3 1/2 inches wide, meeting rails shall be minimum 2 5/8" wide and end stiles minimum of 3 1/2 inches. Meeting rails shall meet to form tongue and groove joint and bottom railconfigured to accept weatherstripping.

3. Glazing shall be ½" insulated tempered glass. Provide seals as required for a watertight assembly.

4. Aluminum finish shall be clear anodized.

5. Provide complete perimeter seals.

B. Counterbalance Assembly

Torsion spring counterbalance mechanism consisting of helical wound oil-tempered steel torsion springs having a minimum spring life of 25,000 cycles, mounted on a solid steel keyed shaft, and connected to door with aircraft quality grade galvanized steel lift cable having a minimum safety factor of 7 to 1. Assembly shall be designed for actual door weight.

C. Tracks and reinforcements

1. Galvanized steel tracks and reinforcement. Reinforce vertical tracks with heavy duty mounting brackets 16 inches oc or continuous steel angles welded or through bolted to track. Incline vertical tracks or otherwise design to ensure weathertight closure at jambs when door unit is closed. Reinforce horizontal tracks with continuous steel angles welded to track. Track system shall allow for normal door movement caused by temperature changes. Provide track size recommended for door size.

2. Track Supports: Galvanized steel shapes, except as otherwise indicated.

3. Door Bumpers: Compression spring or leaf spring bumper located at the end of each horizontal track, designed to cushion and stop door at end of opening operation.

4. Configure track to follow wall and bottom of roof trusses.

D. Operation: Motor.

1. UL listed electric operator assembly, complete with operator/motor unit, factory pre-wired motor controller, limit devices, and remote control stations. Motor shall be removable without disturbing the limit switch adjustment and without affecting the emergency release mechanism. Motor shall be 120VAC single phase and sized to open and close the door. Motor shall be designed to NEMA standards. Motor shall be drip proof type. Provide unit with lockable, integral disconnecting means.

2. V-belt or gear primary drive to suit door load and job conditions, chain and sprocket secondary drive, adjustable safety clutch, solenoid operated brake, emergency release mechanism with an auxiliary steel chain hoist which can be engaged/disengaged from floor level for mechanical operation, provide an interlock device to prevent motor from operating when release mechanism is activated. Chain to remain motionless during electric operation.

   a. Reinforce door section for operation attachment.

3. Provide unit with push button operation with momentary control with three buttons labeled OPEN, CLOSE and STOP.

4. Safety Edge Device: Electric or pneumatic/electric safety switch, extending full width of door bottom, located within a neoprene or vinyl astragal mounted to bottom rail. Contact with safety edge device shall immediately stop the downward travel of the door.

E. Weatherstripping

Provide motor operated doors with vinyl sensing/weather edge to prevent door from closing when impeded. Equip jambs and head with neoprene weatherstripping.

F. Finish

Aluminum to clean anodized. Galvanized steel to be chemically cleaned and shop primed. Parts inaccessible after installation shall be given an additional coat in the shop. Color shall be selected by Owner from full range of colors.

PART 3 -- EXECUTION

3.01 INSPECTION

A. Examine substrates and adjoining conditions, where sectional overhead door is to be installed. Correct unsatisfactory conditions prior to proceeding with the work.

3.02 INSTALLATION

A. Install units and operating equipment complete with necessary hardware, jamb, and head moldings, anchors, inserts, hangers and equipment supports in accordance with final approved shop drawings, manufacturer's printed instructions and as specified herein.

B. Secure and support tracks as required to prevent sag, sway, and detrimental vibration during opening and closing of door. Fasten vertical track assembly to framing with continuous steel angles 24 inches oc or with mounting brackets 16 inches oc. Support horizontal (ceiling) track assembly with laterally-braced hanger at end of track, secured to overhead structural members. For doors 10 feet high and over, install an additional laterally-braced hanger at the center of horizontal tracks. Also secure horizontal track reinforcement at wall.

C. Install bracing and supports as necessary to rigidly secure door operating equipment and appurtenances.

D. Do all cutting, drilling, fitting and other work of similar character required for fitting and setting units in connection with this work and adjoining work of other trades.

E. Coordinate location of chains or pulls so they will not interfere with door operation.

3.03 PROTECTION, CLEANING AND ADJUSTMENT

A. Protect units prior, during and after installation.

B. After installation, lubricate, test and adjust to operate easily and freely from warps, twists or distortion and weathertight fit.

- END OF SECTION -

SECTION 08400

ALUMINUM STOREFRONT

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

A. Furnish all labor, materials, equipment and appliances required for the complete execution of Work as shown on the Drawings and specified herein.

B. Manufacturer shall determine storefront assembly sizes as required to resist wind loads. Where storefront system will not provide adequate strength provide curtainwall assembly.

1.02 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 Submittal Procedures, submit the following:

1. Manufacturer's product data.

2. Test reports confirming compliance with Specifications. Include wind load data showing conformance with wind load requirements as shown on Structural Drawings. Indicate sizes, thicknesses, depth and accessories as required to meet wind load requirements.

3. Complete shop drawings showing elevations, construction details, anchorage, joining, and sealing. Drawings shall be to scale and dimensions represent actual field conditions. Details shall include relationship with adjacent surfaces.

4. Samples of frame, corner section, fasteners and color chart.

1.03 SHIPPING, HANDLING AND STORAGE

A. Deliver material in manufacturer's original sealed containers.

B. Store materials in such a way as to prevent damage. Materials which are damaged, including warping, scratches, dents, etc shall be removed from the site.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The following manufacturers are approved for use.

1. Kawneer Company Inc.

2. EFCO Corporation

3. Vistawall Architectural Products

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4. Oldcastle

2.02 MATERIALS

A. Aluminum: Extruded 6063-T5 or T6 alloy and temper.

B. Glass: In accordance with Section 08800 - Glass and Glazing.

C. Fasteners: Stainless Steel or Aluminum.

D. Thermal Break: Poured in place polyurethane. Non-structural thermal barriers will not be acceptable.

E. Dissimilar Metals: Isolate as recommended by manufacturer.

F. Reinforcements: Manufacturer's standard reinforcements as required to resist wind loads.

2.03 PERFORMANCE CRITERIA

A.	Air Infiltration	ASTM E283	0.06 CFM/sq ft max
B.	Water Infiltration	ASTM E331	No water at 8 psf

C. Maximum deflection shall be 1/175 of the span under wind load indicated on Structural Drawings.

D. Wind load shall be in accordance with Virginia Statewide Building Code, Structural Drawings and not less than 25 psf.

2.04 FABRICATION

A. General

1. Aluminum frame extrusions shall have a minimum wall thickness of 0.080". Door sections shall have a minimum 0.125" wall thickness.

2. All exposed work shall be matched to produce continuity a flush design between adjacent surfaces. Exposed raw edges will not be acceptable.

3. Selection of materials shall be based on wind load requirements.

B. Frame

1. Depth shall not be less than 4.5".

2. Face dimension shall not be less than 2".

3. Frame components shall be screw spline construction.

C. Entrance Doors

1. Door depth shall be not less than 2".

2. Door stiles and rails shall have hairline joints at corners. Corner construction shall be mortise and tenon for physical interlock between rails and stiles.

3. Interior corners shall be joined by heavy concealed reinforcement brackets with screws and filet welded.

4. Doors shall have adjusting mechanism in top rail to provide for minor clearance adjustments.

5. Weatherstripping shall be wool pile.

6. Doors shall have a medium stile.

7. Coordinate security components with Security System Installer

D. Glazing

1. Units shall be dry glazed with EPDM gasket on interior and exterior.

E. Door Hardware

1. Hinging shall be heavy duty pivot set. Size and number as recommended by manufacturer for heavy service.

2. Electrified vertical rod exit device by VonDuprin or equal. Electrified vertical rod shall have a maximum draw less than 1 amp. Coordinate with Security System Installer

3. Flush bolts on inactive door.

3. Single acting concealed overhead closer.

4. Push/pull hardware shall be ADA compliant.

5. Aluminum threshold.

6. Weatherstripping.

2.05 FINISH

A. Finish of all exposed areas of storefront and components with a Class 1 clear anodized finish.

PART 3 -- EXECUTION

3.01 INSPECTION

A. Verify that openings are of proper size and plumb, level, and in proper location and alignment. Notify the Engineer of any variances. Do not begin work until all unacceptable conditions are corrected.

3.02 INSTALLATION

A. Use only skilled tradesmen.

B. Storefront system shall be erected plumb and true, in proper alignment and relation to established lines and grades.

C. Entrance doors shall be securely anchored in place to a straight, plumb and level condition. Weatherstripping contact and hardware operation shall be checked and adjusted for proper operation and performance.

D. Apply sealing materials to provide a weather tight installation.

3.03 ANCHORAGE

A. Adequately anchor to maintain positions permanently when subject to normal thermal movement, building movement and specified windload.

3.04 PROTECTION AND CLEANING

A. Protect materials and finish from damage from construction activities and harmful substances. When performing final cleaning remove all protective devices and clean in accordance with the manufacturer's recommendation.

- END OF SECTION -

SECTION 08710

FINISH HARDWARE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, materials, equipment and appliances required for the complete execution of Work as shown on Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 08110 – Steel Doors and Frames

B. Section 08210 – Wood Doors and Frames

C. Section 08225 – Fiberglass Doors and Frames

D. Section 08400 – Aluminum Storefront

E. Section 16726 – Intrusion Detection System

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of these specifications, the Work shall conform to the applicable requirements of the following documents:

1. ANSI/BHMA 156

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 Submittal Procedures, submit the following:

1. Manufacturers data for each item of hardware. Include installation and maintenance instructions.

2. Furnish templates to fabricators of other work which is to receive hardware.

3. Hardware schedule organized into "hardware sets," indicating complete designation of every item required for each door or opening. Furnish initial draft of schedule at the earliest possible date, in order to facilitate the fabrication of other work (such as hollow metal frames) which may be critical in the project construction schedule. Furnish final draft of schedule after samples, manufacturer's data sheets, coordination with shop drawings for other work, delivery schedules and similar information has been completed and accepted.

4. Prepare a keying schedule in consultation with the Owner.

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1.05 QUALITY ASSURANCE

A. Provide materials, assemblies, equipment and services from a single source for each category except that locksets, latchsets and cylinders must originate from the same manufacturer.

B. Replace any item of finish hardware which cannot be installed or will not function properly.

C. Provide hardware complying with NFPA 80 and UL labeled for fire rated openings.

D. Furnish templates or information to door and frame manufacturer. Coordinate between the manufacturers where two or more articles of hardware are to be mounted on the same door. Verify all dimensions, new and existing.

E. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thicknesses, profile, swing, security and similar requirements indicated, as necessary for proper installation and function.

1.06 DELIVERY, STORAGE AND HANDLING

A. Handle, store, distribute, protect and install hardware in accordance with manufacturer's instructions or recommendations. Deliver packaged materials in original containers with seals unbroken and labels intact.

B. Properly mark or label, so each piece of hardware is readily identifiable with the approved hardware schedule. Tag each change key or otherwise identifying the door of which its cylinder is intended. Where double cylinder functions are used or where it is not obvious which is the key side of a door, appropriate instructions shall be included with the lock and hardware schedule.

C. Provide secure storage area for hardware.

PART 2 -- PRODUCTS

2.01 MATERIALS AND FABRICATION

A. Hand of Door

1. Drawings show swing or hand of each door leaf (left, right, reverse bevel, etc.). Furnish hardware for proper installation and operation of door.

B. Manufacturer's Name Plate

1. Do not use manufacturer's products which have name or trade name displayed in a visible location (omit removable nameplates), except in conjunction with required UL labels.

C. Base Metals

1. Produce hardware units of the basic metal and forming method indicated, using manufacturer's non-corrosive metal alloy, composition, temper and hardness but in no case of lesser quality material than specified.

D. Fasteners

1. Manufacture hardware to conform to published templates, generally prepared for machine screw installation. Do not provide hardware which has been prepared for self tapping sheet metal screws, except as specifically indicated.

2. Furnish stainless steel fasteners for installation with each hardware item. Exposed finish (under any condition) to match hardware finish or surfaces of adjacent work. Match the finish of adjacent work as closely as possible, including surfaces to receive painted finish.

3. Provide fasteners which are compatible with unit fastened and the substrate, and which will not cause corrosion of deterioration of finish hardware, base material or fastener.

E. Tools for Maintenance

1. Furnish a complete set of specialized tools as needed for Owner's continued adjustment, maintenance, removal and replacement of builder’s hardware.

F. Hardware Finishes

1. Stainless steel, US32D unless otherwise noted.

2. Closers shall have a USP finish unless otherwise noted.

G. Field Checks

1. Make periodic checks during installation of finish hardware to ascertain the correctness of the installation. After completion of the work, certify in writing, that all items of finish hardware have been installed, adjusted and are functioning in accordance with Specification requirements.

2.02 DESCRIPTION OF PRODUCTS

A. Hinges

1. Stainless steel full mortise concealed oil impregnated ball bearing type, five knuckle with non-rising pins for interior doors, and non-removable and non-rising pins for exterior doors. Tips shall be flat.

2. Sizes and weights of hinges:

a. Doors up to 36 inches – 4-1/2 inches regular weight.

b. Doors 36 inches to 40 inches – 5 inches regular weight.

c. Doors 40 inches to 48 inches – 5 inches heavy weight.

d. Fire Rated Doors up to 36 inches – 5 inches regular weight.

3. Provide three hinges per door leaf up to and including 90 inches and one additional hinge for each 30 inches of additional height.

4. Acceptable Manufacturers: Stanley Hardware, Hager Hardware

B. Continuous Geared Hinges

1. Acceptable manufacturers:

Ives	Hager	Select
112HD	780-112HD	SL11HD
224HD	780-224HD	SL24HD

2. Provide one of the above models of continuous hinges as specified. Coordinate hinge types with the door supplier. Hinges shall be provided by a single manufacturer.

3 Clearance: Coordinate clearance requirements between hinge, door and frame.

4. Fasteners: Per manufacturer's recommendations.

5. Material: Aluminum 6063-T6

6. Length: Hinge length shall be full height of door minus manufacturer requirements (1" max).

7. Door Reinforcement: Minimum 16 gauge channel.

8. Frame Reinforcement: Minimum 16 gauge channel.

9 Provide electric power transfer (EPT) cutouts, or electric through-wire options as specified in hardware groups.

C. Locksets and Latchsets

1. Stainless steel, heavy-duty mortise type conforming to ANSI A156.13 Series 1000, Grade 1.

2. Wrought steel box strikes.

3. Stainless steel deadbolt with 1" throw approval.

4. 2 3/4 inch back set, 3/4 inch throw, two-piece anti-friction latchbolt.

5. Non-ferrous critical internal parts.

6. Cylinders shall be manufactured to conform to grand master key program.

7. Trim Design: LWM with wrought escutcheon by Corbin\Russwin or equal lever with return. Provide knurling on all levers leading into hazardous rooms and electrical rooms.

8. Acceptable Manufacturers: Yale, Corbin\Russwin, Schlage

D. Keys and Keying

1. Provide construction keyed, removable core master key system as directed by the Owner.

2. Furnish ten core removal keys and a quantity of master keys as directed by the Owner, not to exceed ten each per group. Furnish a minimum of 15 change keys per cylinder.

3. Furnish cylinders with six pin cores.

4. Provide a key schedule showing all key numbers and spaces to which each permits entry. The schedule and key cabinet, along with key gathering envelopes containing keys for each lock endorsed with lock number and space designation, shall be turned over to the Owner. Install keys with proper tags in the key cabinet. Establish a construction master key, and apply to locks and cylinders, except for closets, within major spaces. Locks for closets shall be shipped unlocked and the keys delivered to the Owner with the balance of the keys.

5. Acceptable Manufacturers: Yale, Corbin\Russwin, Schlage

E. Key Cabinet

1. Provide a wall mounted key cabinet with baked enamel interior finish and exterior prime coat with cylinder keyed to project master key system. Cabinet shall accommodate all keys in the project, plus twenty (20) percent additional. Location shall be coordinate in field with Owner.

a. Provide cabinet with key control system consisting of permanent key markers, temporary key markers, "out" key control tags, and cross indexing cards. Instruct Owner personnel how to use system.

b. Acceptable Manufacturers: Yale, Bommer

F. Panic Hardware

1. Heavy duty push bar exit device, U.L. labeled, with corrosive resistant construction.

2. ANSI A156.3, Grade 1.

3. Exterior trim to closely match locksets.

4. Single/active doors: mortise type.

5. ANSI Function 08.

6. Acceptable manufacturer's: Von-Duprin, Adams Rite Manufacturing Company, Corbin/Russwin

G. Closers

1. Cast iron case with seamless one-piece forged steel spring tub.

2. Heavy duty forged steel arm.

3. Non-sized fully adjustable from size 1-6.

4. Backcheck intensity and location valves.

5. Delayed action closing.

6. Full metal cover.

7. Mechanical hold open device, except at fire rated doors.

8. ANSI 156.4, Grade 1.

9. Conforms to ADA 5 lbf. maximum door opening force requirement for non-fire rated interior doors.

10. Provide mounting brackets, and fasteners required for proper attachment.

11. Provide closers at fire rated doors.

12. Acceptable manufacturers: Corbin/Russwin, LCN, Norton

H. Overhead Door Holder

1. Heavy duty bronze, surface mounted with positive grip holder.

2. Track: extruded bronze.

3. Degree of opening: 85 - 110.

4. Finish: Satin Chrome Plated.

5. Acceptable manufacturers: Corbin/Russwin, Glynn-Johnson, Norton.

I. Door Stops and Bumpers

1. Finish: Satin chrome plated.

2. Floor mounted door stops.

   a. Acceptable manufacturers and products: H.B. Ives 444, Hager Hardware Model 267F, and Glynn-Johnson Model FB36.

3. Wall Bumpers

   a. Acceptable manufacturers and products: H.B. Ives Model 407, Hagar Hardware Model 234W, and Glynn-Johnson Model 60C.

J. Flush Bolts

1. U.L. listed.

2. Forged brass construction, 1/2" diameter flattened bolt tip, 12" long rod.

3. Fit standard ANSI door preparation.

4. Acceptable manufacturers: Glynn-Johnson, Hager Hardware, and H.B. Ives.

K. Automatic Flush Bolts

1. U.L. listed.

2. Forged brass or stainless steel construction, 1/2" diameter flattened bolt tip, 12" long rod.

3. Fully automatic.

4. Operation shall incorporate an override function.

5. Tested for a minimum of 100,000 cycles.

6. Provide dust proof strikes.

7. Acceptable manufacturers: Glynn-Johnson, Hager Hardware, and H.B. Ives.

L. Push Plates and Pulls

1. Push and pull plates: 4"x16"x0.050" stainless steel.

2. Pulls: through bolted, 1" diameter, 2 1/2" projection, 12" centers, stainless steel.

3. Acceptable manufacturers: H.B. Ives, Hager Hardware, and Builders Brass Works.

M. Coordinator

1. U.L. labeled and tested for 100,000 cycles.

2. Stop mounted, provide filler strips to fully cover stop.

3. Adjustable holding power and override feature.

4. Acceptable manufacturers: Gylnn-Johnson, Hager Hardware, and H.B. Ives.

N. Kickplates

1. Stainless steel, 0.050" thick, beveled 3 sides, 8" high, width 2 inches less than door width.

2. Acceptable manufacturers: H.B. Ives, Hagar Hardware, and Builders Brass Works.

O. Silencers

1. Rubber silencers: 3 for each single door and 2 for each double doors.

2. Rubber Silencers at fiberglass door locations shall be self-adhesive type.

3. Acceptable manufacturers and products: (Hollow metal doors and frames): Glynn-Johnson Models 64 or 65, Hager Hardware Models 308D or 307D, H.B. Ives Models 20 or 21.

4. Acceptable manufacturers and products: (Fiberglass doors and frames): H. B. Ives Model SR66 or equal.

P. Thresholds

1. Extruded aluminum saddle type and fiberglass for opening with fiberglass door and frames. Provide with stainless steel fasteners. Six inches wide or as shown on drawings.

2. Acceptable manufacturers: Pemko, National Guard Products, Incorporated, and Zero International. Fiberglass threshold by fiberglass door and frame manufacturer.

Q. Door Bottom Seal

1. Extruded aluminum with neoprene seal.

2. Acceptable manufacturers and products: Pemko Model 57, Zero International Model 328 and National Guard Products, Inc. Model 96.

R. Weatherstripping

1. Extruded aluminum with neoprene seal.

2. U.L. Labeled.

3. Acceptable manufacturers and products: Pemko Model 294, National Guard Products, Inc. Model 190, and Zero International Model 328.

PART 3 -- EXECUTION

3.01 GENERAL

A. Templates

1. After the hardware schedule is approved furnish to the various manufacturers, required blueprint templates for fabrication purposes. Templates shall be made available not more than ten (10) days after receipt of the approved hardware schedule.

B. Packaging and Marking

1. Ship hardware with proper non-corrosive fastenings for secure application. Each package of hardware shall be legibly marked indicating the part of the work for which it is intended. Markings shall correspond with the item numbers shown on the approved hardware schedule. Keys shall be tagged within each package set and plainly marked on the face of the envelope with the key control number, door designation and all identification as necessary.

C. Security System

1. Coordinate security system components with Security System Installer. Security devises, power supplied and accessories shall be provided by Security installer. Provide reinforcements, chases, and other accessories required to accommodate security system with minimal exposed parts. Doors with security access system shall have electric strike (HES 1006 or equal) and a door contact installed. Aluminum storefront double doors shall be provided with electrified vertical rod devices as indicated in Specification Section 08400.

3.02 INSTALLATION

A. Install hardware in a manner which will eliminate cracks on surfaces.

B. Mount hardware units at heights recommended in "Recommended Locations for Builders Hardware" by BHMA, except as otherwise indicated or required to comply with governing regulations.

C. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Do not install surface-mounted items until finishes have been completed on the substrate.

D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as is necessary for proper installation and operation.

E. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with factory standards.

F. Cut and fit thresholds and floor covers to profile of door frames, with mitered corners and hair-line joints. Join units with concealed welds or concealed mechanical joints. Cut smooth openings for spindles, bolts and similar items, if any.

G. Screw thresholds to substrate with No. 10 or larger screws, of the proper type for permanent anchorage and of bronze or stainless steel which will not corrode in contact with the threshold metal.

H. Set thresholds in a bed of either butyl rubber sealant or polyisobutylene mastic sealant to completely fill concealed voids and exclude moisture. Do not plug drainage holes or block weeps. Remove excess sealant.

3.03 ADJUST AND CLEAN

A. Adjust and check each operating item of hardware and each door to ensure proper operation or function. Lubricate moving parts as recommended by manufacturer. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application.

B. Final Adjustment

1. One week prior to acceptance or occupancy make a final check and adjustment of all hardware items. Clean and relubricate operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices and compensate for final operation of heating and ventilating equipment.

C. Instruct Owner personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

3.04 HARDWARE SETS

A. The door hardware sets on the Drawings indicates functional and general requirements. Items shall be quality and finish as specified. Hardware set identification refers to set numbers indicated on the Drawings. Coordinate with Security System installer. Provide hardware required to meet Code requirements. Consult Drawings for set number required.

B. Hardware shall be as follows:

<u>Hardware Sets</u>

1. ALUMINUM STORE FRONT DOORS
Cylinder
Remainder of hardware by door manufacturer.
Coordinate with security system installer for devices and wiring.

2. EXTERIOR DOUBLE DOORS EXCEPT ELECTRICAL AND CHEMICAL ROOM DOORS
Hinges
Entrance Lockset
Overhead Door Closer Holder (each leaf)
Flush Bolts
Coordinator
Kickplate
Threshold
Door Bottom Seal
Weatherstripping
Astragal w/Weatherstripping

3. EXTERIOR SINGLE DOORS EXCEPT CHEMICAL ROOMS
   Hinges
   Entrance Lock Set (Storage Lockset at Fire Equipment Room and Security Doors)
   Storage Lockset, Electric Strike, Door Contacts at doors with Security Access Controls (Coordinate with Security System Installer)
   Door Closer
   Kickplate
   Threshold
   Door Bottom Seal
   Weatherstripping

4. INTERIOR SINGLE DOORS INTO STAIRWELL, AND BREAKROOM
   Hinges
   Passage Latchset
   Door Closer
   Kickplate
   Silencers
   Door Bumpers

5. INTERIOR SINGLE DOORS INTO OFFICES AND CONTROL ROOM
   Hinges
   Office
   Storage Lockset, Electric Strike, Door Contacts at doors with Security Access Controls (Coordinate with Security System Installer)
   Kickplate
   Wallbumper
   Silencers

6. INTERIOR SINGLE DOORS INTO MECHANICAL, MAINTENANCE AND STORAGE ROOMS
   Hinges
   Store Room
   Overhead Door Stop
   Kickplate
   Wallbumper
   Silencers

7. INTERIOR SINGLE DOORS INTO UNISEX TOILETS
   Hinges
   Bathroom
   Kickplate
   Wallbumper
   Silencers

8. INTERIOR SINGLE DOORS INTO MULTI-PURPOSE ROOM
   Hinges
   Passage
   Overhead door holder/stop
   Kickplate
   Wallbumper
   Silencers

9. INTERIOR SINGLE DOORS INTO MULTI-STALL BATHROOMS
   Hinges
   Push/Pull
   Door Closer/Holder
   Kickplates
   Silencers

10. INTERIOR SINGLE DOORS THROUGH FIRE RATED WALLS OR LABORATORY
    Hinges
    Entrance
    Door Closer
    Flush Bolts
    Coordinator
    Kickplates (each leaf)
    Threshold
    Door Bottom Seal
    Smoke Seal (jamb)

11. SINGLE DOORS INTO CHEMICAL ROOMS
    Hinges
    Panic Hardware
    Door Closer
    Kickplate
    Weatherstripping
    Threshold
    Door Bottom Seal

12. DOUBLE DOORS INTO CHEMICAL OR ELECTRICAL ROOMS
    Hinges
    Panic Hardware (Active Leaf)
    Door Closer (each leaf)
    Coordinator
    Automatic Flush Bolts
    Kick Plate
    Weatherstripping
    Threshold
    Door Bottom Seal

13. BYPASS SLIDING CLOSET DOORS
    Bypass sliding closet door hardware with soft close, stainless steel wire pulls, and lockset by Johnson or equal.

14. DOUBLE DOORS INTO MAINTENANCE OR STORAGE ROOMS
    Hinges
    Storage Lockset
    Door Closer (each leaf)
    Coordinator
    Automatic Flush Bolts
    Kick Plate
    Weatherstripping
    Threshold
    Door Bottom Seal

15. DOUBLE EGRESS DOORS
    Hinges
    Vertical Rod Panic Hardware
    Door Closer (each leaf)
    Kick Plate
    Weatherstripping
    Threshold
    Door Bottom Seal

16. EXTERIOR SINGLE DOORS EXIT ONLY
    Hinges
    Exit Only
    Door Closer
    Kickplate
    Threshold
    Door Bottom Seal
    Weatherstripping

- END OF SECTION -

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SECTION 08800

GLASS AND GLAZING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, materials, equipment and appliances required for the complete execution of Work as shown on Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 07410 - Metal Wall Panels

B. Section 08110 – Steel Doors and Frames

B. Section 08400 – Aluminum Storefront

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the requirements of these specifications the Work shall conform to the applicable requirements of the following documents:

1. CPSC 16 CFR1201 "Safety Standard for Architectural Glazing Materials."

2. ANSI Z97.1 "Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings."

3. North American Glazing Association "Glazing Manual."

4. Underwriters' Laboratories "Building Materials Directory."

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 Submittal Procedures, submit the following:

1. Sample of each type of glass and color chart.

2. Complete layout and installation drawings and schedules with clearly marked dimensions.

3. Manufacturer's technical descriptions and reports for glass and glazing.

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1.05 JOB CONDITIONS

A. Check openings to verify that frames are plumb and true, square and secure.

B. Take field dimensions for cutting glass and fabricating units.

C. Do not install glazing when ambient temperature is less than 50 degrees F.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in the manufacturer's original unopened labeled containers, clearly marked with their name and brand. Transport large panes of glass in vertical position with spacers to prevent contact between panes and edges.

B. Store glass in a dry, well ventilated location at a constant temperature, maintained above dew point. Handling shall be kept to a minimum. Protect glass from soiling, condensation or moisture of any kind.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications provide products manufactured by one of the following:

1. PPG Industries

2. Libby - Owens - Ford

3. Cardinal IG

2.02 MATERIALS

A. Primary glass shall meet the requirements of ASTM C1036-90. Heat treated glass shall meet the requirements of ASTM C1048-90.

B. Tempered glass shall be plate or float glass tempered by a special heat process and 1/4-inch thick or as noted on Drawings. Tempered glass shall meet the requirements of ANSI Z97.1 and Consumer Product Safety Commission 16 CFR 1201. Tempered glass shall be used for all applications, unless otherwise noted.

C. Insulating glass shall be preassembled units of glass enclosing a hermetically sealed dehydrated air space and certified through the Insulating Glass Certification Council (IGCC) in accordance with ASTM E-773, E-774 with Low-E coating. Glass shall be made from tempered glass, or heat-strengthened glass where recommended by manufacturer for application indicated. The unit shall consist of a tinted 1/4" thick exterior light, 1/2" air space and 1/4" thick clear interior light. Sealing system shall consist of metal spacer with bent or soldered corners, butyl primary and silicone secondary seal. Desiccant shall be manufacturer's standard. Exterior pane shall be tinted and color shall be selected by the Owner from full range of colors. Minimum performance SHGC 0.40 and U Value of 0.38.

D. Fire rated glass shall be FireLite Plus® as manufactured by Nippon Electric Glass Company, Ltd., and distributed by Technical Glass Products or equal glass shall be 5/16” thick. Provide glass fire rated tested for fire rated assembly (doors, windows, or walls) shown in accordance with UL and NFPA requirements. Provide glass that additionally meets the requirements of ANSI Z97.1 and CPSC 16CFR1201 (Cat 1 and II). Glass shall be premium grade ground and polished both sides. Permanently label each piece of glass.

E. Opaque panels shall utilize insulating glass construction, both lights shall be heat strengthened. Tinting to match glass color and shall be applied to the #2 surface and an opaque ceramic frit to the #3 surface.

F. Glazing materials shall be a resilient, non-hardening glazing compound of either a polysulfide or a silicone type. Materials shall not contain any solvents and shall be 100% solids. Oil base putty shall not be used. Glazing compounds shall not be thinned with chlorinated solvents or benzene related compounds. Glazing tape may be used where, and as, recommended by the manufacturer. The color of all exposed glazing materials shall harmonize with the window units.

G. Setting blocks and spacer shims shall be a non-staining material as recommended by the glass manufacturer.

PART 3 -- EXECUTION

3.01 GENERAL

A. Determine glass sizes by measuring the frames to receive the glass at the site. Comply with the manufacturer's specified tolerances for each type of glass including cutting tolerance, minimum edge clearance, minimum face clearance, and cover on glass.

B. The edges of all tempered and insulating glass shall be protected from damage and edges shall not be modified in any way after the glass leaves the factory. Nipping of any glass to reduce size shall not be permitted.

C. Deliver glass with manufacturer's labels showing type, thickness and quality of material (and U.L. label as required). These labels shall not be removed until the glass is set and final approval has been secured.

3.02 INSTALLATION

A. Sheet glass shall be cut and set with waves running horizontally.

B. All glass shall be set in such manner as to avoid possibility of breakage.

C. Rabbets shall be thoroughly cleaned and shall have been prime coated before glass is set.

D. Glass shall be well bedded and back glazed and all surplus compound and markings shall be carefully removed from doors, sash and adjoining work, while still fresh. Compound shall be finished in true, even lines, neatly and smooth faced. Set glass in strict accordance with the manufacturer's printed directions.

E. All glass when set and glazed shall be free from rattle and be watertight.

F. Glazing molds shall be removed and replaced in their correct locations in such a manner as not to mar molding or the screws securing same.

G. Install fire rated glass in strict accordance with manufacturer’s requirements to meet fire rated assembly shown on Drawings.

3.03 PROTECTION AND CLEANING

A. Before and after installation, all work shall be properly protected against damage.

B. On completion and prior to turning the project over to the Owner, all metal work and glass shall be cleaned and left in perfect condition. Glass shall be washed outside and inside.

- END OF SECTION -

SECTION 08950

TRANSLUCENT WALL ASSEMBLIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Section Includes: Translucent wall assemblies, including:

1. Removable, insulated translucent wall panel system including aluminum framing, battens, closures, trim, stiffeners, and flashings.

1.02 REFERENCES

A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

B. American Society for Testing and Materials (ASTM):

1. ASTM C509 – Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.

2. ASTM C864 - Dense Elastomeric Compression Seal Gaskets, Setting Blocks and Spacers.

3. ASTM E283 - Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors.

4. ASTM E330 - Structural Performance of Exterior Windows, Curtainwall, and Doors by Uniformed Static Air Pressure Difference.

5. ASTM E331 - Test Method for Water Penetration of Exterior Windows, Curtain Walls and Door by Uniform Static Air Pressure Difference.

C. Aluminum Association (AA)

1. AA Specifications for Aluminum Structures.

D. American Architectural Manufacturers Association (AAMA)

1. AAMA 501 - Methods for Test for Metal Curtain Walls.

2. 603-98 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.

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3. 2604-98 - Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.

4. 611-98 - Specification for Anodized Architectural Aluminum.

1.03 SYSTEM DESCRIPTION

A. Performance Requirements: Provide translucent wall assembly system which has been manufactured, fabricated and installed to withstand from dead, live, and all other loads required by the Virginia Building Code and performance criteria stated by manufacturer without defects, damage or failure.

B. Removable Structural Wall Requirements

1. Structural framing to be designed to meet the requirements of the Virginia Building Code. System design and calculations must also be furnished in accordance with the Aluminum Association "Specifications for Aluminum Structures" and sealed by a Professional Engineer registered in the Commonwealth of Virginia

2. Framing system shall be designed to be removable.

3. Superstructure shall be pre-fabricated of extruded aluminum alloy 6005-T5 or 6061-T6 tubular box beams. Ferrous metals shall not be allowed. All parts shall be pre-assembled at the factory, and knocked down for shipment to jobsite.

4. Panels shall be as specified herein.

5. Finish on exposed structure shall be as specified herein.

1.04 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1, Submittal Procedures, Section 01 33 00.

B. Product Data: Submit product data. Submit test results showing compliance with requirements specified under Performance Requirements paragraph herein. Include both published data and specific data prepared for this project.

C. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including anchorage, accessories, finish colors, patterns and textures.

1. Submit shop drawings for approval prior to fabrication. Include detailed plans, elevations, and details of framing members, translucent glazing materials, sealants, fasteners, anchors, and thicknesses and types of formed flashing and closures and relationship with adjacent materials. Indicate maximum horizontal and vertical forces at rafters.

2. Submit shop drawings and design calculations, showing design loads and stresses on translucent wall system. Calculations shall be signed and sealed by a professional engineer registered in the Commonwealth of Virginia.

D. Samples – Submit selection and verification samples for finishes, colors and textures.

1. Aluminum Finish: Submit color charts or range samples for initial color selection. Submit finished sample of color selected for use on metal coupons. Translucent Glazing Materials: Submit a verification sample, 12" (305 mm) square of the specified translucent glazing material specified.

E. Quality Assurance Submittals: Submit the following:

1. Design Data: Complete Energy and structural calculations.

2. Test Reports: Manufacturer shall submit certified test reports, independently verified, for the wall system. Reports shall verify that the materials will meet or exceed all performance requirements of this specification. Previously completed test reports will be acceptable if for the current manufacturer of the translucent panel system manufacturer and indicative of the product used proposed for use on this project. Required Test Reports are:

a. Flame Spread and Smoke Developed (ASTM E-84 by UL 790)
b. Burn Extent (ASTM D-635)
c. Color Difference (ASTM D-2244)
d. Erosion Resistance (ASTM D-4060)
e. Impact Strength (UL 972)
f. Tensile Bond Strength (ASTM C-297 after aging by ASTM D-1037)
g. Shear Bond Strength (ASTM D-1002 after five (5) separate conditions)
h. Beam Bending Strength (ASTM E-72)
i. Insulation "U" Factor (NFRC-100)
J. Class A Burning Brand (ASTM E-108)

F. Closeout Submittals: Submit the following:

1. Operation and Maintenance Data: Operation and maintenance data for installed products. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.

2. Warranty: Warranty documents specified herein.

1.05 QUALITY ASSURANCE

A. Qualifications

1. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.

a. Installer: Manufacturer of translucent wall assembly system, or his authorized installer, shall install system.

2. Manufacturer Qualifications: Manufacturer capable of providing field service representation during construction and prequalifying acceptable installer.

3. Manufacturer: Systems shall be manufactured by a firm with a minimum of ten years experience in the fabrication and installation of translucent wall systems.

B. Source Quality: Obtain translucent wall assembly materials from a single manufacturer.

1.06 DELIVERY, STORAGE & HANDLING

A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact. Sequence deliveries to avoid delays, but minimize onsite storage.

B. Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

1. Store and handle in strict compliance with manufacturer's instructions and recommendations, including storing panels on the long edge several inches above ground, blocked and under cover to prevent warping. Protect from damage from sunlight, weather, excessive temperatures and construction operations.

1.07 PROJECT CONDITIONS

A. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1. Measurements: When practical, take accurate field measurements before preparation of shop drawings and fabrication. Do not delay job progress; work from "guaranteed dimensions" and allow for field trimming of perimeter flashing if taking field measurements before fabrication is not possible.

1.08 WARRANTY

A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official.

1. System Warranty: Provide written warranty signed by manufacturer, agreeing to repair or replace work which exhibits defects in materials or workmanship. Defects are defined to include uncontrolled leakage of water, abnormal aging or deterioration, or failure to perform as required.

a. Warranty Period: 5 years from date of substantial completion.

2. Translucent Glazing Material Warranty: Provide written warranty signed by manufacturer, agreeing to repair or replace glazing materials which exhibit defects in materials or workmanship. Defects are defined to include fiberbloom, or more than 6.0 Delta E units of discoloration.

a. Warranty Period: 10 years from date of manufacture.

3. The face sheet manufacturer shall warrant the exterior face sheet against reinforcing fiber exposure, due to weathering, for a period of twenty-five (25) years. Warranty from any other party in this regard is not acceptable.

PART 2 – PRODUCTS

2.01 TRANSLUCENT WALL ASSEMBLIES

A. Manufacturers:

1. Kalwall Corporation (Structures Unlimited, Inc.)

2. Major Industries

2.02 MANUFACTURED UNITS

A. Panel Construction:

1. Provide double-faced, insulated, translucent fiberglass sandwich panels complying with the following:

a. Thickness: 2 3/4" (70 mm).

b. Grid Size: 12" x 24" (305 x 61 mm).

c. Grid Pattern: Square.

d. Light Transmission: 15 % max.

e. Exterior Sheet: 0.070" thick; White as selected from manufacturer's standard colors. To be uniform in strength, impenetrable by hand held pencil and repel an impact equal to 70 ft. lbs., without fracture or tear, when impacted by a 3¼" diameter, 5 lb. Free falling ball per UL 972.

f. Interior Sheet: 0.045" thick UL listed; White as selected from manufacturer's standard colors.

g. Solar Heat Gain Coefficient: 0.16.

h. U-Factor: 0.23

2. Fabricate panels as a true sandwich panel of flat fiberglass sheet bonded to a grid core of mechanically interlocking aluminum I-beams, laminated under a controlled process of heat and pressure.

a. Adhesive bonding line shall be straight, cover the entire width of the I-beam and have neat, sharp edge.

b. White spots at intersections of muntins and mullions shall not exceed 4 for each 50 sq ft (4.65 m2) of panel, nor be more than 3/64" (1.19 mm) in width.

3. Panel Performance:

a. Deflection: Not to exceed 3 1/2" (89 mm) at 34 lb per sq ft (166 kg/m2) loading, and not to exceed 0.090" mm) set deflection after 5 minutes per ASTM E72 on a 4' x 12' (1.22 x 3.66 mm) panel.

b. Support Strength: Panel capable of supporting, without failure, a 300 lb (136.2 kg) concentrated load when applied to a 3" (76.2 mm) diameter disk per ASTM D661.

B. Components and Accessories

1. Structure: Extruded aluminum alloy 6063-T5 or 6063-T6 box beams. System shall be of a Minimum Outward Thrust design.

2. Grid Core: Aluminum l-beams, minimum 7/16" (11.1 mm) width, fabricated of extruded aluminum alloy 6063-T6 with provision for mechanical interlocking of muntin/mullion and perimeter which prevents high and low intersections which do not allow full bonding surface to contact with face material.

3. Translucent Facing: Fiberglass panels manufactured with uniform color, free of ridges, wrinkles, clusters of air bubbles and pinholes, with the following characteristics:

a. Flammability for Interior Face Sheet: Flamespread no greater than 20 and smoke developed no greater than 200 per ASTM E84. Burn extent no greater than 1" (25.4 mm) per ASTM D635.

b. The exterior face shall have a permanent glass erosion barrier embedded beneath the surface to provide maximum long-term resistance to reinforcing fiber exposure. Sacrificial surface films or coatings are not acceptable erosion barrier. Exterior face surface loss shall not exceed .7 mils and 40 mgs when tested in accordance with ASTM D4060-90 employing CS17 abrasive wheels at a head load of 500 grams for 1000 cycles.

c. Weatherability of Exterior Face Sheet: Not more than 3.0 units of color difference Delta E per ASTM D2244 after 5 years outdoor weathering in South Florida at 5 degrees facing south per ASTM D1435. Fabricate from colorfast resin.

d. Strength of Exterior Face Sheet: Uniform in strength and repel an impact equal to 60 ft-lb per Free Falling Ball test per UL 972.

4. Battens and Perimeter Closure Systems: Extruded aluminum alloy 6063-T6 or 6063-T5, for screw clamp-tight closure system. Fasten to panels with Type 304 self-tapping stainless steel screws. Receiving channels for screws shall be continuous, with length of each member extruded as part of the member.

    a. Thermally broken panel and clamping system.

5. Flexible Sealing Tape: Manufacturer's standard sealing tape, pre-applied to closure system at factory under controlled conditions.

6. Laminate Adhesive

    a. Heat and pressure resin type adhesive engineered for structural sandwich panel use, with minimum 25-years field use. Adhesive shall pass testing requirements specified by the International Code Council “Acceptance Criteria for Sandwich Panel Adhesives”.

    b. Minimum tensile strength of 750 psi when the panel assembly is tested by ASTM C-297 after two (2) exposures to six (6) cycles each of the aging conditions prescribed by ASTM D-1037.

    c. Minimum shear strength of the panel adhesive by ASTM D-1002 after exposure to five (5) separate conditions:

        (1) 50% Relative Humidity at 73°F: 540 psi
        (2) 182°F: 100 psi
        (3) Accelerated Aging by ASTM D-1037 at Room Temperature: 800 psi
        (4) Accelerated Aging by ASTM D-1037 at 182°F: 250 psi
        (5) 500 Hour Oxygen Bomb by ASTM D-572: 1,400 psi

2.03 FINISHES (FACTORY)

A. Aluminum Finishes: Provide the following finish for interior and exterior exposed aluminum surfaces:

1. All exposed aluminum to have architectural corrosion resistant finish complying with AAMA 2604. Color to be selected by Owner from manufacturer’s standards.

PART 3 -- EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including product technical bulletins, and manufacturer’s shop drawings for installation.

3.02 EXAMINATION

A. Site Verification of Conditions: Verify substrate conditions which have been previously installed under other sections are acceptable for product installation in accordance with manufacturer's instructions. Take field dimensions and examine conditions of substrates, supports, and other conditions under which this work is to be performed and notify Design/Builder, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected.

3.03 INSTALLATION

A. Translucent Wall Assembly Installation

1. Match profiles, sizes and spacings indicated on approved shop drawings. Ensure that weep and condensation control system operates properly.

2. Coordinate installation with adjacent work, sheet metal and other work to ensure creation of a complete weatherproof assembly. Anchor work securely to supporting structure, but allow for differential and thermal movement.
3. Isolate between aluminum and dissimilar metals with a protective coating or plastic strip to prevent electrolytic corrosion.

3.04 ADJUSTING

A. Adjusting: During installation, remove labels, part number markings, sealant smears, handprints and construction dirt from all components. Touch up damaged coatings and finishes and repair minor damage to eliminate all evidence of repair. Remove and replace work which cannot be satisfactorily repaired.

3.05 CLEANING

A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.

1. Clean exposed surfaces including metal and glass using non-abrasive materials and methods recommended by manufacturer of material or product being cleaned. Remove and replace work that cannot be successfully cleaned.

2. Reclean as necessary to prevent damage.

3.06 PROTECTION

A. Protection: Protect installed product and finish surfaces from damage during construction.

1. Protect completed work from damage and deterioration and inspect immediately before final acceptance of project.

- END OF SECTION -

SECTION 09260

GYPSUM DRYWALL SYSTEM

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, materials, equipment and appliances required for the complete execution of Work as shown on the Drawings and specified herein

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 09900 – Painting

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of these specifications the Work shall conform to the applicable requirements of the following documents:

1. ASTM C-1396 Specification of Gypsum Board

2. ASTM C-840 Specification for Application and Finishing of Gypsum Board

3. ASTM C-854 Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in the Section 01 33 00 Submittal Procedures, submit the following:

1. Product information on each item specified.

2. Metal stud span tables or engineered calculations showing proper size and gauge for spans and anticipated loads.

1.05 SHIPPING, HANDLING AND STORAGE

A. Store materials in a completely enclosed area. Remove from the site and do not use gypsum board, and accessories, which get wet.

B. Stack gypsum wallboard flat with sufficient support underneath to avoid sagging. Take precautions to avoid damage to edge, corners and surfaces.

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PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:

1. National Gypsum Co.

2. United States Gypsum Co.

3. Georgia Pacific

2.02 MATERIALS

A. Regular Mold Resistant Gypsum Board: 5/8-inch thick or thickness as shown on Drawings, with long edges tapered on the face side, and conforming to ASTM C-1396.

B. Fire Retardant Gypsum Board: 5/8-inch thick or thickness as shown on Drawings, with square edges conforming to ASTM C-1396 and fire rated by Underwriters Laboratories. Provide at rated partitions.

C. Moisture and Mold Resistant Gypsum Board: 5/8-inch thick or thickness as shown on Drawings, with tapered edges on the face side and conforming to ASTM C-630. Provide in break-room, toilet, laboratories, janitors, water fountain areas where finish is indicated as paint.

D. Gypsum Ceiling Board: 1/2-inch gypsum core ceiling board with additives to enhance the sag resistance of the core and surfaced with paper, with tapered edges.

E. Tile Backer Board: 5/8-inch thick or thicknesses as shown on Drawings, with glass mesh and reinforced edges and conforming to ASTM D3273. Provide where ceramic tile finish is indicated.

F. Metal Trim: 26 gauge galvanized steel, manufactured by United States Gypsum under the following numbers.

1. Ceiling Trim: No. 200-B

2. Castings: No. 200-A

3. Outside Corner Trim: No. 103

4. Control Joints: No. 093

G. Tape and Joint Compound: As approved by manufacturer of gypsum board.

H. Screws and other fastenings: Type S-12 bugle head with length at least 3/8 inch longer than thickness of gypsum board.

I. Adhesive: As approved by manufacturer of gypsum board.

J. Metal framing for interior non-load bearing walls. Interior walls shall be designed to support 5 psf load and as required by Building Code and loads associated with equipment, casework, etc. mounted to wall.

1. Studs: 1-5/8 inch, 2½ inch, 3-5/8 inch, 4 inch, and 6 inch C-shaped, minimum 22 gauge unless shown otherwise on Drawings, galvanized steel and complying with ASTM C-645. Flange width shall be 1 1/4 inch minimum. Use metal stud gauge as required to meeting loading indicated above. Sizes shown on Drawings or as required to conceal electrical conduit, electrical boxes, structural steel, HVAC ducts, etc. Gauge and size shall be verified with tables or engineered calculations.

2. Track: U-shaped track with 1-1/4 inch legs, minimum 22 gage unless shown on Drawings, galvanized steel complying with ASTM C-645. Size as required by studs.

3. Main Furring Channels: 1½ inch cold rolled steel channel, 0.054 inch, galvanized steel.

4. Cross Furring Channels: ¾ inch cold rolled steel channel, 0.054 inch, galvanized steel.

5. Rigid Furring Channel: 7/8 or 1½ inch hat channel, minimum 25 gage unless shown on Drawings, galvanized steel and conforming to ASTM C-645. Use size as required to conceal electrical conduit, electrical boxes, pipes, etc.

6. Z-Furring Channels: Z-shaped channels with a minimum base steel of 25 gage unless shown on Drawings, galvanized, and complying with ASTM C645. Size as indicated on Drawings.

PART 3 -- EXECUTION

3.01 PRELIMINARY

A. Verification: Examine all Drawings covering the work of this Section, and refer to other Drawings which may affect this work or require coordination by this trade. Execution of work of this trade constitutes acceptance of adjoining work and other conditions as being satisfactory in every respect. Later claims of defects in such cases will not constitute relief in any way from the requirement of the Specifications.

B. Cooperation: Cooperate with all trades supplying materials or performing work in connection with the work under this Section to those of other trades whose work is affected. Provide to the job items required to be built into the work in ample time to avoid delaying the normal progress of such other work.

3.02 INSTALLATION

A. Unless otherwise specified, methods of installation shall be in accordance with the requirements of the GA 216, the Gypsum Association, and the approved manufacturer.

B. Minimum temperature in areas where gypsum board is to be installed shall be 65 degrees F for 24 hours before, during, and after installation. Provide adequate heat and ventilation to remove any moisture.

C. Butt all wallboard joints loosely together. Butt ends shall not be placed against tapered edges. Gap at end joints shall be 1/8-inch minimum.

D. Install in maximum practical lengths to span walls without butt joints. If butt joints do occur, stagger joints and locate as far as possible from center of walls.

E. Support end joints on framing members. Apply end joints compounds to back of board along end joints.

F. No end joints shall align with edges of openings. Install expansion and/or control joints where shown, or required.

G. Install metal trim at doors, corners, edges and elsewhere as shown in accordance with the manufacturer's instructions and recommendations.

H. Openings cut in wallboard to fit mechanical and electrical items shall fit snugly and be small enough to be covered by escutcheons and plates. Both face and back paper shall be cut when cutouts are not made with a saw.

I. Adhesive and joint finishing compounds shall be mixed in strict accordance with the manufacturer's instructions. Mix only enough at one time to be used during the recommended pot life of the compound.

J. Fasteners shall be installed as follows:

    1. Install no closer than 3/8-inch to end or edge.

    2. Begin from center of wallboard and proceed to outer edge.

    3. Pressure shall be applied on wallboard adjacent to fasteners being driven to ensure a tight fit of wallboard to the support without puncturing the paper.

K. Drive screws with a power screw driver as recommended by the manufacturer. Surface of head shall finish below the surface of the paper without puncturing the paper.

L. Where Gypsum Board is adhered directly to a masonry substrate, scrape, clean and remove all loose particles, dust, oil, grease or other foreign material as required or recommended by adhesive and gypsum board manufacturer. Apply adhesive according to manufacturer's recommendations and instructions. Place gypsum board, hold with temporary blocking if required and recommended by manufacturer, so panels are straight, plumb and in proper alignment.

M. Install continuous sound absorbing blanket in partitions indicated on the Drawings. Installation shall be in accordance with manufacturer's directions.

N. Cutting and Fitting: Do all cutting and fitting of the work of this Section as required for the installation of the work of other trades. Do all cutting and fitting in a neat manner, and leave all work in a first-class and presentable condition.

O. Cleaning: At all times during the progress of the work keep all parts clean and remove all rubbish and debris caused by the work of this Section. Upon completion, remove any and all protective coatings, clean off all parts of the work of this Section and leave the entire installation in presentable and orderly condition.

P. Defective Work: All defective, damaged, defaced or other work of sub-standard quality shall be replaced with new work in accordance with this Specifications, at no additional cost to the Owner.

3.03 JOINT TREATMENT AND FINISH

A. Execute joint treatment in accordance with the manufacturer's printed instructions and the Specifications. Provide a minimum level 4 finish in accordance with ASTM C-840.

B. A second and third coat of joint compound or joint finishing compound shall be applied to corner beads, tape and screws after each preceding coat has been allowed to thoroughly dry. Coats shall be spread over tape and the tapered portion of edge and feathered out at the edge.

C. Sand compound when thoroughly dry; avoid roughing surfaces of finish wallboard.

D. Leave all surfaces smooth and uniform, ready to receive paint.

3.04 PATCHING AND REPAIRING

A. After trim is applied, correct all surface damage and defects as required, to the Engineer's satisfaction, so that blemishes will not show through the decoration.

B. If, in the opinion of the Engineer, the wallboard is unrepairable, remove same and replace it with new material at no extra cost to the Owner.

3.05 INSPECTION

A. Wall surfaces, when prepared for painting, or other finish materials, shall be inspected and approved before proceeding further.

B. Wall surfaces shall be prepared and painted in accordance with painting Section 09900 - Painting.

- END OF SECTION -

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SECTION 09310

CERAMIC TILE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, tools, equipment, materials and supplies required for complete execution of Work shown on Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03300 - Cast-In-Place Concrete

B. Section 04200 - Unit Masonry

C. Division 15 - Plumbing Fixtures

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. TCNA Handbook Handbook for Ceramic, Glass and Stone Tile Installation.

B. ANSI A137.1 Specification for Ceramic Tile

1.04 QUALITY ASSURANCE

A. Conform to American National Standard Specifications for the Installation of Ceramic Tile.

1.05 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 Submittal Procedures, submit the following:

1. Samples of each color and type of tile specified.

2. Product data specifications and instructions for using adhesives and grouts.

3. Manufacturer's certification that tile conforms to ANSI A137.1.

4. Cleaning methods, cleaning solutions, stain removal methods, and polishes and waxes recommended.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver tile in unopened grade sealed containers.

B. Maintain tile in protective packaging whenever possible.

C. Protect adhesive from freezing or overheating in accordance with manufacturer's instructions.

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1.07 EXTRA STOCK

A. Deliver to the Owner a minimum of one unopened box of tile of each size and color provided on project for extra stock.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE TILE MANUFACTURERS

A. The following manufacturers are approved for use:

1. Florida Tile Industries, Inc.

2. American Olean Company.

3. Dal Tile Company.

2.02 MATERIALS

A. Provide tile from a domestic manufacture, standard grade, complying with ANSI 137.1. Colors shall be selected by the Owner from manufacturer's full range of colors. Obtain material required for any one type and color of tile from a single source and lot.

B. Ceramic wall tile shall be nonvitreous body, matte glazed, cushion-edged, 6 inches square, unless otherwise shown; with self-spacing lugs on all four edges, including all required trim and cove type base. Provide bull-nosed external corners and square internal corners.

C. Marble Saddles: Double bevel, 4 inches in width and 1/2 inch deep, length, as shown on Drawings. Cope to door frame.

D. Provide trim shapes for typical conditions and as required to make a complete installation at all conditions. Trim shapes shall conform to the following:

1. Base - Cove required.

2. In-Corners - Square.

3. Jambs - Bullnose where tilework projects form jamb.

2.03 SETTING MATERIALS

A. Mortar materials shall conform with ANSI A118.4 Latex Modified Portland Cement with the following properties:

1. Hydrated Lime - ASTM C207 Type S

2. Sand - ASTM C144

3. Water - Potable

4. Portland Cement ASTM C150 Type 1

5. Latex as recommended by manufacturer

B. Provide Portland cement mortar bed were recesses are provided in structural floor to provide proper slope to drain. Install in accordance with ANSI A108.1.

2.04 GROUT TYPE

A. Cementitious type, resistant to shrinking, and manufactured by Jamo, Southern Grouts and Mortars, Inc., American Olean. Grout shall meet the requirements of ANSI A118.7.

2.05 ACCESSORIES

A. Metal edge strips shall be zinc alloy or stainless steel, 1/8 inch x 1-1/4 inch x length required.

PART 3 -- EXECUTION

3.01 CERAMIC TILE INSTALLATION

A. Maximum variations in wall surface shall be 1/8 inch in 8 feet and 1/8 inch in 10 feet for floor surfaces. Report all unacceptable surfaces to Engineer and do not tile such surfaces until acceptable.

B. Before tiling, be sure surfaces to be tiled are free from coatings, oil, grease, wax and dust.

C. Align all wall and floor joints to achieve straight uniform grout lines plumb and level (at walls) and parallel with walls (at floors).

D. Use products in strict accordance with recommendations and directions of manufacturers, ANSI and TCA.

E. All wall surfaces to receive tile shall be primed when recommended by the adhesive manufacturer.

F. Determine locations of all movement joints before starting tile work.

G. Do not set tile on surfaces where other work is specified or detailed to be embedded in or behind the tile work, until such work has been installed and approved.

H. Provide expansion joints or control joints over all structural slab joints as per T.C.A. and manufacturer's recommendations and instructions, and where shown on Drawings. Joints shall be of constant width, neatly done and sealed with specified sealant. Sealant shall match grout color of the tile field in which it is used.

I. Lay out tile to avoid using less than half a tile. Locate tile cuts in both walls and floors to be least conspicuous. Smooth and clean all exposed tile edges prior to installation.

J. Form angles with proper integral round-in and round-out tile, with stop tile and proper trimmers installed where required.

K. Cut and drill tile neatly and accurately, so intersections and returns are perfectly formed. Cut edges of tile shall be carefully ground and fitted. Fit tile closely around electrical and other outlets, piping, fixtures and fittings, so plates, collars and escutcheons, overlap the tile.

L. Do drilling, cutting and fitting where required for the installation of accessories and Work of other trades, and upon completion, do all patching neatly and carefully. Build in all accessories and similar items furnished by others.

M. Furnish and install metal edge strips where tile floor abuts another material. Locate strip below the center line of doors at doorways.

N. Joints shall be of constant width, neatly done and sealed with specified sealant.

3.03 STORAGE AND PROTECTION

A. Apply to all clean, completed tile work a protective coat of neutral cleaner solution, one part cleaner to one part water.

B. Cover all tile floors with heavy duty non-staining construction paper masked in place.

C. Prohibit all foot and wheel traffic from using newly tiled floors for at least 3 days, preferably 7 days after completion of installation.

D. Place large flat boards in walkways and wheelways for 7 days where use of new tiled floors is unavoidable.

3.04 CLEANING

A. Upon completion of grouting, clean all tile surfaces as thoroughly as possible, observing tile manufacturer's recommendations as to the use of acid and chemical cleaners.

B. Just before final acceptance of tile work, remove paper and rinse protective coat for neutral cleaner from all tile surfaces.

- END OF SECTION -

SECTION 09510

ACOUSTICAL CEILING SYSTEM

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, materials equipment, and appliances required for complete execution of Work shown on Drawings and Specified herein.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. ASTM C635 - Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.

B. ASTM C636 - Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.

C. ASTM E580 - Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint.

D. ASTM E1264 - Classification of Acoustical Ceiling Products.

E. Ceilings and Interior Systems Design/Builder s Association (CISCA).

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 Submittal Procedures submit the following:

1. Manufacturer's literature, and installation instructions.

2. Sample tiles showing color and texture.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver in original, unbroken, packages, container, or bundles bearing the manufacturer's label.

B. Carefully store in an area that is protected from the elements in a manner recommended by the product manufacturer. Store in a manner that will prevent damage to the material or marring of its finish.

1.05 EXTRA MATERIAL

A. Provide 100 square feet of extra material to Owner.

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PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Acoustical Panels

1. The following manufacturers are approved for use:

a. U.S. Gypsum.
b. Armstrong World Inc.
c. Celotex

B. Grid Systems

1. The following manufacturers are approved for use:

a. Donn Products, Inc.
b. National Rolling Mills, Inc.
c. Chicago Metallic Co.

2.02 GRID SYSTEM MATERIALS

A. Main tees shall be heavy duty, cold-rolled 15/16 inch exposed 'T', electro-galvanized steel, with corrosion-resistant aluminum cap on exposed surfaces.

B. Cross tees shall be properly sized, 15/16 exposed 'T' cold-rolled, electro-galvanized steel, with corrosion-resistant aluminum cap on exposed surfaces.

C. Wall molding shall be 1-inch x 3/4-inch matching tees in material and finish.

D. Hanger and diagonal bracing wires shall be not lighter than 12-gauge, pre-straightened, galvanized, annealed steel wire.

E. Spacers shall be tempered spring steel and shall be fitted into wall molding to provide tension on the ceiling system.

F. Cloud Trim: Extruded aluminum, 8” high curved trim with a white painted finish.

2.03 ACOUSTICAL PANEL AND TILE MATERIALS

A. ACT, TYPE 1: Non-directional design, mineral fiber, 3/4 inch thick square edge tile or panel with sizes, as specified or shown. Class A per ASTM E-1264 and flame spread 25 or under per Federal Specifications SS-S-118B. CALLA by Armstrong or equal.

B. ACT, TYPE 2: 100% ceramic-bonded mineral fiber, 5/8 inch thick, square edge tile or panel with sizes, as specified or shown, Class A, ASTM E 1264 and a flame spread rating of under 25 per Federal Specifications SS-S 118B. Panels shall have non-directional fine textured design. Design for use in Laboratory.

PART 3 -- EXECUTION

3.01 GENERAL

A. The acoustical ceiling system shall consist basically of continuous main tees and intersecting cross tees, joined together to form the patterns specified or shown herein, and acoustical ceiling panels and tiles layed in. The system shall be complete with all necessary components, anchors, and supports.

B. The system shall be designed so that the ceiling panels may be removed and replaced without damage, and so that main tees and cross tees can be removed or replaced without deforming the members or disturbing the balance of the grid system.

C. Suspension systems and tile work shall be coordinated with lighting fixtures, air diffusers, and other features so that all installations work together without interference.

3.02 INSTALLATION

A. Install in strict accordance with the manufacturer's published directions, instructions, and specifications.

3.03 PROBLEM AREAS

A. Manufacturer's published recommendations and specifications shall be followed for installation, materials, and treatment of problem areas; provided, that the manufacturer's published recommendations and specifications are not less than those required by "Specification for Acoustical Tile and Lay-In Panel Ceiling Suspension Systems" of the Acoustical Materials Association, and the Building Code.

3.04 DEFLECTIONS

A. The ceiling system shall be engineered to carry the applied dead and live loads with a deflection of less than 1/360 of the span and shall be level to within 1/8-inch in 12 feet. The ceiling system shall conform to ASTM C 635 (Heavy Duty classification) with a minimum load carrying capacity of the main runner of 16 pounds per LF of span of 4-feet 0-inches.

3.05 PREPARATION

A. Inspect areas receiving acoustical treatment ensure a proper installation. Do not proceed with work before all conditions are ready to receive the acoustical panel work.

3.06 PATTERN AND SYMMETRY

A. Layout ceiling panels symmetrical about the center of the rooms to provide the least number of cut panels. The panels shall be laid in a pattern with all edges in alignment and with all faces in a plane. There shall be no noticeable variations in the finish ceiling plane. Items located within the ceiling plane such as, but not limited to, the following: light fixtures, air diffusers, speakers smoke detectors, and fire sprinklers shall be coordinated with other trades and shall be installed at the locations shown.

B. Nondirectional tile shall be laid so no fissure pattern direction is established.

C. Tiles shall be held down by use of hold down clips, in exterior and vestibule areas.

3.07 BEAM SPLICES AND TEE INTERSECTIONS

A. Main tees shall be joined together by a splice clip which draws the members tightly together with bottom flanges flush. Cross tee intersections shall be joined together by interlock methods, by positioning the ends of the cross tees snugly against the main tee and in holding the cross tees in vertical alignment with bottom flanges flush. Main tee splices and cross tee intersections shall be capable of withstanding at least 100 lbs. tension or compression.

B. The main tees and cross tees which terminate at the walls shall be attached to a perimeter wall molding, which shall be continuous along at least 2 intersecting walls, with spring steel stops. Wall molding shall be securely attached to the walls at approximately 16-inch intervals in an acceptable manner.

3.08 HANGER WIRES

A. Hanger wires shall be spaced at maximum 48-inch o.c. along the main beams and at the corners of lay-in-fixtures and elsewhere as required for a fire-rate system.

B. Secure to the supporting structure with acceptable fastenings. Hangers and fastenings shall be capable of carrying at least 4 times the design load but not less than 100 lbs.

3.09 HORIZONTAL RESTRAINT

A. Ceiling systems shall be provided with diagonal bracing wires. Horizontal restraints shall be effected by 4 No. 12-gage wires secured to the main tees within 2 inches of the cross tee intersection and splayed 90 degrees from each other at an angle not exceeding 45 degrees from the plane of the ceiling. The horizontal restraint points shall be placed 12 feet on center in both directions with the first point within 4 feet from each wall. The restraint wire attachment to the supporting structure shall be adequate for the loads imposed.

3.10 FINISHED CONDITION

A. Acoustical ceiling system shall be free from any discoloration, dire, smidges, scratches, chips blemishes, and/or any misalignment. All damaged materials shall be replaced so that a new uniform acoustical ceiling system is provided.

- END OF SECTION -

SECTION 09650

RESILIENT FLOORING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all materials and labor required to complete the work required for the complete execution of the work including but not limited to:

1. Vinyl Composite Tile in rooms and spaces designated "VCT" on Finish Schedule on the Drawings.

2. Rubber Base in rooms and spaces designated "Rubber" on Finish Schedule on the Drawings.

3. Extruded Vinyl Edge Strips at exposed edges of resilient flooring.

4. Rubber stair treads and landings on enclosed exit stairs.

5. Underlayment, adhesives, leveling compound and accessories required to complete Work of this Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03300 - Cast-In-Place Concrete

1.03 REFERENCE SPECIFICATION, CODES AND STANDARDS

A.	ASTM F 1066	Standard Specification for Vinyl Composite Floor Tile
B.	ASTM F 1861	Standard Specification for Resilient Wall Base
C.	ASTM E 84	Test Method for Surface Burning Characteristics of Building Materials.

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 Submittal Procedures, submit the following:

1. Samples of each product clearly marked to show the manufacturers name, product identification, color and pattern

2. Manufacturer's technical literature, installation instruction and maintenance instructions.

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1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver manufactured materials in original, unbroken packages, containers or bundles bearing the name of the manufacturer.

B. Carefully store as recommended by the manufacturer in an area that is protected from the elements. Storage shall be in a manner that will prevent damage to the products and marring of their finishes.

1.06 EXTRA STOCK

A. Provide 1 carton of extra material to Owner.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The following manufacturers are approved for use.

1. Armstrong World Industries, Inc.

2. Mannington Commercial

3. Azrock Products, Inc.

2.02 ACCESSORY MATERIALS

A. The Owner will select the color and texture from the manufacturer's full range of materials within each category specified. More than one color or texture of each material may be selected.

B. Accessory materials which are necessary for proper installation and for problem areas shall be as recommended or specified in the manufacturer's published specifications and installation instructions.

C. Adhesives shall be solvent-free premium latex adhesive, and be approved by the manufacturer of the floor covering or wall base being used. The adhesive shall be resistant to both alkali and moisture and shall be capable of securely holding the floor covering or wall base firmly in place and hermetically sealing and binding the joints. Adhesive shall comply with SCAQMD Rule 1168.

2.03 MATERIALS

A. Vinyl-Composition Tile shall conform to ASTM F 1066, Class 2, 12 inches x 12 inches x 1/8 inch thick, asbestos free. Colors shall be selected from manufacturer's full range of colors by the Owner.

B. Rubber base shall meet requirement of ASTM F 1861-98, Group 2, Style B, Type TP, top-set cove type, 1/8 inch thick in heights indicated on the Drawings. Provide premolded internal and external corners and end pieces. Colors shall be selected from manufacturer's full range of colors by the Owner.

C. Provide molded rubber stair treads, risers and stringers. Stair treads shall conform to Federal Specification FR-T650C, Composition A, Types 1, 2, and 4. Provide abrasive strip design. Provide rubber flooring at landings to match color and pattern of stair tread. Provide materials by Roppe Corporation, Flexco Company.

D. Edge strips shall be one inch wide by 1/8 inch thick with one edge beveled and rounded. Edge strips shall be extruded vinyl as produced by the manufacturer of vinyl flooring.

E. Underlayment, primers and adhesives shall be of the waterproof type, compatible with materials with which used and as manufactured or recommended by the approved flooring manufacturer.

PART 3 -- EXECUTION

3.01 PREPARATORY WORK

A. Prior to commencing any Work, test the substrate for moisture to ascertain its acceptability to receive the finish flooring. Remove all dirt, grease, oil and other foreign matter which might impair the proper bond of materials. Do all straightening, leveling and smoothing as required for level floor. Inspect dividing and edging strips for position and elevation.

B. Commencement of any Work of this Section will be construed to mean that all surfaces and conditions were found to be acceptable and subsequently will be construed as a waiver to any claim to the contrary.

3.02 INSTALLATION

A. Install in strict accordance with the manufacturer's specifications and instructions governing each type of flooring.

B. Lay all flooring flush with adjacent surfaces whether or not surfaces are similar or dissimilar. Where the substrate requires filling or building-up to produce flush surfaces with adjacent material, such work shall be done in an approved manner, without additional cost to the Owner.

1. Remove excessive cement and all stains from the surfaces.

C. Cutting of flooring shall be neatly done and closely fit, with all contours neatly scribed and cut.

D. Joints shall be as tight and inconspicuous as possible with all surfaces smooth, straight and free from buckles, waves or projecting edges.

1. Lay joints parallel and at right angles to surrounding walls, symmetrical about the center line of the room.

3.03 CLEANING, WAXING AND POLISHING

A. After installation thoroughly clean off any surface dirt or dust then wax and buff dry by machine, bringing the surface to a sheen. Inspect the work and make immediate adjustment, after the final buffing. All tile showing broken edges, corners, or fracture lines partially or entirely across their surface, shall be carefully removed and new materials of same color and thickness installed.

3.04 REPLACEMENT MATERIAL

A. Provide one additional box of each type, color and pattern of resilient flooring and base used on the project and store them where directed by the Owner.

- END OF SECTION -

SECTION 09680

CARPET

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, materials, equipment, and appliances required for the complete execution of Work as shown on the Drawings and specified herein.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS.

A. ASTM E 84 Test Method for surface Burning Characteristics of Building Materials.

B. Carpet and Rug Institute's - "Carpet Specifier's Handbook"

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 Submittal Procedures, submit the following:

1. Carpet (minimum of 12 colors) and edge samples. Patterns, textures and colors shall be as selected by the Engineer. Up to three colors may be selected.

2. Manufacturer's literature on care, stain removal, cleaning and maintenance.

1.04 QUALITY ASSURANCE

A. Carpet

1. Product of a manufacturer who has specialized in the manufacturing of similar products for a period of at least 5 years or more in the production of materials of the kind and quality specified.

B. Installer

1. Install carpet by an experienced installer. Submit the following evidence of qualifications of installer:

a. Continuously in business for minimum of 5 years.

b. Experience in commercial carpet installations of comparable size and type specified.

C. Test Requirements

1. The carpeting shall meet or exceed requirements of ASTM E 84 (Steiner Tunnel Test), Class "A" rating.

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1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver carpet and accessories in original, unbroken packages, containers, or wrappings, bearing the name of the manufacturer along with identification markings.

B. Store materials in an area that is protected from the elements and in a manner recommended by the manufacturer.

PART 2 -- PRODUCTS

2.01 CARPET

A. General requirements:

1. Construction - Tufted, level loop pile

2. Gage - 1/10-inch

3. Stitches per - 10 minimum

4. Pile Height 1/8-inch minimum

5. Face Yarns - 3 ply (minimum) continuous filament, solution dyed nylon with static protection and soil resistant.

6. Face Weight - 28 ounce per square yard.

7. Primary Back - Polypropylene or woven polypropylene

8. Secondary Back - Stainless jute, or woven polypropylene.

9. Total Weight - 66 ounce per square yard minimum.

10. Size - 2 feet x 2 feet.

11. Color - As selected by the Engineer from the manufacturer's standard selections.

12. Warranty: 10 year stain resistant warranty, minimum.

2.02 ACCESSORIES

A. Accessories: Type recommended and approved by carpet manufacturer.

B. Edging: An extruded aluminum, heavy-duty type. Color and type as selected by the Engineer from submitted samples.

C. Seam Adhesive: Moisture resistant seaming adhesive approved by manufacturer.

D. Fillers and Leveling Materials: As recommended by manufacturer.

E. Provide one unopened box of each color selected.

PART 3 -- EXECUTION

3.01 GENERAL

A. Surfaces to receive carpeting shall meet minimum requirements established in the printed recommendations of the carpeting manufacturer. Determine actual area dimensions and surface conditions and correct surface defects before starting installation.

3.02 FLOOR SURFACE PREPARATION

A. Immediately prior to the installation of carpet, prepare sub-flooring to be free of defects, irregularities, droppings, grease, oil, paint, varnish, hardeners, sprinkled cement, plaster, or any material that would interfere with the proper adhesion between the carpet and sub-floors surface. Sub-floors shall be level and free of irregularities to assure one constant floor height after carpet is installed. Level irregularities by a process of grinding high spots and filling low spots with a suitable filling and leveling material for floor patching.

3.03 CARPETING INSTALLATION

A. Install carpet in accordance with referenced specifications and manufacturer's instructions and recommendations for seam locations, uniformity of direction and lay of pile.

B. Prior to installation, sweep the floor using a non-oil base sweeping compound.

C. Install carpet within allowable temperature range stated by the manufacturer.

D. Layout tile to center in space. Cut evenly along walls. Fit evenly around projections and into trim strips. Fit closely and evenly to and through thresholds.

E. Extend carpet under open-bottomed obstructions, removable flanges and furnishings and into closets or alcoves of each space or area.

F. Provide cutouts where required and bind cut edges properly where not concealed by protective edge guards.

G. Perform field cuts with straight edge or other acceptable methods to produce a true straight cut. Uneven cuts will be cause for rejection of carpet.

H. Install tile with adhesive in strict accordance with manufacturer’s instructions and recommendations.

I. Install carpet edge guards wherever carpet edge is exposed or abuts thinner finish flooring materials. Anchor edge guards securely to substrate.

3.04 CLEANING AND PROTECTION

A. After installation is complete, remove dirt and debris and clean spots with proper spot remover. Remove loose threads with sharp scissors and vacuum carpet clean.

B. Protect installed carpeting. Do not allow traffic and movement of equipment and furnishing on carpet for at least 24 hours after installation.

C. Remove spots and clean carpet by vacuuming.

- END OF SECTION -

SECTION 09740

EPOXY FLOOR TOPPING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Scope:

1. Furnish all labor, materials, equipment, and incidentals required to furnish and install seamless Epoxy Floor Topping systems as shown and specified.

2. There are two type of Epoxy Floor Topping (EP). Epoxy Floor Topping shall utilize a granular broadcast and Epoxy Terrazzo (ET) shall utilize a flake broadcast.

3. Epoxy Floor Topping Work includes:

a. Surface preparation and installation of Epoxy Floor Topping.

b. Epoxy Coved Bases at all walls, curbs and columns adjacent to areas of epoxy flooring.

c. All clean-up following installation of the Epoxy Floor Topping.

B. Coordination: Review installation procedures under other Sections and coordinate the installation of items that must be installed with the Epoxy Floor Topping systems.

1.02 QUALITY ASSURANCE

A. Manufacturer's Instructions: In addition to specified requirements, strictly comply with resin Manufacturer's printed instructions and recommendations, including:

1. Preparation of substrate.

2. Storing.

3. Mixing and applying materials.

4. Curing of Epoxy Floor Topping Work.

B. Installer's Qualifications:

1. All Epoxy Floor Topping and coved base shall be applied only by a firm which:

a. Is a recognized installer of epoxy flooring systems and has at least five (5) years proven experience in the installation and repair of epoxy flooring, or similar type flooring systems.

b. Is approved and certified by the materials Manufacturer to install the product.

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C. System Coordination and Source:

1. In order to obtain a completely coordinated flooring system with compatible components, all materials shall be supplied and/or coordinated through the Manufacturer of the flooring resins.

2. All components, and all installation methods and procedures shall be in strict conformance with the resin Manufacturer's written recommendations.

D. Epoxy components shall not produce volatile organic compounds during installation and all air regulations shall be complied with during installation of work.

1.03 SUBMITTALS

A. Samples:

1. Submit 6-inch samples of accessories such as divider strips, edge strips, expansion strips, etc.

2. Provide flat samples, 36" x 36" minimum, of the full thickness flooring materials, with differing amounts of skid-resistance:

a. Provide a minimum of three such samples, installed on hardboard backing for District review, and selection of surface finish required.\

3. Color samples.

B. Shop Drawings:

1. Submit Shop Drawings for layout and details of all stop and divider strips, expansion strips and base strips.

C. Manufacturer's Certificate:

1. Submit copies of manufacturer's written certification that all epoxy flooring system materials meet or exceed the properties specified herein.

D. Qualifications:

1. Submit installer qualifications including letter from manufacturer stating that the installer is certified and approved to install flooring. Provide letter showing a listing a minimum of five projects of similar scope and using the same materials and manufacturer proposed.

2. Submit detailed Plan of Operation for building ventilation and access restrictions prior to beginning Work in any new area or location.

PART 2 -- PRODUCTS

2.01 SYSTEM

A. The flooring system shall consist of the following:

1. Concrete surface preparation and moisture testing in accordance with manufacturer's printed recommendations and installation instructions.

2. Surface priming with a moisture tolerant primer with excellent wetting properties.

3. An epoxy bodycoat with multi-colored quartz aggregate broadcast or flake to simulate terrazzo.

4. Two topcoats as required to provide desired finish.

5. Final cleaning.

B. Finished Floor Physical Properties:

1. Compressive Strength: 8,000 minimum PSI after 7 days.

2. Flexural Strength: 2,400 PSI minimum.

3. Tensile Strength: 1, 500 PSI minimum.

4. Water Absorption: 0.20% maximum.

5. Hardness (Shore D): 85-90.

6. Nominal Finished Floor and Coved Base Thickness:

a. 3/32-inch minimum, unless indicated otherwise at specific areas. Provide additional coats as recommended by manufacturer to achieve desired thickness.

D. Finished Floor Performance Properties:

1. Bond Strength to Concrete: 400 PSI minimum or cohesive failure of concrete.

2. Flammability: Self-extinguishing; ASTM-D-635-63.

3. Fungus and Bacteria Resistance: Will not support growth of fungus or bacteria when subjected to tests; MIL-F-52505, Section 4.4.2.11.

4. Wear Resistance (Taber): 60 mg, maximum loss per 1000 cycles.

5. Slip resistance as required to meet accessibility and safety codes.

E. Product and Manufacturer:

1. Stonshield SLT (Epoxy Floor Topping) and Stontec UTF (Epoxy Terrazzo) as manufactured by Stonhard.

2. Steri-Quartz B (Epoxy Floor Topping) and Steri-Flake (Epoxy Terrazzo) as manufactured by Dudick, Inc.

3. Series 222 Deco-Tred (Epoxy Floor Topping) or Deco-Flake (Epoxy Terrazzo) as manufactured by TNEMEC.

4. Ceramic Carpet #4000 (Epoxy Floor Topping) or Decorative Mosaic (Epoxy Terrazzo) by General Polymers.

5. Or equal.

2.02 COMPONENTS

A. General: All components of the Epoxy Floor Topping system are to be coordinated by the Manufacturer and mixed and installed in strict compliance with the Manufacturer's recommendations. The following are intended to be general component descriptions only, and are not intended to alter the resin Manufacturer's specific formulation or recommendations.

B. Surface Primer: Two component, penetrating, moisture tolerant epoxy primer applied at 150-200 square feet per gallon. Provide crack isolation membrane or coat where recommended by manufacturer.

C. Bodycoat shall epoxy resin.

D. Boardcast aggregates and flakes into surfaces in accordance with manufacturer’s recommendations. After cure sweep and remove all loose. Sand as required to create a smooth surface.

E. Seal Coat: UV resistant top coat with excellent abrasion, chemical, and color stability.

F. Expansion Joints:

1. At structural expansion or control joints.

2. Joint Filler: Elastomeric sealant.

G. Trim and/or Divider Strips: Non-corrosive materials (plastic, PVC, etc.) only, as recommended by the Manufacturer to be compatible with the usage and exposure conditions stated for the flooring materials.

H. Provide cove base to match color and finish of floor. Isolate as recommended by manufacturer.

I. Colors shall be selected by Owner from custom blends based of standard colors. Each room shall have a unique color. Second floor corridor shall include a logo at the elevator entrance.

PART 3 -- EXECUTION

3.01 INSPECTION

A. Design/Builder shall examine the areas and conditions under which the flooring work is to be installed and notify the District of conditions detrimental to the proper and timely completion of the Work.

B. Proceed with the Work only after deficiencies have been satisfactorily corrected. If after surface preparations voids or honeycombs appear on the concrete, repair with suitable material.

C. Verify that all new concrete surfaces have received a steel trowel finish, slope toward the floor drains, are at least four weeks old, and have been free of standing water for at least 7 days.

D. Verify that all surfaces have been properly cleaned and conditioned, and that curing, hardening or waterproofing agents have not been used in curing new concrete surfaces which are to receive flooring.

3.02 VENTILATION AND SAFETY

A. The Design/Builder shall provide adequate temporary ventilation of all indoor areas at all times. Air changes per hour in the enclosed room shall be 12 minimum.

1. Vent odors from low areas (fumes heavier than air) to the outside. Do not allow fumes to enter any air conditioning ducts or air intake ducts. Fumes are flammable; verify all fans and electrical equipment are suitable to operate in area.

2. Seal off all adjacent areas. Provide Plan of Operation prior to this Work for Owner review and approval.

3. Prevent fans or air movement from blowing dust particles onto wet flooring areas.

4. Suitable respirators shall be used by all workers. Provide two additional respirators for Plant Personnel and Construction Inspectors.

5. Installer shall use a Portable Gas Monitor in all enclosed rooms/buildings to monitor combustible levels. Monitor shall be listed by a third party as intrinsically safe to Class I, Division I, Groups A, B, C, and D. Monitor range shall be 0-100 percent with a 1 percent resolution. Monitor shall be Passport Personal Alarm as manufactured by MSA Instruments or equal.

B. Provide suitable safety clothes and glasses for construction workers, plant personnel, and construction inspectors as necessary.

C. Install temporary potable water eyewashes and safety showers.

D. Keep open flames and sparks away from the area.

3.03 INSTALLATION TEMPERATURE

A. In order to promote proper curing of the coating systems, the Design/Builder shall be required to maintain a minimum air temperature surrounding all structures which have surfaces to be topped with resin materials.

1. Temperature requirements shall be maintained at least two days before the trowel coat topping installation begins and shall continue through the curing period required for the seal coat.

2. Minimum air temperature shall be 65°F. Provide warmer conditions if required by the resin Manufacturer.

3. The building heating and air handling units shall not be used by the Design/Builder.

B. In addition to the ambient air requirements, the temperatures of all surfaces to receive flooring shall also be maintained at a minimum temperature of 65°F.

3.04 FLOORING INSTALLATION

A. Comply with the Manufacturer's recommendations for preparation and priming of substrate, proportioning mixes, installation of strips, placing, curing, sealing and finishing.

B. Once flooring operations have commenced, control all unnecessary foot traffic, construction activities, etc., in the area in order to keep substrate clean.

C. General Substrate Preparation:

1. Concrete: Mechanical clean surfaces to remove oils, fats, greases, waxes, membrane coatings, paints, etc. Mechanically scarify surfaces to remove surface laitance and profile in accordance with ICRI 310.2, (CSP) Concrete Surface Profile 3 - 5. Chip and chase terminations and at edges of floor drains and other built in components as recommended by manufacturer.

2. Cover tops of floor drains with duct tape or similar material to allow placement of and finishing of abutting floor materials.

3. Test floor for moisture content prior to beginning work. Do not install flooring until moisture content is within allowable ranges recommended by manufacturer.

D. Install flooring materials at coved bases, curbs, stair treads and risers, and landings without interruptions or seams, except where divider strips, control joints and expansion joints are shown, or required, or specifically recommended by the resin Manufacturer.

E. Provide control joints where required by manufacturer and approved on shop drawings. Install joints flush with floor by placing angle-type divider strips back-to-back with neoprene rubber filler cemented between strips.

1. Install control joints immediately above all joints of structural concrete, or above all control or construction joints in new concrete slabs.

F. Provide expansion joints where shown or required.

G. Provide trim or finish strips along any exposed edges of flooring or along tops of coved bases that are exposed to view.

1. Apply a continuous bead of clear silicone caulking along all trim strip edges to seal any gaps or irregularities between masonry (or concrete) surfaces and the trim strip material.

H. All installation procedures shall be in strict accordance with manufacturer's recommendations and these specifications.

I. Floor shall be smooth with a slip resistance as required to meet accessibility requirements.

3.05 CLEANING AND PROTECTION

A. Protection:

1. Provide protection for finished floor topping Work until building is ready for occupancy.

2. Immediately repair any damaged surfaces in accordance with Manufacturer's instructions.

B. Final Cleaning:

1. Thoroughly wash all surfaces prior to final acceptance of the Work included under this Contract. Washing shall be by high pressure water cleaner with TSP (trisodium-phosphate).

- END OF SECTION -

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SECTION 09900

PAINTING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on Drawings and Specified herein.

B. Section Includes:

1. Paint Materials

2. Shop Painting

3. Field Painting

a. Surface Preparation

b. Piping and Equipment Identification

c. Schedule of Colors

d. Work in Confined Spaces

e. OSHA Safety Colors

1.02 RELATED SECTIONS

A. Section 15030 - Piping and Equipment Identification Systems

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of these specifications the Work shall conform to the applicable requirements of the following documents:

1. SSPC – The Society for Protective Coatings Standards

a.	SSPC-Vis 1	Pictorial Surface Preparation Standards for Painting Steel Structures
b.	SSPC-SP2	Hand Tool Cleaning
c.	SSPC-SP3	Power Tool Cleaning
d.	SSPC-SP5	White Metal Blast Cleaning
e.	SSPC-SP6	Commercial Blast Cleaning

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f. SSPC-SP10 Near-White Metal Blast

g. SSPC-SP13/NACE6 Surface Preparation of Concrete

2. NACE - National Association of Corrosion Engineers

3. ASTM D1737 - Test Method for Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus

4. ASTM B117 - Method of Salt Spray (Fog) Testing

5. ASTM D4060 - Test Method for Abrasion Resistance of Organic Coating by the Taber Abraser

6. ASTM D3359 - Method for Measuring Adhesion by Tape Test

B. **Hampton Roads Sanitation District (HRSD) Coatings Manual** shall be referenced for additional requirements. Equal systems and methods within the Coatings Manual shall be considered equal to specified materials and methods herein.

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 30 00 Submittal Procedures, submit the following:

1. Manufacturer's literature and Material Safety Data Sheets for each product.

2. Painting schedule identifying surface preparation and paint systems proposed. Cross-reference with Tables 9-1 and 9-2 and HRSD Coating Manual. Provide the name of the paint manufacturer, and name, address, and telephone number of manufacturer's representative who will inspect the work. Submit schedule for approval as soon as possible following the Award of Contract, so approved schedule may be used to identify colors and specify shop paint systems for fabricated items.

1.05 SYSTEM DESCRIPTION

A. Work shall include surface preparation, paint application, inspection of painted surfaces and corrective action required, protection of adjacent surfaces, cleanup and appurtenant work required for the proper painting of all surfaces to be painted. Surfaces to be painted are designated within the Painting Schedule and may include new and existing piping, miscellaneous metals, equipment, buildings, exterior fiberglass, and appurtenance.

B. Perform Work in strict accordance with manufacturer's published recommendations and instructions, unless the Engineer stipulates that deviations will be for the benefit of the project.

C. Paint surfaces which are customarily painted with the exception of electrical conduit and HVAC ductwork, whether indicated to be painted or not, with painting system applied to similar surfaces, areas and environments, and as approved by Engineer.

D. Piping and equipment shall receive color coding and identification. Equipment shall be the same color as the piping system.

1.06 QUALITY ASSURANCE

A. Painting operations shall be accomplished by skilled craftsman.

B. Provide a letter indicating that the painting applicator has five years of experience, and 5 references which show previously successful application of the specified or comparable painting systems. Include the name, address, and the telephone number for the Owner of each installation for which the painting applicator provided services.

1.07 STORAGE AND DELIVERY

A. Bring materials to the job site in the original sealed and labeled containers.

B. Container label to 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. Store paint materials 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.

PART 2 -- MATERIALS

2.01 GENERAL INFORMATION

A. The term "paint" is defined as both paints and coatings including emulsions, enamels, stains, varnishes, sealers, and other coatings whether organic or inorganic and whether used as prime, intermediate, or finish coats.

B. Purchase paint from an approved manufacturer. Manufacturer shall assign a representative to inspect application of their product both in the shop and field. The manufacturer's representative shall submit a report to the Engineer at the completion the Work identifying products used and verifying that surfaces were properly prepared, products were properly applied, and the paint systems were proper for the exposure and service.

C. Provide primers and intermediate coats produced by same manufacturer as finish coat. Use only thinners approved by paint manufacturer, and only within manufacturer's recommended limits.

D. Ensure compatibility of total paint system for each substrate. Test shop primed equipment delivered to the site for compatibility with final paint system. Provide an acceptable barrier coat or totally remove shop applied paint system when incompatible with system specified, and repaint with specified paint system.

E. Use painting materials suitable for the intended use and recommended by paint manufacturer for the intended use.

F. Require that personnel perform work in strict accordance with the latest requirements of OSHA Safety and Health Standards for construction. Meet or exceed requirements of regulatory agencies having jurisdiction and the manufacturer's published instructions and recommendations. Maintain a copy of all Material Safety Data Sheets at the job site of each product being used prior to commencement of work. Provide and require that personnel use protective and safety equipment in or about the project site. Provide respiratory devices, eye and face protection, ventilation, ear protection, illumination and other safety devices required to provide a safe work environment.

2.02 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:

1. Tnemec Company Inc.

2. Ameron

3. CARBOLINE

4. Sherwin-Williams

5. Additional acceptable manufacturers are indicated in the HRSD Coatings Manual.

PART 3 -- EXECUTION

3.01 SHOP PAINTING

A. Shop prime fabricated steel and equipment with at least one shop coat of prime paint compatible with finish paint system specified. Prepare surface to be shop painted in strict accordance with paint manufacturer's recommendations and as specified. Finish coats may be shop applied, if approved by the Engineer. Package, store and protect shop painted items until they are incorporated into Work. Repair painted surfaces damaged during handling, transporting, storage, or installation to provide a painting system equal to the original painting received at the shop.

B. Identify surface preparation and shop paints on Shop Drawings. Verify compatibility with field applied paints.

3.02 SURFACE PREPARATION

A. General

1. Surfaces to be painted shall be clean and dry, and free of dust, rust, scale, and foreign matter. No solvent cleaning, power or hand tool cleaning shall be permitted unless approved by the Engineer.

2. Protect or remove, during painting operations, hardware, accessories, machined surfaces, nameplates, lighting fixtures, and similar items not intended to be painted prior to cleaning and painting. Reposition items removed upon completion of painting operations.

3. Examine surfaces to be coated to determine that surfaces are suitable for specified surface preparation and painting. Report to Engineer surfaces found to be unsuitable in writing. Do not start surface preparation until unsuitable surfaces have been corrected. Starting surface preparation precludes subsequent claim that such surfaces were unsuitable for the specified surface preparation or painting.

4. Surface preparation shall be in accordance with specifications and manufacturer's recommendations. Provide additional surface preparation, and fill coats where manufacturer recommends additional surface preparation, in addition to requirements of specification.

5. Touch-up shop or field applied coatings damaged by surface preparation or any other activity, with the same shop or field applied coating; even to the extent of applying an entire coat when required to correct damage prior to application of the next coating. Touch-up coats are in addition to the specified applied systems, and not considered a field coat.

6. Protect motors and other equipment during blasting operation to ensure blasting material is not blown into motors or other equipment. Inspect motors and other equipment after blasting operations and certify that no damage occurred, or where damage occurred, the proper remedial action was taken.

7. Field paint shop painted equipment in compliance with Color Coding and as approved by Engineer.

8. Specific requirements for surface preparation are also contained in the HRSD Coatings Manual.

B. Metal Surface Preparation

1. Conform to current The Society for Protective Coatings Standards (SSPC) Specifications for metal surface preparation. Use SSPC-Vis-1 pictorial standards or NACE visual standards TM-01-70 or TM-01-75 to determine cleanliness of abrasive blast cleaned steel.

2. Perform blast cleaning operations for metal when following conditions exist:

   a. Moisture is not present on the surface.

   b. Relative humidity is below 80%.

   c. Ambient and surface temperatures are 5°F or greater than the dew point temperature.

   d. Painting or drying of paint is not being performed in the area.

   e. Equipment is in good operating condition.

   f. Proper ventilation, illumination, and other safety procedures and equipment are being provided and followed.

3. Sandblast ferrous metals to be shop primed, or component mechanical equipment in accordance with SSPC-SP5, White Metal Blast or manufacturer's recommended surface preparation for superior performance.

4. Sandblast field prepared ferrous metals in accordance with SSPC-SP10, Near White Metal Blast, where metal is to be submerged, in a corrosive environment, or in severe service.

5. Sandblast field prepared ferrous metals in accordance with SSPC-SP6 Commercial Blast, where metal is to be used in mild or moderate service, or non-corrosive environment.

6. Clean nonferrous metals, copper, or galvanized metal surfaces in accordance to SSPC-SP1, Solvent Cleaning, or give one coat of metal passivator or metal conditioner compatible with the complete paint system.

7. Prime cleaned metals immediately after cleaning to prevent rusting.

8. Clean rusted metals down to bright metal by sandblasting and immediately field primed.

C. Concrete Surface Preparation

1. Cure concrete a minimum of 30 days before surface preparation, and painting begins.

2. Test concrete for moisture content, pH and salts using test method recommended by the paint manufacturer. Do not begin surface preparation, or painting until moisture content is acceptable to manufacturer.

3. Prepare concrete surfaces to receive coatings in accordance with SSPC-13 – Concrete Surface Preparation. Remove contaminants, open bugholes, surface voids, air pockets, and other subsurface irregularities using blasting or grinding. Do not expose underlying aggregate. Use dry, oil-free air for blasting operations. Surface texture after blasting shall achieve profile as required by manufacturer or where not defined by manufacturer similar to that of medium grit sandpaper. Remove residual abrasives, dust, and loose particles by vacuuming or other approved method.

4. Surface defects, such as hollow areas, bugholes, honeycombs, and voids shall be filled with polymeric filler compatible with painting system. Complete fill coats may be used in addition to specified painting system and as approved by the Engineer. Fins, form marks, and all protrusions or rough edges shall be removed.

5. Repair existing concrete surfaces which are deteriorated to the point that surface preparation exposes aggregate with fill coats or patching mortar as recommended by paint manufacturer and as directed by the Engineer.

6. Clean concrete of all dust, form oils, curing compounds, oil, tar, laitance, efflorescence, loose mortar, and other foreign materials before paints are applied.

D. Wood

1. Clean wood surfaces free of all foreign matter, with cracks and nail holes and other defects properly filled and smoothed. Remove sap and resin by scraping and wipe clean with rags dampened with mineral spirits.

2. Saturate end grain, cut wood, knots, and pitch pockets with an appropriate sealer before priming.

3. Prime and backprime wood trim before setting in place.

4. After prime coat has dried, fill nailholes, cracks, open joints, and other small holes with approved spackling putty. Lightly sand wood trim prior to applying second coat of paint.

E. Castings

1. Prepare castings for painting by applying a brush or a knife-applied filler. Fillers are not to be used to conceal cracks, gasholes, or excessive porosity.

2. Apply one coat of primer with a minimum thickness of 1.2 mils in addition to coats specified. Allow sufficient drying time before further handling.

F. Masonry

1. Cure for a minimum of 30 days prior to paint application.

2. Clean masonry surfaces free from all dust, dirt, oil, grease, loose mortar, chalky deposits, efflorescence, and other foreign materials.

3. Test masonry for moisture content. Use test method recommended by paint manufacturer. Do not begin painting until moisture content is acceptable to manufacturer.

G. Gypsum Drywall

1. Sand joint compound with sandpaper to provide a smooth flat surface. Avoid sanding of adjacent drywall paper.

2. Remove dust, dirt, and other contaminants.

H. Previously-Painted Surfaces

1. Totally remove existing paint when: surface is to be submerged in a severe environment, paint is less than 75% intact, brittle, eroded or has underfilm rusting.

2. Surfaces which are greater than 75% intact require removal of failed paints and then spot primed. Spot priming is in addition to coats specified.

3. Remove surface contamination such as oil, grease, loose paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers.

4. Clean and dull glossy surfaces prior to painting in accordance with the manufacturer's recommendations.

5. Check existing paints for compatibility with new paint system. If incompatible, totally remove existing paint system or apply a barrier coat recommended by the paint manufacturer. Remove existing paints of undetermined origin. Prepare a test patch of approximately 3 square feet over existing paint. Allow test patch to dry thoroughly and test for adhesion. If proper adhesion is not achieved remove existing paint and repaint.

3.03 APPLICATION OF PAINT

A. Apply paint by experienced painters with brushes or other applicators approved by the Engineer, and paint manufacturer.

B. Apply paint without runs, sags, thin spots, or unacceptable marks.

C. Apply at rate specified by the manufacturer to achieve at least the minimum dry mil thickness specified. Apply additional coats, if necessary, to obtain thickness.

D. Special attention shall be given to nuts, bolts, edges, angles, flanges, etc., where insufficient film thicknesses are likely. Stripe paint prior to applying prime coat. Stripe painting shall be in addition to coats specified.

E. Perform thinning in strict accordance with the manufacturer's instructions, and with the full knowledge and approval of the Engineer and paint manufacturer.

F. Allow paint to dry a minimum of twenty-four hours between application of any two coats of paint on a particular surface, unless shorter time periods are a requirement by the manufacturer. Longer drying times may be required for abnormal conditions as defined by the Engineer and paint manufacturer. Do not exceed manufacturer's recommended drying time between coats.

G. Suspend painting when any of the following conditions exist:

1. Rainy or excessively damp weather.

2. Relative humidity exceeds 85%.

3. General air temperature cannot be maintained at 50°F or above through the drying period, except on approval by the Engineer and paint manufacturer.

4. Relative humidity will exceed 85% or air temperature will drop below 40°F within 18 hours after application of paint.

5. Surface temperature of item is within 5 degrees of dewpoint.

6. Dew or moisture condensation are anticipated.

7. Surface temperature exceeds the manufacturer's recommendations.

3.04 INSPECTION

A. Each field coat of paint will be inspected and approved by the Engineer or his authorized representative before succeeding coat is applied. Tint successive coats so that no two coats for a given surface are exactly the same color. Tick-mark surfaces to receive black paint in white between coats.

B. Use magnetic dry film thickness gauges and wet fiber thickness gauges for quality control. Furnish magnetic dry film thickness gauge for use by the Engineer.

C. Coatings shall pass a holiday detector test.

D. Determination of Film Thickness: Randomly selected areas, each of at least 107.5 contiguous square feet, totaling at least 5% of the entire control area shall be tested. Within this area, at least 5 squares, each of 7.75 square inches, shall be randomly selected. Three readings shall be taken in each square, from which the mean film thickness shall be calculated. No more than 20 percent of the mean film thickness measurements shall be below the specified thickness. No single measurement shall be below 80 percent of the specified film thickness. Total dry film thickness greater than twice the specified film thickness shall not be acceptable. Areas where the measured dry film thickness exceeds twice that specified shall be completely redone unless otherwise approved by the Engineer. When measured dry film thickness is less than that specified additional coats shall be applied as required.

E. Holiday Testing: Holiday test painted ferrous metal surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures. Mark areas which contain holidays. Repair or repaint in accordance with paint manufacturer's printed instructions and retest.

   1. Dry Film Thickness Exceeding 20 Mils: For surfaces having a total dry film thickness exceeding 20 mils: Pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.

   2. Dry Film Thickness of 20 Mils or Less: For surfaces having a total dry film thickness of 20 mils or less: Tinker & Rasor Model M1 non-destructive type holiday detector, K-D Bird Dog, shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flow, shall be added to the water prior to wetting the detector sponge.

F. Paint manufacturer or his representative shall provide their services as required by the Engineer. Services shall include, but not be limited to, inspecting existing paint, determination of best means of surface preparation, inspection of completed work, and final inspection of painted work 11 months after the job is completed.

3.05 PROTECTION OF ADJACENT PAINT AND FINISHED SURFACES

A. Use covers, masking tape, other method when protection is necessary, or requested by Owner or Engineer. Remove unwanted paint carefully without damage to finished paint or surface. If damage does occur, repair the entire surface adjacent to and including the damaged area without visible lapmarks and without additional cost to the Owner.

B. Take all necessary precautions to contain dispersion of sandblasting debris and paint to the limits of the work. Take into account the effect of wind and other factors which may cause dispersion of the sandblasting debris and paint. Suspend painting operations when sanding debris or paint cannot be properly confined. Assume all responsibilities and cost associated with damage to adjacent structures, vehicles, or surfaces caused by the surface preparation and painting operations.

3.06 PIPING AND EQUIPMENT IDENTIFICATION

A. Piping and equipment identification shall be in accordance with Section 15030, Piping and Equipment Identification Systems.

3.07 SCHEDULE OF COLORS

A. Match colors indicated. Piping and equipment colors are indicated in Section 15030. Colors which are not indicated shall be selected from the manufacturer's full range of colors by the Engineer. No variation shall be made in colors without the Engineer's approval. Color names and numbers shall be identified according to the appropriate color chart issued by the manufacturer of the particular product in question.

3.08 WORK IN CONFINED SPACES

A. Provide and maintain safe working conditions for all employees. Supply fresh air continuously to confined spaces through the combined use of existing openings, forced-draft fans and temporary ducts to the outside, or direct air supply to individual workers. Exhaust paint fumes to the outside from the lowest level in the contained space. Provide explosion-proof electrical fans, if in contact with fumes. No smoking or open fires will be permitted in, or near, confined spaces where painting is being done. Follow OSHA, state and local regulations at all times.

3.09 OSHA SAFETY COLORS

A. Paint wall around wall-mounted breathing or fire apparatus with the appropriate safety red color; area not exceed 2-feet wide by 3-feet high, unless apparatus covers the area. Fire apparatus include fire hoses, extinguisher, and hydrants.

B. Paint hazardous areas and objects in accordance with OSHA regulations.

3.10 SCHEDULE

A. See following page for Painting Schedule.

TABLE 9-1
PAINTING SCHEDULE

SURFACE	APPLICATION	PAINTING SYSTEM & NO. OF COATS	PRODUCT REFERENCE (TABLE 9.2)	TOTAL MIN. DRY FILM THICKNESS (MILS)
Concrete and Masonry				
Interior masonry	All concrete masonry walls. HRSD System: E-2-C	1 coat sealer 2 coats acrylic epoxy	101 120	75-85 sq.ft./gal. 4-6/coat
Exterior below grade		Waterproofing	See Section 07100	
Submerged water		2 coats NSF approved epoxy polyamide Provide filler as required and recommended by manufacturer	105	4-6/coat
Containment Liner[1]	Secondary containment floors, tank supports and walls UNO. HRSD System E-4-C	1 coat fillet 2 coats high solids epoxy coating	117 119	1/16” 6-10/coat
Containment Liner[1]	Secondary containment floors, tank supports and walls for Sodium Hypochlorite, Sodium Bisulfate, and Sulfuric Acid. HRSD System VE-1	1 coat fillet 2 coats vinyl ester coating	117	1/16”
Metals				
Interior non-submerged	All new blowers, pumps, motors and mechanical equipment, piping, etc HRSD System E-1-NF.	1 coat epoxy polyamide primer 1 coat epoxy polyamide	104 102	4-6 4-6
Exterior non-submerged	All new blowers, pumps, motors and mechanical equipment, piping, etc. HRSD System EU-1-NF	1 coat epoxy polyamide primer 1 coat epoxy polyamide 1 coat aliphatic polyurethane	104 102 115	4-6 4-6 3-5
Interior insulated	HRSD System	1 coat acrylic latex	103	4
Submerged water	All metal piping, and mechanical equipment, etc.	2 coats NSF approved epoxy polyamide	105	4-6/coat
Interior exposed metals	Steel doors, and door frames, steel stairs, monorails, structural steel, misc. metals (steel) HRSD System A-1	1 coat primer 1 coat alkyd or acrylic		
Aluminum surfaces in contact with concrete		2 coats coal tar	107	26

1. Painting manufacturer shall verify compatibility of containment liner and chemical to be contained. Where incompatible substitute a compatible coating system.

TABLE 9-1
PAINTING SCHEDULE (CONTINUED)

SURFACE	APPLICATION	PAINTING SYSTEM & NO. OF COATS	PRODUCT REFERENCE (TABLE 9.2)	TOTAL MIN. DRY FILM THICKNESS (MILS)
Other Interior: Gypsum Wallboard	All drywall surfaces. Similar to HRSD System L-1	2 coats acrylic latex matte or satin	103	2-3/coat
PVC Piping	Chemical piping. Similar to HRSD System EU-1-FRP	1 coat epoxy polyamide 1 coat aliphatic polyurethane	102 115	5-8 3-4

TABLE 9-2

PRODUCT LISTING

REF.	SYSTEM	PURPOSE	PRODUCT			
			Tnemec Series	PPG/AMERON	CARBOLINE	Sherwin-Williams
101	Acrylic filler	Primer-sealer	130-6601	BLOXFIL 4000	Sanitile 100	Cement-Plex 875
102	Epoxy polyamide	Finish coat semi-gloss or gloss	66	AMERLOCK 2/400	Carboguard 890	Macropoxy 646
103	Acrylic latex	Prime/Finish	1029	PITT TECH PLUS	Carbocrylic 3359DTM	DTM Acrylic Primer/Finish
104	Epoxy Polyamide – metal	Primer	66	AMERCOAT 385	Carboguard 893SG	Macropoxy 646
105	Epoxy	Primer/Finish	20	AMERLOCK 2	Carboguard 561/56LT	Macropoxy 646 PW
106	Coal tar epoxy	Finish high-coat build	46H-413	AMERCOAT 78HB	Bitumastic 300M	Hi-Mil Sher Tar Epoxy
107	Coal tar	Sealer	46-465	AMERCOAT 78HB	Bitumastic 300M	Hi-Mil Sher Tar Epoxy
108	Alkyd-medium oil	Finish coat	2H	DEVGUARD 4308	Carbocoat 8215	Industrial Enamel
109	Alkyd-long oil	Finish coat	1029	DEVGUARD 4308	Carbocoat 8215	Industrial Enamel
110	Epoxy polyamide	Primer	66-1211	AMERCOAT 385	Carboguard 893SG	Macropoxy 646
112	Epoxy polyamide	Sealer	66-1211	AMERCOAT 385	Carboguard 893SG	Macropoxy 920 Pre-Prime
113	Urethane	Barrier coat	530	AMERLOCK SEALER	Rustbond	--
114	Polyamine Epoxy	Intermediate coat	27	AMERLOCK 385	Carboguard 893SG	--
115	Aliphatic Polyurethane	Finish coat	1074 or 1075	AMERCOAT 450 HS	Carbothane 134HG	Acrolon 218HS
116	Acrylic epoxy	Finish coat	113 or 114	AQUAPON WB	Sanitile 255	Water-Based Catalyzed Epoxy
117	Epoxy block filler	Sealer	218	AMERLOCK 400 BF	Sanitile 600	Cement Plex 875
118	Catalyzed epoxy	Finish coat	84	AMERLOCK 2/400	Carboguard 890	Macropoxy 646
119	High solids epoxy	Finish coat	104	Pitt-Guard 97	Carboguard 890	Dura-Plate 235
120	Epoxy	Top coat	N69	Pitt-Guard 97-145	Carboguard 890	Macropoxy 646

- END OF SECTION -

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SECTION 10100

VISUAL DISPLAY BOARDS

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

A. Furnish all labor, materials, equipment, and appliances required for the complete execution of Work as shown on Drawings and specified herein.

B. Provide one 4'x6' markerboards with custom wood frame in Multipurpose Room.

C. Provide one 4' x 6' markerboard with custom wood frame in Office Area.

D. Provide one 4'-4' tackboard in Breakroom.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. ASTM A424 - Steel Sheets for Porcelain Enameling.

B. ASTM B221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

C. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

D. NPA A208.1 - Mat Formed Wood Particleboard.

E. PEI (Porcelain Enamel Institute) - Performance Specifications for Porcelain Enamel Chalkboards.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements of Section 01 33 00 – Submittal Procedures, submit the following:

1. Product data on each item specified.

2. Samples: Submit two samples illustrating materials and finish, color and texture of markerboard and trim, and tackboard surfacing.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. The following manufacturers are approved for use.

1. Marsh Chalkboard Company

2. Lemco

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3. Greensteel

2.02 MARKERBOARD MATERIAL

A. 24 gauge steel face with a porcelain enamel finish.

2.03 TACKBOARD SURFACING MATERIAL

A. Cork: Fine grain natural cork, homogeneous composition.

B. Tackboard Covering: Tight woven cloth fabric flame retardant treated; fire rating of class A in accordance with ASTM E84.

2.04 CORE AND FRAME MATERIALS

A. Particle Board: NPA A208.1, set with waterproof resin binder, sanded faces.

B. Frame and Chalkrail: Aluminum extrusions, ASTM B221, 6064, alloy, T5, temper.

2.05 ACCESSORIES

A. Adhesives: Type used by manufacturer, waterproof type.

B. Map Supports: Formed aluminum sliding hooks, to fit map rail.

2.06 FABRICATION - MARKERBOARDS

A. Outer Face Sheet: Steel, 24 gauge thick.

B. Core: Particle board1/2 inch thick.

C. Backing Surface: Steel, 28 gauge thick.

D. Splice Joint: Concealed spline of sheet steel.

2.07 FABRICATION - TACKBOARDS

A. Outer Facing: Cork, 1/4 inch thick.

B. Core: Particle board, 3/8 inch thick.

2.08 FABRICATION - FRAME AND TRIM

A. Aluminum Frame: Of thin profile; concealed fasteners, map rail with cork insert over markerboard, and tackboard surfaces.

B. Aluminum Chalkrail: One piece full length of markerboard, closed ends; concealed fasteners.

2.09 FINISHES

A. Porcelain Enamel: Glass fibered enamel, baked to vitreous surfaces; Porcelain Enamel Institute Type A. Color as selected by Owner.

B. Tackboard Surface: Fabric, 16 ounce per linear yard, 2-ply yarn, Class A, ASTM E-84. Color as selected by Owner

C. Aluminum Frame and Trim: Clear anodized finish.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Install markerboards, and tackboards in accordance with manufacturer's instructions.

B. Establish bottom of perimeter frame at 40 inches above finished floor.

C. Secure units level and plumb.

- END OF SECTION -

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SECTION 10155

RECYCLED PLASTIC TOILET PARTITIONS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, materials, equipment and appliances required for the complete execution of the work as shown on the Drawings and specified herein.

1.02 RELATED DOCUMENTS

A. Section 10800 - Toilet and Bath Accessories

1.03 REFERENCES

A. American Society for Testing and Materials:

1. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Material

2. ASTM D1037 Direct Screw Withdrawal Test

3. ASTM D570 Standard Test Method for Water Absorption

4. ASTM A167, 18-8, Type 304 Cast Stainless Steel

5. ASTM D638 Standard Test Method for Tensile Properties of Plastics

6. ASTM D790 Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics

7. ASTM D1693 Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics

B. National Fire Protection Association (NFPA).

C. ADA, Accessibility Guidelines for Buildings and Facilities.

D. Virginia Statewide Building Code.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's detailed technical data for materials, fabrication, and installation, including catalog cuts of anchors, hardware, fasteners, and accessories in accordance with Section 01 33 00 – Submittal Procedures.

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B. Shop Drawings: Furnish Shop Drawings for fabrication and installation of Toilet Partitions and Urinal Screens. Include plans, elevations, sections, details and anchorages/attachments to other work.

C. Samples for Initial Selection:

1. Submit manufacturer's color chart with manufacturer's full range of Standard Colors. Each toilet room may have a separate color

D. Samples for Verification:

1. Submit 6" square Samples of each color and finish on same substrate used in work, for color verification after selections have been made.

2. Submit one (1) Sample of the following:

a. Hardware (Complete)
b. Pilaster (12" X 12")
c. Divider Panel (12" X 12")
d. Aluminum Mounting Bracket
e. Aluminum Hinge

E. Maintenance Instructions: Provide manufacturer's printed Instructions for Cleaning and Maintenance of Installed Work.

F. Manufacturer's Written Warranty: Provide manufacturer's Written Warranty as detailed herein.

1.05 QUALITY STANDARDS

A. Antimicrobial Requirements: When tested in accordance with the JIS Z 2801-2000 Quantitative Test, Toilet Partition, and Urinal Screen shall have an Efficacy Rating greater than 4.0. Non-Migratory Antimicrobial Agent (Columbia Guard®) shall be compounded into Plastic Resin prior to extrusion or injection molding, giving the Toilet Partition Components permanent Non-Migratory Antimicrobial properties.

B. Flame Spread: When tested in accordance with ASTM E84, Toilet Partition, and Urinal Screen materials shall meet or exceed all requirements for Class A Flame Spread Rating and Smoke Developed and shall carry a Class A Fire Rating Certification in accordance with the requirements of NFPA and ICC.

1. Flame Spread shall not exceed 75.

2. Smoke Developed shall not exceed 450.

D. Impact Resistance Requirements: When tested in accordance with ASTM D2794, Partition materials shall withstand an Impact Force Value in excess of 45 inch-lbs.

E. Screw Holding Strength: When tested in accordance with ASTM D1037, Direct Screw Withdrawal Test, Partition materials shall withstand a direct pull force that exceeds 1,100 lbs per fastener.

F. Tensile Strength: When tested in accordance with ASTM D638, Partition materials shall have a Tensile Modulus of 339,000 PSI, a Tensile Strength at Yield of 4500 PSI, and a Tensile Strength at Break of 2030 PSI.

G. Flexural Properties: When tested in accordance with ASTM D790 Partition materials shall have a Flexural Modulus of 235,000 PSI.

H. Environmental Stress-Crack Resistance: When tested in accordance with ASTM D1693, Partition material shall exceed 15.0 HR.

I. Water Absorption Requirements: When tested in accordance with ASTM D570 Partition materials shall have a Water Absorption Rate of less than 0.09%.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating units without field measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to Established Dimensions.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original packaging to protect from damage.

B. Store materials in manufacturer's original packaging in accordance with manufacturer's instructions. Store materials indoors, protected from the elements and construction hazards.

C. Handle materials in a manner that will protect the finished product.

1.08 MANUFACTURER'S WARRANTY

A. Provide manufacturer's Fifteen (15) year written limited warranty on its Panels, Pilasters and Doors, against chipping, breakage, corrosion, delamination and defects in workmanship; to be replaced without charge excluding labor.

B. Provide manufacturer's Ten (10) year written limited warranty on all Cast Stainless Steel Hardware, Hinges and Mounting Brackets, as well as on all full high aluminum mounting brackets, against defects in material and workmanship.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. Recycled Antimicrobial Class A Fire Rated Plastic HDPE (Columbia PolyLife®) Toilet Partitions and Urinal Screens, manufactured by COLUMBIA PARTITIONS®, a Division of PSiSC®, is Basis of Design. Equal products by other manufacturers will be considered.

2.02 INSTALLATION TYPES

A. Toilet Partitions, Shower Dividers and Dressing Compartments shall be:

1. Overhead-Braced Floor Supported

B. Urinal Screens shall be:

1. Type II, Wall Hung

2.03 MATERIALS

A. Material shall be Columbia PolyLife® Recycled Antimicrobial Class A Fire Rated Plastic HDPE, protected by Columbia Guard®, a Non-Migratory Antimicrobial Agent or approved equal. All Toilet Partitions and Urinal Screens shall have an Antimicrobial Efficacy Rating of 4.0 or greater when tested in accordance with the JIS Z 2801-2000 Quantitative Test and shall be manufactured of 100% Post Consumer materials. Surface and edges shall be nonporous and shall not support fungus or bacteria and shall be Microbiocidal. PolyLife® shall be waterproof and nonabsorbent and shall have a self-lubricating surface to resist marks from pens and other writing instruments. Provide material with surface flatness and even texture. Exposed surfaces which exhibit pitting, seam marks, roller marks, stains, telegraphing, or other imperfections on finished units are not acceptable. Minor color inconsistencies will be allowed. Columbia PolyLife® Antimicrobial Plastic HDPE shall meet or exceed all requirements for Class A Flame Spread Rating and Smoke Developed calculated according to ASTM E84, and shall carry a Class A Fire Rating Certification.

B. Material Thicknesses and Heights:

1. Doors – Minimum 1.00” (25 mm) Finished Thickness, 55” High

2. Divider Panels – Minimum 1.00” (25 mm) Finished Thickness, 55” High

3. Pilasters – Minimum 1.00” (25 mm) Finished Thickness, 82” High

C. Pilasters, doors and panels shall have edges machined to a .250” radius. Pilasters, Doors and Panels shall be provided with a self-adhesive peel coat to protect the finish during installation.

D. Colors: To be selected by Owner from Manufacturer’s Standard Colors.

2.04 HARDWARE

A. Continuous Hinge: Continuous Hinge with Cover Plate (54") shall be made of Extruded 6063-T5 Aluminum with a Satin Anodized Finish. Hinge shall be 3" wide and shall have five (5) Stainless Steel wire springs for self-closing action. Pivot pin shall be .250" in diameter, and shall be made of Type 304 Stainless Steel. Hinges shall provide emergency access by lifting the door. Hinges shall be pre-drilled for mounting to door and pilaster with Theft Proof Stainless Steel Torx Head with Pin Through-Bolts. Brass inserts are unacceptable. Each Hinge Set is to be packaged in a separate carton, and is to be labeled by stock number, manufacturer, and left or right hand. Furnish one per door.

B. Slide Latch: Slide Latch shall be Heavy Duty Extruded 6063-T5 Aluminum with a Satin Anodized Finish. The Slide Latch shall be surface mounted and shall provide emergency access by lifting the door. The slide bar shall be .250" thick, .95" wide and 3.125" long. The slide bar and know shall have a black anodized finish. Latch shall have an internal buffering spring to prevent damage when door is inadvertently slammed against the Latch. Mounting holes are to be spaced at 3.50" O.C. The Slide Latch shall be mounted to the Door with Theft Proof Stainless Steel Torx Head with Pin Through-Bolts. Furnish one per door.

C. Strike and Keeper: Strike and Keeper shall be Heavy Duty Extruded 6063-T5 Aluminum with a Satin Anodized Finish. The Strike and Keeper shall be 6.00" high, with three (3) mounting holes. The wall thickness shall be a minimum of .125". The Strike and Keeper shall be mounted to the Pilaster with Theft Proof Stainless Steel Torx Head with Pin Through-Bolts. The Strike and Keeper shall have an integral rubber bumper door stop. The Strike and Keeper shall provide emergency egress by lifting of the door. Furnish one per door.

D. Coat Hook: Coat Hook shall be made of Heavy Duty Chrome Plated Zamac. Coat Hook and Bumper shall be 2.340" high, 1.230" wide and shall protrude out from the door 3.05". The hook portion shall have a finished diameter of .250". Coat Hooks shall be mounted to the Door with Theft Proof Chrome Plated Steel Torx Head with Pin Screws. Stamped Stainless Steel Coat Hooks are unacceptable. Furnish one per door.

E. Pull Handle: Pull Handle shall be made of Heavy Duty Chrome Plated Zamac. Stamped Stainless Steel Door Stops are unacceptable. The Pull Handle shall protrude from the face of the door .940" and shall be 4.735" long. The Pull Handle shall have mounting holes drilled and tapped for 10/24 threads at 3.50" O.C. The Pull Handle shall be .655" wide. Furnish two for each Disabled Accessible door.

F. Door Stop: Door Stop shall be Heavy Duty Chrome Plated Zamac. Stamped Stainless Steel Door Stops are unacceptable. Door Stop shall have a 2.125" base diameter and shall protrude 1.80" from the wall. The bumper at the end of the Door Stop shall be .250" thick. The diameter of the shaft shall be .6875". Furnish one for each Disabled Accessible or Outswing Door.

G. Continuous Brackets: Brackets shall be Full High (54"), Extruded 6063-T5 Aluminum with a Satin Anodized Finish. Each Bracket is to have a minimum wall thickness of .125". Continuous Double Ear and Single Ear Brackets shall be used to mount Panel/Pilaster to wall. Continuous 'U' Brackets shall be used to mount Panel to Pilaster. Inside opening of Bracket shall be 1.00" for Panels and Pilasters. All holes in Brackets for mounting to wall and Panel/Pilaster shall be pre-drilled. Holes are to be spaced at 12" O.C. along the full length of the Bracket for a total of ten (10) holes for mounting to wall, and five (5) for mounting to panel or pilaster. Panels and Pilasters shall be secured to Brackets with Theft Proof Stainless Steel Torx Head with Pin Through-Bolts. Furnish as required.

H. Overhead Bracing (Headrail): Continuous Heavy Duty Extruded 6063-T5 Aluminum Headrail with Anti-Grip profile. Headrail shall have a Satin Anodized Finish and shall have integral reinforcing channel and curtain track. Provide Headrail Corner Brackets, Wall Brackets, and Headrail End Caps as required. The Headrail and Aluminum Headrail Corner Brackets shall have a minimum wall height of 2". The minimum wall thickness of the Headrail and Headrail Corner Brackets shall be .125". The Headrail Wall Brackets shall be made of Type 304, 18 Gauge Stainless Steel.

I. Pilaster Shoes: Pilaster Shoes shall be Type 304, 18 Gauge Stainless Steel and shall have a #4 Polished Satin Finish. Shoes shall be 3" high and shall have an integral heel for structural connection to the floor with Stainless Steel fasteners. Shoes shall be attached to Pilasters with Theft Proof Stainless Steel Torx Head with Pin Screws. Zinc Plated fasteners for connection to the floor are unacceptable.

J. Anchorages and Fasteners: All Fasteners shall be Type 304 Stainless Steel and shall have Theft Proof Torx Heads with Pin. Stainless Steel Through-Bolts shall withstand a direct pull force in excess of 2000 lbs. each. All Fasteners shall be Through-Bolted unless noted otherwise. Chrome Plated Steel, Zinc Plated Steel and Brass Fasteners are not acceptable.

2.05 FABRICATION

A. General: Provide Doors, Panels, Pilasters and Urinal/Entrance Screens fabricated for the partition system, complete with all accessories and hardware listed above and as required for installation of a fully functional system, unless otherwise noted. Provide units with cutouts and drilled holes to receive partition-mounted hinges, accessories, and grab bars as indicated. Doors and Panels are to be mounted 14" above finished floor.

B. Pilasters: Each Pilaster shall have zinc plated threaded insert(s) threaded into the base of the Pilaster to receive 5/16" X 2.5" Type 304 Stainless Steel Jack Bolt(s) for leveling purposes.

C. Doors: Unless otherwise indicated, provide 24" (610 mm) wide in-swinging doors for standard Toilet Partitions and 36" (914 mm) wide out-swinging doors with a minimum 32" (813 mm) wide clear opening for Partitions indicated to be Handicapped Accessible.

D. Floor Anchored Privacy Screens: Furnish Privacy Screens consisting of a pilaster and a panel of the same construction and finish as the Toilet Partitions. Furnish in accordance with the drawings.

PART 3 -- EXECUTION

3.01 SITE INSPECTION

A. Verify that room dimensions are in accordance with Toilet Partition, Shower Divider, and Dressing Compartment Shop Drawings. Inspect walls to insure that they are plumb and suitable for the Wall Brackets.

B. Check location of entrance doors and location of plumbing fixtures. Verify that these are in accordance with Toilet Partition, Shower Divider and Dressing Compartment Shop Drawings and that there is adequate clearance between plumbing fixtures and dividing panels or screens.

C. Have any inappropriate conditions corrected before beginning installation.

3.02 INSTALLATION

A. Comply with manufacturer's written installation instructions. Install Partitions rigid, straight, plumb, and level. Provide clearances of not more than .50" (13 mm) between pilasters and panels, and not more than 1.0" (25 mm) between pilasters/panels and walls. No evidence of drilling, cutting and patching shall be visible in finished work.

B. Overhead-Braced Floor Supported Partitions: Secure Pilasters to floor and level, plumb, and tighten. Maintain proper Door Openings and secure continuous Overhead Brace (Headrail) to each pilaster with not less than two (2) Theft Proof Stainless Steel Torx Head with Pin Through-Bolts. Hang Doors and adjust so that tops of Doors are parallel with Overhead Brace and are the same height as the panels when doors are in closed position. Mount Doors and Panels 14" above finished floor.

C. Ceiling Hung with Stabilizer Bars: Secure Pilasters to structural steel above ceiling and level, plumb, and tighten. Maintain proper Door Openings and install Stabilizer Bars between Pilasters and continually behind Pilasters. Attach Stabilizer Bar to wall and to Pilasters with Theft Proof Stainless Steel Torx Head with Pin Through-Bolts. Hang Doors and adjust so that tops of Doors are the same height as the Panels when doors are in closed position. Mount Doors and Panels 14" above finished floor.

D. Screens: Attach with anchoring devices according to manufacturer's written instructions and to suit supporting structure. Set units level and plumb.

3.03 ACCESSORIES

A. Mount accessories to Partition units in accordance with accessory manufacturer's instructions.

3.04 ADJUSTING AND CLEANING

A. Hardware Adjustment: Adjust hardware according to manufacturer's written instructions for proper operation. Adjust cam on all out-swinging doors to hold doors in closed position when unlatched. Adjust cam on all in-swinging doors to hold doors in open position when unlatched.

B. Provide final protection and maintain conditions that ensure Toilet Partitions and Screens are without damage or deterioration at the time of Substantial Completion. Clean all exposed surfaces of Toilet Partitions and hardware.

- END OF SECTION -

SECTION 10350

FLAGPOLE

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

A. Furnish all labor, materials, equipment, and appliances required for the complete execution of Work as shown on Drawings and specified herein.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. AASHTO M-36 - Corrugated Metal Culvert Pipe.

B. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

C. ASTM A123 - Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products.

D. ASTM A312 - Seamless and Welded Austenitic Stainless Steel Pipe.

E. ASTM B221 - Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.

F. ASTM B241 - Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.

G. CDA (Copper Development Association) - Handbook.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements of Section 01 33 00 – Submittal Procedures, submit the following:

1. Shop Drawings: Indicate detailed dimensions, base attachment details, anchor requirements, and imposed loads.

2. Product Data: Provide data on pole, accessories, and configurations.

3. Samples: Submit two samples illustrating pole material, color, and finish.

1.04 OPERATION AND MAINTENANCE DATA

A. Operation Data: Provide operating data.

B. Maintenance Data: Provide lubrication and periodic maintenance requirement and schedules.

1.05 QUALIFICATIONS

A. Design flagpole, foundation, and supports under direct supervision of a licensed Professional Structural Engineer experienced in design of this Work.

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1.06 DELIVERY, STORAGE, AND HANDLING

A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.

B. Protect flagpole and accessories from damage or moisture.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. The following manufacturers are approved for use.

1. Concord Industries, Incorporated

2. John Ewing and Company, Incorporated

3. Baartol Company Incorporated

2.02 POLE MATERIALS

A. Aluminum: ASTM B-241, 6063 alloy, T6 temper.

2.03 POLE CONFIGURATION

A. Design flagpolet to resist 110 mph wind.

B. Outside Butt Diameter: 6 inches.

C. Outside Tip Diameter: 3.5 inches.

D. Nominal Wall Thickness: 0.188 inch.

E. Nominal Height: 30'-0" ft.; measured from nominal ground elevation.

F. Flagpole: Ground mounted type.

G. Flagpole Design: Cone tapered.

H. Halyard: Exterior type.

2.04 COMPONENTS AND ACCESSORIES

A. Finial Ball: Aluminum, 6 inch diameter.

B. Truck Assembly: Cast aluminum; revolving, stainless steel ball bearings, non-fouling.

C. Flag: United States of America flag, 48x72 inch size, three ounce nylon fabric, brass grommets, hemmed edges.

D. Cleats: 9 inch, cast aluminum with stainless steel fastenings, two per halyard.

E. Cleat Box: Aluminum, with built-in hinge and hasp assembly, attached to pole with tamper proof screws inside box.

F. Halyard: 5/16 inch diameter polypropylene, braided, white.

2.05 OPERATOR

A. Hand Crank: Removable type.

2.06 MOUNTING COMPONENTS

A. Foundation Tube Sleeve: AASHTO M-36, corrugated 16 gage steel, galvanized, depth of 3'-0" inches.

B. Lighting Ground Rod: 24 inch long copper rod, 3/4 inch diameter.

2.07 FINISHES

A. Metal Surfaces in Contact With Concrete: Asphaltic paint.

B. Concealed Steel Surfaces: Galvanized to ASTM A123 1.25 oz/sq ft.

C. Aluminum: Clear anodized.

D. Finial: Gold anodized finish.

PART 3 -- EXECUTION

3.01 EXAMINATION

A. Verify that concrete foundation is ready to receive work and dimensions are as instructed by the manufacturer.

3.02 PREPARATION

A. Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials with asphaltic paint.

3.03 INSTALLATION

A. Install flagpole and fittings in accordance with manufacturer's instructions.

B. Fill foundation tube sleeve with concrete specified in Section 03300 - Cast-in-Place Concrete.

3.04 ERECTION TOLERANCES

A. Maximum Variation From Plumb: 1 inch.

3.05 ADJUSTING

A. Adjust operating devices so that halyard and flag function smoothly.

- END OF SECTION -

SECTION 10400

IDENTIFYING DEVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, materials, equipment and appliances required for the complete execution of the Work as shown on the Drawings and specified herein.

B. Principal items of work include:

1. Plastic engraved door and informational signs as indicated on the Drawings.

2. Safety signs

1.02 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Color and finish samples for all nameplates, signs and building name letters.

2. Shop Drawings shall include, but not be limited to:

a. Complete details for all signs and building name letters giving sizes and styles of lettering and colors.

b. Complete schedules for all nameplates, signs, and building name letters giving location, message, letter, size, color, and method of attachment.

c. Details of fabrication and attachment of all items.

1.03 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in unopened, unbroken and undamaged original packaging bearing the manufacturer's label and identification for installation.

B. Handle all materials with care to prevent defacement of any nature.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:

1. Andco Industries Corporation

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2. Innerface Architectural Signage Incorporated

3. Environmental Sign Systems

4. Talley Sign Company

5. Architectural Graphics Inc.

2.02 MATERIALS

A. Signs

1. Interior signs shall be self extinguishing plastic with raised letters meeting the requirements of the American with Disabilities Act of 1990; total thickness minimum of 0.125 inch; rounded corners.

2. Exterior signs shall be aluminum with vinyl lettering and numbering.

B. Character size and style shall be 3/4 inch high minimum upper case Helvetica. Spacing and proportions of letters shall be in strict accordance with the Americans with Disabilities Act of 1990.

C. Colors shall be as selected by the Owner from the manufacturer standard colors.

D. Materials shall be suitable for exterior or interior exposure as applicable.

2.03 ACCESSORIES

A. Mounting Hardware: Stainless steel screws.

B. Tape Adhesive: Double sided tape, permanent adhesive.

2.04 FABRICATION

A. All items specified herein to be factory fabricated to the extent practicable.

B. Provide all attachments and anchors necessary for concealed installments for door numbers, room name plates, and bulletin boards.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. All materials specified herein shall be installed in compliance with the approved manufacturer's printed specifications. Mounting devices, bolts, screws, nuts and the like shall be of high strength aluminum or stainless steel. The final location of each sign shall be as determined by the Engineer.

B. Plastic door numbers and room name plates shall be attached with double sided tape as recommended by sign manufacturer. Provide door signage for each door. Coordinate room name and door numbers with Owner.

1. Submit a schedule of door numbers and name plates to the Engineer for approval.

2. Install door and name plates after final field finish has been applied and thoroughly dried.

3.02 ADJUSTMENT AND CLEANING

A. After completion of project, remove all protective devices, touch up as necessary and clean all exposed surfaces with a mild solution of detergent and warm water. Leave all surfaces in a neat and clean condition.

3.03 SCHEDULES see Drawing A5 and additional signs indicated below.

A. FIRE RELATED SIGNS provide each sign with wording and pictogram. Signs shall have red background and white letters and pictogram.

Wording	**Size**	**Quantity**
FIRE CONTROL PANEL (exterior - coordinate wording with local fire marshal)	24x24	1

B. EXTERIOR BUILDING SIGNAGE

1. Laser cut aluminum signage. Provide two signs mounted to building. Aluminum match Owner's logo and include colors to match.

2. Laser cut aluminum building number signage indicating building address.

- END OF SECTION -

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SECTION 10522

FIRE EXTINGUISHERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish and install fire extinguishers as shown on the Drawings and specified herein.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of these Specifications the Work shall conform to the applicable requirements of the following documents:

1. NFPA 10 - Portable Fire Extinguishers

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Complete detail and installation drawings for Fire Extinguisher Cabinets.

2. Manufacturer's data sheets and verification of U.L. ratings.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications provide products from one of the following manufacturers:

1. Kidde Fire Extinguisher Company

2. Ansul Fire Protection

3. Potter - Roemer

4. J. L. Industries

2.02 MATERIALS

A. Dry Chemical (DC) Fire Extinguishers

1. Provide where indicated on drawings, 10 lb. capacity, hand portable, with heavy duty wall mount, provide wall cabinet where fire extinguishers are shown on metal stud

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and drywall partitions, tri-class dry chemical type, with Underwriters' Laboratories rating of 4-A: 60 BC. Provide where shown on Drawings.

B. Carbon Dioxide (CO_2) Fire Extinguishers

1. Provide two (2) 10 lb. capacity, portable carbon dioxide type with heavy duty wall mounts, having Underwriters' Laboratories rating of 10-BC. Provide in electrical rooms as shown on Drawings.

C. Cabinet: Semi-recessed mounted cabinets #4 finish 304 stainless steel, Dual Vertical door with 1/8-inch thick DSA glass size. Maximum projection into room or corridor shall be 4". Doors shall be minimum of 1/2" thick. Hardware shall include pull handle, self-adjusting roller catch and continuous piano hinge constructed of stainless steel. Provide cabinets to except 10 lb capacity fire extinguisher. Provide in all walls which have a gypsum board finish.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Fire extinguishers shall be installed where directed by the Engineer.

B. Wall mounts for extinguishers shall be securely mounted to masonry with lag bolts and shields.

C. Fire extinguishers shall be installed so that the top of the fire extinguisher is not more than 5 feet above the floor.

- END OF SECTION -

SECTION 10523

FIRST AID CABINETS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish and install first aid cabinets as shown on the Drawings and as specified herein. Coordinate work in this Section with painting and marking as specified in Section 09900, Painting. Certain equipment items will be field located by Owner, if not otherwise shown on the Drawings.

1.02 SUBMITTALS

A. Submit Shop Drawings, Performance Affidavit, Operation and Maintenance Instructions and other information as specified for all items of equipment in this Section in accordance with Section 11000, Equipment General Provisions and Section 01 33 00 – Submittal Procedures. Shop Drawings shall also include complete erection, installation, and adjustment instructions and recommendations.

1.03 MANUFACTURERS

A. The materials covered by these Specifications are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturers' recommendations.

PART 2 -- PRODUCTS

2.01 FIRST AID CABINET

A. The first aid cabinets shall be a Fisher Scientific Co. Catalog #19-035-116, or equal. Three first aid cabinets shall be provided. Provide one in Control Room, one in Laboratory, and one in the Break Room. Mounting brackets for masonry mounting shall be provided. Cabinets shall be field located as directed by the Engineer.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. First aid cabinets shall be installed where shown on the Drawings or as directed by the Engineer. Where required by OSHA regulations, the background of the mounting location shall be painted the appropriate color.

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- END OF SECTION -

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SECTION 10525

CHEMICAL HANDLING SAFETY EQUIPMENT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish and install chemical handling safety equipment as shown on the Drawings and as specified herein. Coordinate work in this Section with painting and marking as specified in Section 09900, Painting. Certain equipment items will be field located by Owner, if not otherwise shown on the Drawings.

1.02 SUBMITTALS

A. Submit Shop Drawings, Performance Affidavit, Operation and Maintenance Instructions and other information as specified for all items of equipment in this Section in accordance with Section 11000, Equipment General Provisions and Section 01 33 00, Submittal Procedures. Shop Drawings shall also include complete erection, installation, and adjustment instructions and recommendations.

1.03 MANUFACTURERS

A. The materials covered by these Specifications are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturers' recommendations.

PART 2 -- PRODUCTS

2.01 CHEMICAL HANDLING SAFETY EQUIPMENT

A. Chemical Handling Safety Equipment shall include respirators, chemical splash goggles, and chemical resistant work aprons, gloves and boots as manufactured by Fisher Scientific, Mine Safety Appliances, or equal.

B. Respirators shall be twin replaceable cartridge-type bearing NIOSH approval. Cartridges shall be as recommended by the manufacturer. Three (3) complete respirator units each with six replacement cartridges shall be provided.

C. Chemical splash goggles shall have soft vinyl frames with optical quality, distortion-free, replaceable plastic lenses. Three (3) splash goggles shall be provided.

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D. Chemical resistant work aprons and gloves shall be cloth with a double coating of abrasion-resistant and chemical resistant elastomer. Chemical resistant boots shall have non-slip soles and steel shank and toe and shall be coated with a chemical resistant elastomer. Sizes of gloves and boots shall be selected by the Owner. Three (3) complete sets of aprons, gloves and boots shall be provided.

E. Chemical Handling Safety Equipment shall be stored in a wall-mounted double door steel cabinet of approved size to prevent cramping of equipment specified. Cabinet shall be field located as directed by the Engineer.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Chemical handling safety equipment shall be installed where shown on the Drawings or as directed by the Engineer. Where required by OSHA regulations, the background of the mounting location shall be painted the appropriate color.

- END OF SECTION -

SECTION 10605

WIRE MESH PARTITIONS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on the Drawings and specified herein.

B. Provide one 12’-0” tall wire mesh partition where shown on Drawings.

1.02 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Manufacturer's product data.

2. Shop drawings showing fabrication and installation of wire mesh partitions. Include plans, elevations and large scale details showing anchorage and accessory items.

3. Color samples.

1.03 QUALITY ASSURANCE

A. Provide wire mesh partitions, mounting accessories, fittings, fasteners, hardware and other accessory items by a single manufacturer.

B. Take field measurements prior to fabrication to ensure proper fitting of work.

1.04 DELIVERY AND STORAGE

A. Take all measures necessary to protect products against damage during delivery and storage.

B. Store materials in a well ventilated and dry location.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Specifications provide products manufactured by one of the following:

1. The G-S Company

2. Acorn Wire and Iron Works, Inc.

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3. Miller Wire Works, Inc.

2.02 MATERIALS

A. General

1. Do not use materials less than size indicated. Use larger sizes when recommended by manufacturer.

2. Provide cutouts for pipes, ducts, beams, and other items shown or necessary for partition installation. Finish edges to provide a neat protective edge at cutouts.

B. Mesh: 6 gauge crimped steel wire woven into 2 inch diamond mesh, securely clinched to frame members.

C. Frames

1. Framing Members: 1½ inch by ¾ inch cold-rolled steel channels with 3/8 inch bolt holes approximately 18 inches on center.

2. Horizontal Reinforcing Members: 1½ inch by ¾ inch by 1/8 inch cold-rolled steel channel with wire woven through, or other detail recommended by the manufacturer for heavy duty partitions. Space horizontal reinforcing members as recommended by manufacturer.

3. Stiffening Bars: Provide flat bar stiffener post between all abutting panel frames. Size as required for partition height. Increase size where required to provide partition rigidity.

4. Top Capping Bars: 3" x 4.1 pounds channel secured to top framing member with 1/4 inch "U" bolts spaced not more than 28 inches on center.

5. Corner Posts: 1½ inch by 1½ inch by 1/8 inch angles with floor shoe and 3/8 inch bolt holes to align with bolt holes in vertical frame members.

6. Posts for Three Way and Four Way Intersections: Where three or four way intersections occur, use 2 inch x 2 inches tubular steel post with floor shoe and 3/8 inch bolt holes aligned for bolting to adjacent panels.

7. Posts for Intersections Other Than 90 Degrees: Use manufacturer's recommended round pipe corner posts and installation accessories.

8. Line Posts: Where runs exceed 20 feet without intersection or connection to overhead framing, furnish a 3 inches x 4.1 pound line post with a 1/4 inch base plate of a size recommended by the manufacturer. Position line post where required and recommended by the manufacturer to provide a rigid and stable partition.

9. Floor Shoes: Cast metal, sized to suit vertical framing and to provide 3 inches of clear space between finished floor and bottom horizontal frame members.

2.04 FINISH

A. Provide manufacturer's standard vinyl powder coating. Color shall be selected from manufacturer's full range of colors.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Erect partitions plumb, rigid, properly aligned, and securely fastened in place, complying with drawings and manufacturer's recommendations.

B. Provide additional field bracing as necessary for rigid, secure installation. Erector to provide additional clips and bracing as required. Partition shall be capable of supporting 5 psf load as required by the Virginia State Building Code for interior walls.

C. Touch-up damaged finish after completion of installation using field-applied paint to match color of shop applied finish.

- END OF SECTION -

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SECTION 10800

TOILET AND BATH ACCESSORIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish and install toilet and bath accessories as shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 04200 - Unit Masonry

B. Section 10155 – Recycled Plastic Toilet Partitions

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Manufacturer's data.

1.04 QUALITY ASSURANCE

A. Coordinate with other work to avoid interference and to assure proper operation and servicing of accessory units.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The following manufacturers are approved for use.

1. American Specialties Inc.

2. Bobrick Washroom Equipment, Inc.

3. Bradley Corp.

4. McKinney Parker

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2.02 MATERIALS

A. Provide the following (Model numbers are Bobrick Washroom Equipment, Inc. numbers and are used for convenience only).

1. Surface Mounted Toilet Tissue Dispenser for Two Rolls At each water closet - Model B-686, Type 304 -stainless, polished finish, concealed stainless steel wall plate.

2. Recessed Mounted Paper Towel Dispenser and Disposal: Satin finish stainless steel, with removable receptacle. Dispenses C-fold, multifold, or single fold towels. Model B-369.

3. Wall Mirrors at single lavatory: One (1) at each lavatory - stainless steel angle frame mirror, Model B-290. Corners shall heliarc welded, ground and polished smooth. No. 1 quality, ¼" (6mm) select float glass mirror electrolytically copper-plated; guaranteed against silver spoilage for 15 years. Provide 1/8 inch (3mm) thick, water-resistant, shock-absorbing padding and 20 gauge galvanized steel back. Concealed mounting. Size as shown on Drawings.

4. Mop Holder: 18 gauge, 304 stainless steel shelf, hooks and anti-slip mop holders with spring loaded rubber cam., 34 inch, Model B-239 x 34.

5. Grab Bars: 1-1/2 inch diameter, 18 gauge, stain finish, Type 304 stainless steel, concealed mounting with set screws. Joints and supports shall be contour cut and heliarc welded. Length shall be as indicated on the Drawings, and shall comply with the requirements of the Americans with Disabilities Act.

6. Sanitary Napkin Disposal: 22 gauge stainless steel, type 304, satin finish, seamless flanges, and self closing door(s). Capacity shall be 1.2 gallons (4.6 liters). Retain receptacle behind cabinet door with tumbler lock. Surface mounted: Model B-254.

7. Folding Shower Seat: Meet American with Disability Act. Seat shall be constructed of durable, water-resistant, solid phenolic slats. Frame and mounting brackets shall be Type 304 stainless steel able to support a minimum of 250 pounds. Model B-5181 or Model B-5171.

8. Robe Hooks: Three stainless steel hooks and flanges, bright polished finish mounted to a four inch high, 1/2 inch thick solid laminated plastic mounting strip with wood grain finish. Model B-232.

9. Surface Mounted Soap Dispenser: 304 stainless steel back and body with satin finish. Capacity of 40 fluid ounces. Corrosion-resistant valve and dispenser. Unbreakable refill window. Vandal resistant. Large, locked, hinged, stainless steel filler top. Model B-2112.

10. Shower Curtain and Rod: Provide one inch diameter stainless steel shower curtain rod with concealed fasteners Model B-207. Provide opaque, matte white vinyl 0.008 inch (2mm) thick shower curtain with nickel-plated brass grommets at 6" centers. Hem edges. Size to fit opening of shower stalls. Provide stainless steel shower curtain hooks.

11. Wall Mirrors: Type I transparent flat type, Class 1-clear glass. Glazing Qualtiy q1 ¼" thick conforming to ASTM C1036. Coat glass on one surface with silver coating, copper protective coating and mirror backing paint. Silver coating shall reflect 83 percent or more of incident light when viewed through ¼" glass. Silver coating shall be free of pinholes or other defects. Copper and backing paint shall

protect mirror from damage. Provide frameless mirrors width of countertop in multi-stall bathrooms. Mirrors shall be a minimum of 4'-0" high.

12. Hand Dryer : Durable, 22 gauge steel with exposed surface type 304 stainless steel with a #4 satin finish with vertical grain. Slim design to limit project from wall to 4". Provide unit with automatic sensor. Unit shall have dual air outlets and a 1/7 hp motor sealed ball bearings at drive shaft end and self-lubricating sleeve bearing at non drive end and equipped with automatic thermal overload switch. Heating elements shall be located on outlet side of fan protected from vandals and have a thermal overload switch. Automatic sensor shall turn on unit when sensor path is crossed and turn off when removed from sensor path. Unit shall turn off approximately 1 ½" minutes if an object is not moved from the sensor path and reset after item is removed from the sensor path. 115 V AC, 15 amp, 1725 Watts, 60 Hz. Single Phase, UL listed. Unit shall have 10 year warranty except for motor brushes shall be warranted for a minimum of 3 years. Model B-7120.

PART 3 -- EXECUTION

3.01 INSPECTION

A. Examine substrates, previously installed inserts and anchorages necessary for mounting of toilet accessories and other conditions under which installation is to occur, and notify the Design/Builder of conditions detrimental to proper completion of work. Do not proceed until unsatisfactory conditions have been corrected in a manner acceptable.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions, using fasteners which are appropriate to substrate and recommended by the manufacturer of the unit. Install plumb and level, firmly anchored in locations indicated.

B. Install mirrors with back frame concealed fasteners.

C. Mounting heights shall comply with the American with Disabilities Act.

3.03 ADJUST AND CLEAN

A. Adjust for proper operation of that mechanisms function smoothly.

B. Clean and polish exposed surfaces after removing protective coating.

- END OF SECTION -

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SECTION 11000

EQUIPMENT GENERAL PROVISIONS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Design/Builder shall furnish, install, test, and place in acceptable operation all mechanical equipment and all necessary accessories as specified herein, as shown on the Drawings, and as required for a complete and operable system.

B. The mechanical equipment shall be provided complete with all accessories, special tools, spare parts, mountings, and other appurtenances as specified, and as may be required for a complete and operating installation.

C. It is the intent of these Specifications that the Design/Builder shall provide the Owner complete and operational equipment/systems. To this end, it is the responsibility of the Design/Builder to coordinate all interfaces with related mechanical, structural, electrical, instrumentation and control work and to provide necessary ancillary items such as controls, wiring, etc., to make each piece of equipment operational as intended by the Specifications.

D. The complete installation shall be free from excessive vibration, cavitation, noise, and oil or water leaks.

E. The requirements of this section shall apply to equipment furnished under Divisions 11, 13, 14, and 15 with the exception of Sections 11400, 11410, 11415, 11500, and 11700.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. All equipment, materials, and installations shall conform to the requirements of the most recent editions with latest revisions, supplements, and amendments of the specifications, codes, and standards listed in Section 01090, Reference Standards.

1.03 SHOP DRAWINGS

A. Shop Drawings shall be submitted to the Owner and the Engineer for all equipment in accordance with Section 01 33 00, Submittal Procedures and shall include the following information in addition to the requirements of Section 01 33 00, Submittal Procedures:

1. Performance characteristics and descriptive data.

2. Detailed equipment dimensional drawings and setting plans.

3. General lifting, erection, installation, and adjustment instructions, and recommendations.

4. Complete information regarding location, type, size, and length of all field welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society. Special conditions shall be fully explained by notes and details.

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5. The total uncrated weight of the equipment plus the approximate weight of shipped materials. Support locations and loads that will be transmitted to bases and foundations. Exact size, placement, and embedment requirements of all anchor bolts.

6. Details on materials of construction of all components including applicable ASTM designations.

7. Information on bearing types and bearing life.

8. Gear box design and performance criteria and AGMA service factor.

9. Piping schematics.

10. Motor data sheet indicating motor horsepower; enclosure type; voltage; insulation class; temperature rise and results of dielectric tests; service-rating; rotative speed; motor speed-torque relationship; efficiency and power factor at ½, ¾, and full load; slip at full load; running, full load, and locked rotor current values; and safe running time-current curves.

11. Equipment and motor protective device details. Connection diagrams for motor and all protective devices.

12. Equipment shop coating systems, interior and exterior.

13. Panel layout drawings, schematic wiring diagrams, and component product data sheets for control panels.

14. A list of spare parts and special tools to be provided.

15. Any additional information required to show conformance with the equipment specifications.

16. Warranty documentation including statement of duration of warranty period and contact phone numbers and addresses for warranty issues.

1.04 OPERATION AND MAINTENANCE INSTRUCTION/MANUALS

A. Operation and Maintenance (O&M) manuals shall be submitted in accordance with Section 01 78 23, Operations and Maintenance Data.

B. O&M manuals shall include instructions, equipment ratings, technical bulletins, and any other printed matter such as wiring diagrams and schematics, prints or drawings, containing full information required for the proper operation, maintenance, and repair of the equipment. Included in this submission shall be a spare parts diagram, complete spare parts list, bill of materials, OEM part numbers and manufacturer's catalog information of all equipment components.

C. Written operation and maintenance instructions shall be required for all equipment items supplied for this project. The amount of detail shall be commensurate with the complexity of the equipment item.

D. Information not applicable to the specific piece of equipment installed on this project shall be struck from the submission.

E. Information provided shall include a source of replacement parts and names of service representatives, including address and telephone number.

F. Extensive pictorial cuts of equipment are required for operator reference in servicing.

G. When written instructions include Shop Drawings and other information previously reviewed by the Engineer, only those editions thereof which were approved by the Engineer, and which accurately depict the equipment installed, shall be incorporated in the instructions.

1.05 GENERAL INFORMATION AND DESCRIPTION

A. All parts of the equipment furnished shall, be designed and constructed for the maximum stresses occurring during fabrication, transportation, installation, testing, and all conditions of operation. All materials shall be new, and both workmanship and materials shall be entirely suitable for the service to which the units are to be subjected and shall conform to all applicable sections of these Specifications.

B. All parts of duplicate equipment shall be interchangeable without modification. Manufacturer's design shall accommodate all the requirements of these Specifications.

C. Equipment and appurtenances shall be designed in conformity with ASTM, ASME, AIEE, NEMA, and other generally accepted applicable standards.

D. All bearings and moving parts shall be adequately protected by bushings or other approved means against wear, and provision shall be made for accessible lubrication by extending lubrication lines and fittings to approximately 30 inches above finished floor elevation.

E. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc., shall be finished in appearance. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.

F. Machinery parts shall conform within allowable tolerances to the dimensions shown on the working drawings.

G. All machinery and equipment shall be safeguarded in accordance with the safety codes of the USA and the State in which the project is located.

H. All rotating shafts, couplings, or other moving pieces of equipment shall be provided with suitable protective guards of sheet metal or wire mesh, neatly and rigidly supported. Guards shall be removable as required to provide access for repairs.

I. All equipment greater than 100 pounds shall have lifting lugs, eyebolts, etc., for ease of lifting, without damage or undue stress exerted on its components.

J. All manufactured items provided under this Section shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.

1.06 EQUIPMENT WARRANTIES

A. Warranty requirements may be added to or modified in the individual equipment specifications.

B. All materials furnished shall be guaranteed to be free from defects in design and/or materials for a period of one (1) year following Substantial Completion. The period of such warranties shall start on the date the Performance Testing as indicated in the General Requirements have been completed and Substantial Completion has occurred. Any design and/or material (or part thereof) which is defective or showing undue wear within the correction period or not meeting performance requirements, shall be corrected, repaired or replaced with new material; furnishing all materials, labor, etc., necessary to return to the specified performance level without charge to the Owner. Where defective designs and/or materials have been repaired or replaced, the correction period for such shall be extended in accordance with the General Conditions.

C. The Design/Builder shall provide an equipment warranty log book prepared specifically for this project and submit two (2) copies of the document to the Owner prior to final payment. The equipment warranty log book shall include a summary listing of all equipment warranties provided, date received, and start date and end date of warranty period. A copy of each equipment warranty and equipment start-up certification shall also be provided in the document.

D. The Equipment Supplier shall guarantee to the Owner that all equipment offered under these specifications, or that any process resulting from the use of such equipment in the manner stated is not the subject of patent litigation, and that he has not knowingly offered equipment, the installation or use of which is likely to result in a patent controversy, in which the Owner as user is likely to be made the defendant.

Where patent infringements are likely to occur, each Equipment Supplier shall submit license arrangements between himself, or the manufacturer of the equipment offered, and the patent owner or the controller of the patent, which will permit the use in the specified manner of such mechanical equipment as he may be supplying.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The materials covered by these Specifications are intended to be equipment of proven reliability, and as manufactured by reputable manufacturers having experience in the production of such equipment. The Design/Builder shall, upon request of the Owner, furnish the names of not less than 5 successful installations of the manufacturer's equipment of the same size and model of that offered under this contract. The equipment furnished shall be designed, constructed, and installed in accordance with the industry accepted practices and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturer's recommendations.

2.02 ANCHORS AND SUPPORTS

A. The Design/Builder shall furnish, install, and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of the devices included in the equipment specified. Working Drawings for installation shall be furnished by the equipment manufacturer, and suitable templates shall be used by the Design/Builder when required in the detailed equipment Specifications.

B. Anchor bolts and fasteners shall be furnished in accordance with Section 05050, Metal Fastening, and with the individual equipment Specifications. All anchor bolts shall be a minimum of 1/2-inch diameter. All anchor bolts, handrail bolts, washers, clips, clamps, and fasteners of any type shall be constructed of 316 stainless steel, unless otherwise specified the individual equipment Specifications.

C. The Design/Builder shall provide all concrete pads or pedestals required for equipment furnished. All concrete equipment pads shall be a minimum of 6" high, unless otherwise shown on the Drawings and shall be doweled into the slab.

D. Pipe sleeves or other means of adjusting anchor bolts shall be provided where indicated or required. Equipment shall be leveled by first using sitting nuts on the anchor bolts, and then filling the space between the equipment base and concrete pedestal with non-shrink grout, unless alternate methods are recommended by the manufacturer and are acceptable to the Engineer (such as shim leveling pumps, or chemical grout). Non-shrink grout shall be as specified in Section 03600, Grout.

2.03 STRUCTURAL STEEL

A. Structural steel used for fabricating equipment shall conform to the requirements of Section 05120, Structural Steel.

B. All materials shall conform to applicable provisions of the AISC Specifications for the design and fabrication of structural steel, and to pertinent ASTM Standard Specifications.

2.04 DISSIMILAR METALS

A. All dissimilar metals shall be properly isolated. to the satisfaction of the Engineer.

2.05 GALVANIZING

A. Where required by the equipment specifications, galvanizing shall be performed in accordance with Section 05035, Galvanizing.

2.06 STANDARDIZATION OF GREASE FITTINGS

A. The grease fittings on all mechanical equipment shall be such that they can be serviced with a single type of grease gun. Fittings shall be "Zerk" type.

2.07 ELECTRICAL REQUIREMENTS

A. All electrical equipment and appurtenances, including but not limited to motors, panels, conduit and wiring, etc., specified in the equipment specifications shall comply with the applicable requirements of the Division 16 specifications and the latest National Electric Code.

B. Motors shall conform to the applicable requirements of Section 15170, Low Voltage Electric Motors.

C. In the individual equipment specifications, specified motor horsepower is intended to be the minimum size motor to be provided. If a larger motor is required to meet the specified operating conditions and performance requirements, the Design/Builder shall furnish the larger sized motor and shall upgrade the electrical service (conduit, wires, starters, etc.) at no additional cost to the Owner.

D. Where variable frequency drives (VFDs) are specified, the Design/Builder shall be responsible for coordinating between equipment supplier and VFD supplier to ensure a complete and operational system. VFDs shall be furnished under Division 16 and shall be as specified in Section 16495, Low Voltage Variable Frequency Drive Systems.

E. Motor starters and controls shall be furnished and installed under Division 16 and Division 17 unless otherwise specified in the individual equipment specifications.

2.08 ACCESSORIES, SPARE PARTS, AND SPECIAL TOOLS

A. Spare parts for equipment shall be furnished where indicated in the individual equipment specifications.

B. Spare parts shall be identical and interchangeable with original parts.

C. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

D. Painting requirements for spare parts shall be identical to those for original, installed parts. Where no painting or protective coating is specified, suitable provisions shall be made to protect against corrosion.

E. Spare parts shall be delivered at the same time as the equipment to which they pertain. Spare parts shall be stored separately in a locked area, maintained by the Design/Builder, and shall be turned over to the Owner in a group prior to Final Completion. All of these materials shall be properly packed, labeled, and stored where directed by the Owner.

F. The Design/Builder shall furnish all special tools necessary to operate, disassemble, service, repair, and adjust the equipment in accordance with the manufacturers operation and maintenance manual.

G. The manufacturer shall submit a list of at least four manufacturer's standard lubricants which may be used interchangeably for each type of lubricant required.

2.09 EQUIPMENT IDENTIFICATION

A. All mechanical equipment shall be provided with a substantial stainless steel nameplate, mechanically fastened with stainless steel hardware in a conspicuous place, and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.

B. Each pump and other piece of mechanical equipment shall also be identified as to name and number by a suitable laminated plastic or stainless steel nameplate mechanically fastened with stainless steel hardware; for example, "Raw Water Pump #1". Coordinate name and number with same on remotely located controls, control panel, and other related equipment.

C. Nameplates shall not be painted over.

PART 3 -- EXECUTION

3.01 SHOP TESTING

A. All equipment shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and that it will operate in the manner specified or implied.

B. No equipment shall be shipped to the project until the Owner and Engineer has been furnished a certified copy of test results and has notified the Design/Builder, in writing, that the results of such tests are acceptable.

C. Five (5) certified copies of the manufacturer's actual test data and interpreted results thereof shall be forwarded to the Owner and Engineer for review.

D. If required by the individual equipment specifications, arrangements shall be made for the Owner to witness performance tests in the manufacturer's shop. The Owner shall be notified ten working days before shop testing commences. Expenses are to be paid by Owner.

E. Shop testing of electric motors shall be in accordance with applicable requirements of Section 15170, Low Voltage Electric Motors; and Section 16000, Basic Electrical Requirements.

3.02 STORAGE OF EQUIPMENT AND MATERIALS

A. Design/Builder shall store his equipment and materials at the job site in strict accordance with the manufacturer's recommendations and as directed by the Owner, and in conformity to applicable statutes, ordinances, regulations, and rulings of the public authority having jurisdiction.

B. Stored electrical equipment is to be protected from the elements and shall have space heaters energized.

C. Design/Builder shall not store unnecessary materials or equipment on the job site and shall take care to prevent any structure from being loaded with a weight which will endanger its security or the safety of persons.

D. Design/Builder shall observe all regulatory signs for loadings on structures, fire safety, and smoking areas.

E. Design/Builder shall not store materials or encroach upon private property without the written consent of the owners of such private property.

3.03 MANUFACTURER'S FIELD SERVICES

A. The Design/Builder shall arrange for a qualified Technical Representative from each manufacturer or supplier of equipment who is regularly involved in the inspection, installation, start-up, troubleshooting, testing, maintenance, and operation of the specified equipment. Qualification of the Technical Representative shall be appropriate to the type of equipment furnished and subject to the approval of the Engineer and the Owner. Where equipment furnished has significant process complexity, furnish the services of engineering personnel knowledgeable in the process involved and the function of the equipment. When necessary, the Design/Builder shall schedule multiple Technical Representatives to be present at the same time for the purpose of coordinating the operation of multiple pieces of related equipment.

B. For each site visit, the Technical Representative shall submit jointly to the Owner, the Engineer, and the Design/Builder a complete signed report of the results of his inspection, operation, adjustments, and testing. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified.

C. The manufacturer's Technical Representative shall provide the following services.

1. Installation: The Technical Representative shall inspect the installed equipment to verify that installation is in accordance with the manufacturer's requirements. Where required by individual equipment specifications, the Technical Representative shall also supervise the installation of the equipment.

2. Testing: After installation of the equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the Technical Representative shall inspect, operate, test, and adjust the equipment as required to prove that the equipment is in proper condition for satisfactory operation under the conditions specified. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for startup and that nothing in the installation will render the manufacturer's warranty null and void. The report shall include date of final acceptance field test, as well as a listing of all persons present during tests.

3. Startup: The Technical Representative shall start up the equipment for actual service with the help of the Design/Builder. In the event that equipment or installation problems are experienced, the Design/Builder and the representative shall provide the necessary services until the equipment is operating satisfactorily and performing according to the specifications at no additional cost to the Owner. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.

4. Training: The Technical Representative shall instruct the Owner's operating personnel in correct operation and maintenance procedures. The instruction shall

demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment. Such instruction shall be scheduled at a time arranged with the Owner at least 2 weeks in advance of the training and shall be provided while the respective Technical Representative's equipment is fully operational. The Design/Builder shall have submitted, and had accepted, the O&M Manuals prior to commencement of training. Training shall be provided to three separate shifts of the Owner's personnel between the hours of 8:00 A.M. and 6:00 P.M. as necessary.

5. Services after Startup: Where required by the individual equipment specifications, the Technical Representative shall return to the project site thirty (30) days after the start up date to review the equipment performance, correct any equipment problems, and conduct operation and maintenance classes as required by the Owner. This follow-up trip is required in addition to the specified services of Technical Representative prior to and during equipment startup. At this time, if there are no equipment problems, each manufacturer shall certify to the Owner in writing that his equipment is fully operational and capable of meeting operating requirements. If the equipment is operating incorrectly, the Technical Representative will make no certification to the Owner until the problems are corrected and the equipment demonstrates a successful thirty (30) days operating period.

D. Services of the Technical Representative will require a minimum of two (2) site visits, one for installation and testing and one for startup and training, and will be for the minimum number of days recommended by the manufacturer and approved by the Owner but will not be less than the number of days specified in individual equipment sections.

E. The times specified for services by the Technical Representative in the equipment Specifications are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

F. The Design/Builder shall notify the Owner at least 7 days in advance of each equipment test or Owner training session.

G. The Technical Representative shall sign in and out at the office of the Design/Builder on each day he is at the project.

3.04 INSTALLATION

A. The Design/Builder shall obtain written installation manuals from the equipment manufacturer prior to installation. Equipment shall be installed strictly in accordance with recommendations of the manufacturer. A copy of all installation instructions shall be furnished the Engineer's field representative one week prior to installation.

B. The Design/Builder shall have on hand sufficient personnel, proper construction equipment, and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character. To minimize field erection problems, mechanical units shall be factory-assembled insofar as practical.

C. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Drawings.

D. All equipment sections and loose items shall be match-marked prior to shipping.

E. For equipment such as pumping units, which require field alignment and connections, the Design/Builder shall provide the services of the manufacturer's qualified mechanic, millwright, or machinist, to align the pump and motor prior to making piping connections or anchoring the pump base. Alignment shall be as specified herein.

F. The Design/Builder shall furnish oil and grease for initial operation and testing. The manufacturer and grades of oil and grease shall be in accordance with the recommendations of the equipment manufacturer.

3.05 ALIGNMENT

A. Set equipment to dimensions shown on drawings. Dimensions shall be accurate to +/- 1/16 inch unless otherwise noted on the drawings. Wedges shall not be used for leveling, aligning, or supporting equipment.

B. General Equipment Leveling: Non-rotating equipment shall be set level to +/- 1/16 inch per 10 foot length (.005 inch per foot) unless otherwise noted on the drawings. Shims shall be used unless equipment is furnished with leveling feet. Set shims flush with equipment baseplate edges. When grouting is required, equipment shall be shimmed to allow a minimum of one inch grout thickness. Grout shall cover shims at least 3 inches. Final level check shall be held for inspection and approval by Engineer before proceeding.

C. Grouting

1. Fill anchor bolt holes or sleeves with grout, after bolt alignment is proven, and prior to placing grout under equipment bases.

2. Surface Preparation. Roughen surface by chipping, removing laitance, and unsound concrete. Clean area of all foreign material such as oil, grease, and scale. Saturate area with water at least 4 hours prior to grouting, removing excess water ponds.

3. Application. Place grout after the equipment base has been set and its alignment and level have been approved. Form around the base, mix grout, and place in accordance with the grout manufacturers published instructions. Eliminate all air or water pockets beneath the base using a drag chain or rope.

4. Finishing. Point the edges of the grout to form a smooth 45 degree slope.

5. After grout has cured (not before 3 days after placement) paint exposed surfaces of grout with shellac.

6. Level Verification. After grout has cured, and immediately prior to drive alignment, recheck equipment for level and plumb. Re-level and square as necessary. Hold final checks for inspection and approval by Engineer.

D. Inspect for and remove all machining burrs or thread pulls in female holes on mating surfaces of mounting frame and machine feet.

E. Inspect and clean equipment mounting base pads, feet, and frames to remove all grease, rust, paint and dirt.

F. Assembled equipment shafts shall be set level to .0015 inches per foot of shaft length (+/- .0005 inches) up to a maximum of 0.015 inches for any length shaft unless the manufacturers requirements are more stringent or unless otherwise noted in the equipment specifications. Use the machined surfaces on which the equipment sets for the base/mounting frame leveling plane. Use the machined shaft surface for equipment leveling plane.

G. Sprocket and Sheave Alignment. Check shaft mounted components for face runout and eccentricity (outside diameter) runout by magnetically mounting a dial indicator on a stationary base and indicating over 360 degrees on a continuous machined surface at the outside diameter of the component. Maximum allowable total indicated face runout and eccentricity for sprockets and sheaves will be per ANSI Standard B29.1-1975.

H. Belt tensioning. Set drive belt tension to manufacturer's specification for the belt type. Recheck alignment after drive tensioning.

I. Thermal/Mechanical Growth. Thermal/mechanical growth corrections for driver and driven machines will be used in vertical and horizontal alignment where applicable. The equipment manufacturer will determine thermal/mechanical growth applicability for any machine and provide the correction offsets to be used.

J. Rotating Shaft Alignment

1. Fixtures will be set up on the driver and driven machine, machines shaft surfaces. Machined coupling hubs may be used only if there is no clearance to mount fixtures directly on the shafts.

2. Primary alignment method for direct drive machines is when coupled. Uncoupled alignment will be used only when approved by the Engineer.

3. Account for possible coupling flex by always rotating coupled machines in the same direction during alignment.

4. Uncoupled machines must be connected so that both shafts turn together without relative motion during alignment.

5. Indicator bar sag will be measured and included for each reverse indicator alignment setup.

6. Reverse Dial Indicator. The final maximum allowable misalignment: vertical and horizontal from the desired targets of .000 inches (for a non-thermal growth machine) or from the given target readings (for a thermal growth machine) must meet BOTH of the following conditions simultaneously: 1/2 the final total indicator reading at each indicator will be no more than shown in the table below AND the final remaining correction at each machine foot be no more than .001 inches of required movement.

Machine Speed (RPM)	Total Misalignment* (inches)
Up to 1800	.002
1800 and greater	.001

* 1/2 indicator reading

3.06 FIELD TESTING

A. All equipment shall be set, aligned and assembled in conformance with the manufacturer's drawings and instructions. Provide all necessary calibrated instruments to execute performance tests. Submit report certified by the pump manufacturer's representative.

B. Equipment testing and startup shall be performed in accordance with Section 01 91 14 – Facility Startup.

3.07 VIBRATION TESTING

A. Unless specified otherwise in the detailed equipment specifications, each pump, blower, compressor, motor or similar item of stationary rotating equipment having a rated power in excess of 40HP shall be tested after installation for acceptable vibration levels.

B. Vibration testing shall be performed by an experienced factory-trained and authorized third-party analysis expert (not a sales representative) retained by the Design/Builder and approved by the Owner. Each unit or pump system shall be tested separately without duplicate equipment running. All field testing shall be done in the presence of the Owner and the Engineer. The Owner and the Engineer shall be furnished with four (4) certified copies of vibration test data for each test performed.

C. For systems with variable speed drives, tests shall be conducted at various speeds between maximum and minimum. For systems with two-speed drives, tests shall be conducted at both speeds. For systems with constant-speed drive, tests shall be conducted under various loading conditions as determined by the Engineer.

D. All field vibration tests shall be performed with the equipment operating on the product for which it is intended, or a substitute acceptable to the Engineer.

E. The term displacement, as used herein, shall mean total peak-to-peak movement of vibrating equipment, in mils; velocity or speed of the vibration cycle, measured in G's. Displacement and velocity shall be measured by suitable equipment equal to IRD Mechanalysis, Bentley, Nevada.

E. Frequency of vibration, in cycles per minute (cpm), shall be determined when vibration exceeds specified levels or as otherwise necessary. Vibration shall be measured on the bearing housing, unless other locations are deemed necessary by the vibration analysis expert and Engineer.

F. For all equipment tested, vibration shall be checked in the radial and axial directions. Unless otherwise specified elsewhere, axial vibration shall not exceed 0.1 in/sec; and radial vibration shall not exceed 0.2 in/sec. For pumps radial vibration shall not exceed that permitted by the Hydraulic Institute Standards except that, at vibration frequencies in excess of 8,000 cpm, the velocity shall not exceed 0.2 in/sec.

G. Copies of test results shall be submitted to the Owner for review. Should the vibration field test results exceed shop test results, the manufacturer's recommendations, or the limits specified herein, the Design/Builder shall correct the deficiencies within thirty (30) days. After corrections have been completed, the vibration testing shall be re-run and the results re-submitted to the Owner for review.

H. Noise or vibration in any rotating equipment which the Owner judges to be excessive or damaging, shall be cause for rejection.

3.08 FAILURE OF EQUIPMENT TO PERFORM

A. Any defects in the equipment, or failure to meet the guarantees or performance requirements of the Specifications shall be promptly corrected by the Design/Builder by replacements or otherwise.

B. If the Design/Builder fails to make these corrections, or if the improved equipment shall fail again to meet the guarantees or specified requirements, the Owner may reject said equipment and order the Design/Builder to remove it from the premises at the Design/Builder's expense.

C. The Design/Builder shall then obtain specified equipment to meet the contract requirements or upon mutual agreement with the Owner, adjust the contract price to reflect not supplying the specific equipment item.

3.09 PAINTING

A. All surface preparation, shop painting, field repairs, finish painting, and other pertinent detailed painting specifications shall conform to applicable sections of Section 09900, Painting.

B. All shop coatings shall be compatible with proposed field coatings.

C. All inaccessible surfaces of the equipment, which normally require painting, shall be finished painted by the manufacturer. The equipment and motor shall be painted with a high quality epoxy polyamide semi-gloss coating specifically resistant to chemical, solvent, moisture, and acid environmental conditions, unless otherwise specified.

D. Gears, bearing surfaces, and other unpainted surfaces shall be protected prior to shipment by a heavy covering of rust-preventive compound sprayed or hand applied which shall be maintained until the equipment is placed in operation. This coating shall be easily removable by a solvent.

3.10 WELDING

A. The Equipment Manufacturer's shop welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirement of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.

B. The Design/Builder's welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirements of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.

C. The Design/Builder shall perform all field welding in conformance with the information shown on the Equipment Manufacturer's drawings regarding location, type, size, and length of all

welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society, and special conditions, as shown by notes and details.

- END OF SECTION -

SECTION 11100

PUMPS - GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Design/Builder shall furnish, install, test, and make fully operational all pumping equipment, complete with all necessary accessories, in compliance with the Contract Documents.

B. All pumping equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions.

C. The provisions of this section shall apply to all pumps and pumping equipment specified except where specifically noted otherwise in the Contract Documents and with the exception of Sections 11400, 11410, 11415, 11500, and 11700.

D. The pumps shall be provided complete with all accessories, shims, sheaves, couplings, and other appurtenances as specified, and as may be required for a complete and operating installation.

E. All pump component materials in contact with process water shall be in compliance with the 2014 Reduction of Lead in Drinking Water Act.

1.02 SHOP DRAWINGS

A. Shop Drawings shall include the following information in addition to the requirements of Section 01 33 00, Submittals Procedures and Section 11000, Equipment General Provisions.

1. Details of shaft sealing system

2. Pump performance curves at rated speed and reduced speed (if reduced speeds are specified). Curves shall indicate flow, head, efficiency, brake horsepower, NPSH required, and minimum submergence. Curves shall include limits (minimum and maximum flows) for stable operation without cavitation, overheating, recirculation, or excessive vibration.

3. General cutaway sections, materials, dimension of shaft projections, shaft and keyway dimensions, shaft diameter, dimension between bearings, general dimensions of pump, suction head bolt orientation, and anchor bolt locations and forces.

4. Foundry certificates and results of Brinnell hardness testing showing compliance to ASTM A 532 (where required in the individual pump specifications).

5. Submersible pump submittals shall also include:

a. Product data sheets for power and control cables and length of cables.
b. Details on pump guide rail system and mounting requirements.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. All materials employed in the pumping equipment shall be suitable for the intended application. Material not specifically called for shall be high-grade, standard commercial quality, free from all defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements unless otherwise specified in individual pumping equipment Specifications:

1. Cast iron pump casings and bowls shall be of close-grained gray cast iron, conforming to ASTM A 48, or equal.

2. Stainless steel pump shafts shall be of Type 400, Series. Miscellaneous stainless steel parts shall be of Type 316.

B. Suction and discharge flanges shall conform to ANSI standard B16.1 or B16.5 dimensions.

C. Handholes on pump casings shall be shaped to follow the contours of the casing to avoid any obstructions in the water passage.

2.02 APPURTENANCES

A. Pressure Gauges

1. The Design/Builder shall furnish and install pressure gauges on the suction and discharge of each pump, except wet-pit submersible pumps and vertical turbine pumps.

2. The Design/Builder shall furnish and install pressure gauges on the discharge piping of each wet-pit submersible pump and vertical turbine pump in the locations shown on the Drawings or as directed by the Engineer.

3. Suction gauges shall be of the single scale compound type to indicate both pressure and vacuum. Each suction gauge shall be graduated in feet of water over the span of 34 feet below and above zero.

4. Discharge gauges shall be graduated in feet from zero to a minimum of five (5) feet of water above the respective pump shutoff head or to a minimum of 30% above the maximum operation pressure, whichever is greater. Graduation shall be in feet of water.

5. All gauges shall be supplied by one manufacturer and shall be as specified in Section 17650, Pressure Gauges.

6. All gauges shall be provided with diaphragm seals or isolating ring seals as specified in Section 17698, Instrumentation and Control System Accessories.

B. Flexible couplings for direct driven pumps shall be as manufactured by Falk, Dodge, Woods Corp., or equal and shall be furnished with guards in accordance with OSHA Rules and Regulations. Spacer couplings shall be provided where necessary to allow removal of the pump rotating element without disturbing the driver.

2.02 ELECTRICAL REQUIREMENTS

A. All pumps shall be furnished with motors such that the motor shall not be overloaded throughout the full range of the pump operation, unless otherwise specified in the individual pump specifications or specifically approved by the Engineer.

B. Where variable frequency drives (VFDs) are specified, the Design/Builder shall be responsible for coordinating between pump supplier and VFD supplier to ensure a complete and operational system. VFDs shall be furnished under Division 16 and shall be as specified in Section 16495, Low Voltage Variable Frequency Drive Systems.

C. Motor starters and controls shall be furnished and installed under Division 16 and Division 17 unless otherwise specified in the individual pump specifications.

2.03 EQUIPMENT IDENTIFICATION

A. In addition to the requirements of Section 11000, Equipment General Provisions, nameplate data for each pump shall include the rating in gallons per minute, rated head, speed, and efficiency at the primary design point.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Drains: All gland seals, air valves, and drains shall be piped to the nearest floor drain or trench drain as indicated in Section 15390, Schedules, properly supported with brackets.

B. Solenoid Valves: Where required, the pump manufacturer shall furnish and install solenoid valves on the water or oil lubrication lines. Solenoid valve electrical rating shall be compatible with the motor control voltage and shall be furnished complete with all necessary conduit and wiring installation from control panel to solenoid.

3.02 SHOP TESTING

A. Shop tests shall be performed in accordance with Section 11000, Equipment General Provisions, and except where stated otherwise herein, shall be conducted in accordance with the latest version of Hydraulic Institute Standard 14.6, Hydraulic Performance Acceptance Tests.

B. Pump testing shall be witnessed by the Owner and/or the Engineer where specified in the individual pump specifications. The testing procedure shall be submitted to the Engineer for

review before scheduling the testing. The Owner and/or the Engineer shall be given at least 2 weeks advanced notice of the scheduled testing date.

C. Certified test curves for shall be provided for all centrifugal pumps unless otherwise specified in the individual pump specifications. Certified tests will not be required for submersible sump pumps (as specified in Sections 11133 and 11136) with motors less than 5 hp.

D. Pumps shall be within the tolerances specified for Acceptance Grade 1U, in accordance with the latest version of Hydraulic Institute Standards 14.6.

E. For wet pit submersible pumps and vertical turbine pumps, all tests shall be run at minimum pump submergence specified in the individual pump specifications.

3.03 FIELD TESTING

A. Field tests shall be performed in accordance with in Section 11000, Equipment General Provisions and additionally as specified below and in the individual pump specifications.

B. Functional and performance tests shall demonstrate the following:

1. The pumps have been properly installed and are in proper alignment.

2. The pumps operate without overheating or overloading of any parts and without objectionable vibration. Vibration shall be within the Hydraulic Institute limits, or manufacturer's limits if more stringent.

3. The pumps can meet the specified operating conditions. All pumps shall be checked at maximum speed for a minimum of four points on the pump curve for capacity, head, and amperage. The rated motor nameplate current shall not be exceeded at any point. Pumps with drive motors rated at less than five horsepower shall only be tested for overcurrent when overheating or other malfunction becomes evident in general testing.

- END OF SECTION -

SECTION 11103

MAGNETIC DRIVE CENTRIFUGAL SAMPLE PUMP

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Design/Builder shall furnish magnetic drive centrifugal pumps at the locations shown on the Drawings and as specified herein.

B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions and Section 11100, Pumps - General.

C. All pump components in the fluid path shall be NSF 61 rated.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

	SMPFE-1
Quantity	1
Design Capacity (gpm)	3.5
Total Dynamic Head (feet)	5.4
Pump Speed (rpm)	1,750
Temperature of Liquid Pumped	Ambient
Suction Condition	Flooded Suction
Minimum Suction Diameter (in.)	5/8
Minimum Discharge Diameter (in.)	5/8
Minimum Impeller Diameter (in.)	2.062

1.03 SUBMITTALS

A. Submittals shall be provided in accordance with Section 01 33 00, Submittal Procedures and Section 11000, Equipment General Provisions.

1.04 WARRANTY AND GUARANTEE

A. Warranty and Guarantee shall be as specified in Section 11000, Equipment General Provisions.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The pumps shall be MDX Series magnetically driven seal-less centrifugal pumps as manufactured by March Manufacturing, Inc., or approved equal.

2.02 MATERIALS OF CONSTRUCTION OF MAGNETIC DRIVE CENTRIFUGAL PUMPS

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A. These Specifications shall be considered as minimum requirements. The manufacturer shall add features as necessary for satisfactory operation and shall guarantee the suitability of the materials used in the manufacture of the pump. Motors shall be non-overloading over the range of pump performance.

B. The pump shall be seal-less magnetic drive type applying all the laws of centrifugal pump design. The pump housing shall be non-metallic. The impellers shall be balanced to minimize vibration. The bearings shall support driven magnetic assembly and shall be lubricated by pumped liquid. Pump materials shall be provided as follows:

Front and Rear Housing	Kynar/Carbon Filled/ Polyproplene
Impeller	Polypropylene
O-Rings	Buna N
Shaft	Carbon Filled Kynar
Thrust Washers	Teflon/Carbon
Bushing	Carbon or Ceramic

C. Pumps shall be provided with a substantial stainless steel nameplate, securely fastened in a conspicuous place and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.

2.03 ELECTRICAL AND CONTROL REQUIREMENTS

A. All conduit and associated appurtenances shall be furnished and installed under Division 16.

B. Electrical Requirements

	Centrifugal Sample Pump
Motors	
Rating	120V, 1 ph, 60 Hz
Horsepower	1/55
Speed, rpm	1750
Insulation	Class F
Inverter Duty	No
Service Factor	1.15
Space Heater	No
Motor Winding Temperature Switches	No

C. Motors shall be as specified in Section 15170, Low Voltage Electric Motors.

2.04 SPARE PARTS

A. Spare parts shall be provided in accordance with Section 11000, Equipment General Provisions.

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions. For each series of pumps, field services shall include the following site visits:

Service	**Number of Trips**	**Number of Days/Trip**
Installation and Testing	1	1
Startup and Training	1	1

3.02 SHOP TESTING

A. Shop testing shall be in accordance with Section 11000, Equipment General Provisions.

- END OF SECTION -

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SECTION 11122

PROGRESSIVE CAVITY PUMPS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Design/Builder shall furnish, test, and place in satisfactory operation three progressive cavity type pumps. All pumps shall be supplied by the same manufacturer.

B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions.

1.02 RELATED WORK

A. Section 01 91 14 – Equipment Testing and Facility Startup
B. Section 01 78 23 – Operations and Maintenance Data
C. Section 11000 – Equipment, General Provisions
D. Section 11100 – Pumps, General

1.03 SUBMITTALS

A. The following items shall be submitted with the Shop Drawings.

1. The Manufacturer shall submit Working Drawings, which shall consist of the following:

a. Manufacturer's literature, data sheets, fabrication information, installation instructions, assembly views.

b. Materials of construction and associated specifications (such as AISI, ASTM, SAE, etc.), including grade and type.

c. Identify each component by tag number to which the catalog data and detail sheets pertain.

d. Certified installation drawings showing all details of construction, dimensions, and anchor bolt requirements.

e. The weight of each component, and total static and dynamic loads imparted by the equipment to the supporting structure.

f. Complete motor data including size, make, type and characteristics along with wiring diagrams.

g. Details of shaft sealing system

h. Pump performance curves at rated speed and reduced speed (if reduced

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speeds are specified). Curves shall indicate flow, head, efficiency, brake horsepower, NPSH required, and minimum submergence. Curves shall include limits (minimum and maximum flows) for stable operation without cavitation, overheating, recirculation, or excessive vibration.

i. General cutaway sections, materials, dimension of shaft projections, shaft and keyway dimensions, shaft diameter, dimension between bearings, general dimensions of pump, suction head bolt orientation, and anchor bolt locations and forces. Description of coating system, surface preparation and shop painting, including certification that the shop paint is compatible with the finish paint.

j. Spare parts list and manufacturer recommended spare parts.

k. Complete lubrication instructions and lubricant schedule, including manufacturers of recommended lubricants. All lubricants shall be Food-Grade, NSF61 approved. Schedule shall include frequency of lubricant application, type of lubricant, and instructions regarding lubricant application.

2. Submit results of factory tests, field tests, and start up reports.

3. Performance curves submitted shall be for the entire pump assembly, including efficiency corrections and losses.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Each pump shall be a progressive cavity type pump. The progressive cavity pumps shall be the MOYNO 2000 as manufactured by Robbins and Myers, the NEMO as manufactured by Netzsch, equivalent by Seepex, or equal.

2.02 WARRANTY AND GUARANTEE

A. All materials furnished shall be guaranteed to be free from defects in design and/or materials for a period of one (1) year following Substantial Completion. The period of such warranties shall start on the date the Performance Testing as indicated in the General Requirements have been completed and Substantial Completion has occurred. Any design and/or material (or part thereof) which is defective or showing undue wear within the correction period or not meeting performance requirements, shall be corrected, repaired or replaced with new material; furnishing all materials, labor, etc., necessary to return to the specified performance level without charge to the Owner. Where defective designs and/or materials have been repaired or replaced, the correction period for such shall be extended in accordance with the General Conditions.

2.03 MATERIALS

A. Casing shall be made of close-grained cast iron conforming to ASTM A48. The suction housing shall incorporate two rectangular inspection ports, 180° apart, and provide access to the universal joints within the suction housing. Suction and discharge connections, where flanged, shall be 125 pound ANSI Standard flat face flanges. The pump casing shall be

configured to allow for removal and replacement of the stator without disconnecting the suction or discharge piping.

B. All materials and coatings in contact with process water shall be NSF 61 compliant for use in drinking water systems.

C. Rotor shall be machined and polished tool steel, chrome-plated single helix design. The chrome-plate shall have a nominal thickness of 0.010" for maximum abrasion resistance.

D. Stator shall be a molded elastometric, double helix chemically bonded to a steel tube. The BUNA-N stator shall use 720° clamp rings to fasten the normal horizontal flange and suction housing, with sealed ends or thru-bolts. The clamp rings shall facilitate stator removal. The stator seals shall be designed to prevent the material being pumped from contracting the stator bonding and tube.

E. Universal joints shall be of the grease lubricated, totally enclosed sealed and shielded, crowned gear type. The operating angle of these joints shall not exceed 1-1/2° off center. Mechanical components of the gear joints shall be designed to operate for 10,000 hours at the maximum speeds and pressures specified. They shall be of adequate design to transmit the required thrust and torque while allowing the rotor to move in its eccentric path. The joint seal shall be designed to prevent any liquid from contaminating the gear, while the shield shall be designed to prevent any foreign objects from rupturing the seal. The low angularity shall maximize universal joint life.

F. Connecting rod shall be splined and shall connect the gear joints of the eccentrically moving rotor and the drive shaft. The connecting rod shall pass through the suction housing/shaft seal area within the hollow drive shaft quill so that no eccentric loads are imparted on the packed seal. This connecting rod shall be rigid and not susceptible to chipping.

G. Shafting shall be of the two-part design with the chrome-plated, hollow quill removable for repair. The quill shall be replateable and shall be removable without removing the bearings from the bearing housing or disconnecting the driver.

H. Bearings shall be of the grease lubricated tapered roller type with diverging pressure angles for maximum shaft stability. The B-10 life of the bearing shall exceed 30,000 hours under maximum operating conditions of this Specification. The bearings shall be protected from contamination by means of a bearing cover plate bolted to the bearing housing.

I. Shaft seal shall be a single mechanical seal, requiring no external flush water, AESSEAL Converter II, or equal. Seals shall have silicon carbide vs. silicon carbide faces, Viton O-rings, and stainless steel springs and hardware.

J. The common pump, speed reducer and motor base shall be cast iron or carbon steel, suitably constructed to support the full weight of pump drive unit and motor and shall be provided with grout holes and drain connections with a drip lip.

K. Pump shaft connections to drives and/or speed reducers shall be through flexible couplings as manufactured by Falk, Dodge, or equal. Couplings shall be provided with coupling guards.

L. The speed reducer shall consist of a parallel shaft gear reducer provided by the pump manufacturer. The speed reducer shall be a double reduction parallel shaft helical gear

drive. The case shall be all cast iron with integral mounting feet. The gears shall be A.G.M.A. Class I with a minimum Rockwell "C" hardness of 60. Lubrication shall be splash type with oil maintained in the housing. Anti-friction bearings shall be used throughout, and shafts sealed with shielded spring-loaded lip type seals. The cast iron motor mount shall be rabbeted, doweled or sleeved so that automatic alignment is maintained when bolted to the gearbox. It shall be designed to accept a standard frame NEMA motor.

M. Gauges shall be furnished and installed under Section 11100, Pumps - General.

2.04 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

	Settled Solids Recycle Pumps
Number of Pumps	3
Capacity (gpm)	115
Design Differential Pressure (ft H_2O)	< 1
Number of Pump Stages (minimum)	1
Maximum Pump Speed (rpm)	310
Solids Concentration (%)	0.2 – 0.5%
Minimum Suction Diameter (inches)	4
Minimum Discharge Diameter (inches)	4
VFD Speed Range	25 -100%
Low Suction Pressure Switch	Yes
High Discharge Pressure Switch	Yes
In-Line Fluid Detection System	No

2.05 ELECTRICAL AND CONTROL REQUIREMENTS

A. Electrical Requirements

	Settled Solids Recycle Pumps
Motors	
Rating	460V, 3 ph, 60 Hz
Horsepower	5
Speed, rpm	1800
Enclosure	TEFC
Insulation	Class F
Inverter Duty	Yes
Service Factor	1.15
Space Heater	Yes
Motor Winding Temperature Switches	No
Separate Cooling Fan	No

B. High discharge and low suction pressure switches and associated full line size isolating ring seals shall be furnished for each pump.

2.06 DELIVERIES

A. The Manufacturer shall be responsible for delivering the equipment to the Nansemond Treatment Plant site. Unloading of delivered equipment shall be by the DESIGN/BUILDER.

B. On-site storage, if required, shall be performed according to the Manufacturer's recommendations.

2.05 SPARE PARTS

A. Spare parts shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following for each series of pumps.

One (1) - set of motor and pump bearings

Two (2) - sets of gaskets and O-ring seals

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions. For each series of pumps, field services shall include the following site visits:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	1
Startup and Training	1	2

3.02 SHOP TESTING

A. Shop testing shall be in accordance with Section 11000 and Section 11100.

3.03 FIELD TESTING

A. After start-up and prior to final acceptance, the Manufacturer shall conduct functional tests in accordance with Section 01 91 14 and 11100.

B. Vibration Test

1. Manufacturer's field service representative shall conduct field vibration tests of equipment furnished under this Section. Submit results of tests and Manufacturer's recommended vibration limits to the DESIGN/BUILDER.

2. The entire installation shall operate within the acceptable field vibration limits as established by the Hydraulic Institute for this class of equipment, on any plane at all speeds and loads within the operating ranges specified herein.

3. The Manufacturer shall make modifications that may be required to provide vibration within specified tolerances without additional cost to the DESIGN/BUILDER or Owner.

- END OF SECTION -

SECTION 11130

SUBMERSIBLE PUMPS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The DESIGN/BUILDER shall furnish and install submersible pumps at the locations shown on the Drawings and as specified herein. All pumps shall be supplied by the same manufacturer.

B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions and Section 11100, Pump - General.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

GFP-0111, GFP-0121

Number of Units		2	
Operating point	Var. Speed	Var. Speed	Full Speed
Design Capacity (gpm)	350	850	850
Total Dynamic Head (feet)	50	60	145
Maximum Brake Horsepower			55
Maximum Pump Speed (rpm)			1800
Temperature of Liquid Pumped			Ambient
Suction Condition			Flooded
Min. Submergence for Cont. Operation (in)			≤ 20
Minimum Discharge Diameter (in.)			6

BWP-0112, BWP-0122

Number of Units	2	
Operating point	Var. Speed	Full Speed
Design Capacity (gpm)	355	1700
Total Dynamic Head (feet)	25	70
Maximum Brake Horsepower		40
Maximum Pump Speed (rpm)		1800
Temperature of Liquid Pumped		Ambient
Suction Condition		Flooded
Min Submergence for Con. Operation (in)		≤ 20
Minimum Discharge Diameter (in.)		6

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DP-1211, DP-1221	
Number of Units	2
Design Capacity (gpm)	1100
Total Dynamic Head (feet)	75
Maximum Brake Horsepower	40
Maximum Pump Speed (rpm)	1200
Temperature of Liquid Pumped	Ambient
Suction Condition	Flooded
Min. Submergence for Cont. Operation (in)	≤ 20
Minimum Discharge Diameter (in.)	6

1.03 SUBMITTALS

A. Shop Drawings shall be submitted in accordance with requirements specified in Section 01 33 00, Submittal Procedures; and Section 11000, Equipment General Provisions:

1.04 WARRANTY AND GUARANTEE

A. All materials furnished shall be guaranteed to be free from defects in design and/or materials for a period of one (1) year following Substantial Completion. The period of such warranties shall start on the date the Performance Testing as indicated in the General Requirements have been completed and Substantial Completion has occurred. Any design and/or material (or part thereof) which is defective or showing undue wear within the correction period or not meeting performance requirements, shall be corrected, repaired or replaced with new material; furnishing all materials, labor, etc., necessary to return to the specified performance level without charge to the Owner. Where defective designs and/or materials have been repaired or replaced, the correction period for such shall be extended in accordance with the General Conditions.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Each pump shall be a submersible, non-clog, centrifugal pump, as manufactured by KSB, Fairbanks Morse, Flowserve, or approved equal.

2.02 MATERIALS

A. The pump and all related equipment shall be designed for the applications specified herein and shall be suitable for continuous or intermittent operation. The pump shall be bottom suction, side discharge construction and shall be supplied with a foot mounted discharge connection elbow and integral sliding rail removal system of the pump manufacturer's design matched to the pumps being supplied.

B. All materials and coatings in contact with the pumped media on pumps GFP-0111, GFP-0121, BWP-112, and BWP-122 shall be NSF 61 compliant for use in drinking water systems.

C. The lifting cover, stator housing, and volute casing shall be close grained cast iron conforming to ASTM A48-Class 30, 35, or 40. Ductile iron pump volute shall be furnished if recommended by pump manufacturer for specified pressure rating. All exposed nuts, bolts, washers, and other fastening devices shall be AISI type 316 stainless steel.

D. Casing shall be a smooth surface devoid of blowholes, pits, burrs, or other irregularities. The casing shall have a suction cover, which can be easily removed for easy access to the impeller. All non-stainless steel metal surfaces coming in contact with the pumped media shall be spray coated with an NSF 61 compliant coating. The volute shall be single piece, non-concentric design and shall have smooth fluid passages large enough at all points to pass any size solids which can pass through the impeller. Pump volute shall be provided with a cleanout port to allow for removal of any foreign material blocking or impeding performance of the pump.

E. All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile or Viton rubber O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces. This will result in controlled compression of the O-rings without the requirement of a specific torque limit. Secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease or other devices shall not be acceptable.

F. The impeller shall be hard alloy gray cast iron conforming to ASTM A-48 Class 30, 35, or 40. Impellers shall be dynamically balanced, closed non-clogging design with multiple vanes. The impeller shall be capable of handling solids of specified sphere size, fibrous materials, heavy sludge, and other matter found in normal wastewater applications. The impeller shall be mechanically secured to the motor shaft per manufacturer's recommendations utilizing machined stainless steel components. Adhesive or friction-type fits are not acceptable. Impeller shall be coated with the same system applied to the interior of the casing.

G. A wear ring system shall provide efficient sealing between the volute and impeller. Casing and impeller wear ring shall be of stainless steel construction. Supplier shall submit AISI grades of stainless steel proposed for the wear rings. Rings shall be drive fitted to the volute inlet and heat-shrink fitted to the impeller.

H. Shafting shall be constructed of AISI 329 stainless steel or 400 Series stainless steel for the pump and motor, sufficiently large in diameter to transmit safely the maximum torque developed by the drive unit and of such a design as to provide a rigid support for the impeller and to prevent excessive vibration. The shaft shall be suitably heat-treated, turned, ground, and polished over its entire length.

I. Shaft Seals

1. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies of high-pressure design. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. Seal lubricant shall be FDA Approved, nontoxic.

2. The lower, primary seal unit, located between the pump and the lubricant chamber shall contain one stationary and one positively driven rotating, industrial duty, corrosion resistant, seal rings (Tungsten carbide/Tungsten carbide or Tungsten carbide/silicon carbide). The lower seal shall be independent of the impeller hub.

3. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, chamber shall contain one stationary and one positively driven rotating, industrial duty, corrosion resistant, seal rings (ceramic/carbon or carbo/Ni-resist).

4. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counter clockwise direction of rotation without damage or loss of seal. The seal system shall not be damaged when run dry. No external source of seal cooling or lubrication water shall be required.

5. The following seal types shall not be considered acceptable nor equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. Cartridge type systems will not be acceptable. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.

J. The pump shaft shall rotate on at least two (2) heavy duty permanently lubricated bearings. Bearings shall be designed to carry all radial and axial thrust loads and shall have a minimum AFBMA B-10 life of 100,000 hours at all points along the usable portion of the pump curve at maximum pump speed.

K. Each pump, as specified herein or as recommended by the manufacturer, shall be provided with an integral, self-supplying cooling system that is adequately designed to cool the motor without an external cooling source. The cooling jacket shall be of cast-iron construction and shall surround the stator housing. The cooling jacket shall provide heat dissipation for the motor regardless of whether the motor unit is submerged in the pumped media or surrounded by air. The impeller back vanes shall provide the necessary circulation of the cooling liquid, a portion of the pumpage, through the cooling system. The cooling liquid shall pass through a classifying labyrinth prior to entering the cooling jacket. Two cooling liquid supply pipes, one discharging low and one discharging high within the jacket, shall direct the cooling liquid to the jacket. An air evacuation tube shall be provided to facilitate air removal from within the jacket. Any piping internal to the cooling system shall be shielded from the cooling media flow allowing for unobstructed circular flow within the jacket about the stator housing. Two cooling liquid return ports shall be provided. The internals to the cooling system shall be non-clogging by virtue of their dimensions. Drilled and threaded provisions for external cooling and, seal flushing or air relief are to be provided. The cooling jacket shall be equipped with two flanged, gasketed and bolted inspection ports of not less than 4"diameter located 180° apart. The cooling system shall provide for continuous submerged or completely non-submerged pump operation in liquid or in air having a temperature of up to 40°C (104°F), in accordance with NEMA standards. Restrictions limiting the ambient or liquid temperatures at levels less than 40°C are not acceptable.

L. Gauge taps shall be provided on the discharge piping of the submersible pump. Gauge taps shall be threaded corporation stops, conforming to the requirements of Section 15000, Basic

Mechanical Requirements. Gauges shall be as specified in Section 17650, Pressure Gauges.

M. The Slide Rail Mounting System shall be as shown on the Contract Drawings and as specified herein.

1. A rail system shall be provided and installed for each pump. The pump shall be easily removed from the wetpit for inspection or service without entering the pit or disconnecting piping.

2. The pump shall be provided with a foot mounted discharge connection elbow constructed of cast iron conforming to ASTM A48-Class 30 or 35, permanently installed in the wet well along with the discharge piping. The discharge connection elbow shall be constructed with a 125 lb. ANSI standard flat faced flange. The pump shall be automatically connected to the discharge connection elbow when lowered into place, and shall be easily removed for inspection or service. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple downward motion of the pump.

3. A sliding guide bracket shall be an integral part of the pump unit. The entire weight of the pump unit shall be guided by the guide bar(s) and pressed tightly against the discharge connection elbow to provide positive sealing under all conditions.

4. The entire sliding rail system shall be designed to safely withstand all stresses imposed thereon by vibration, torque, shock and all possible direct and eccentric loads. No portion of the pump shall bear directly on the floor of the sump.

5. Lower guide bar holders shall be integral with the discharge connection. Guide bars shall be of at least standard weight 316 stainless steel pipe of a conservative size adequate for its intended use. The guide bars shall not support any portion of the weight of the pump.

6. All anchor bolts, lifting bolts, eye lugs and lifting cable, etc. necessary for a complete installation and maintenance of the pump shall be constructed of Type 316 stainless steel and shall be adequately designed for its intended use.

N. All anchor bolts, lifting bolts, eye lugs, etc. necessary for complete installation and maintenance of the pump shall be furnished by Supplier and constructed of Type 316 stainless steel and shall be adequately designed for its intended use.

2.03 ELECTRICAL AND CONTROL REQUIREMENTS

A. The pump manufacturer shall provide the power and control cables between the pump and the local disconnect switch, junction box, or control panel (see Drawings) and shall be responsible for reviewing the electrical drawings as necessary to determine the required cable length. All pumps for the same pumping application shall be provided with the same length of cable. No splices shall be allowed unless specifically indicated on the Drawings. Cables shall be PVC or oil resistant cloroprene rubber jacketed type SPC cable suitable for submersible pump applications, shall be sized according to NEC and ICEA standards, and shall meet with MSHA approval. Stainless steel strain relief connectors shall be furnished for all cables.

B. Cable Entry Water Seal

1. The cable entry water seal design shall insure a watertight and submersible seal without specific torque requirements. The cable entry shall be comprised of a single cylindrical elastomer grommet, flanked by stainless steel washers all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the entry body containing a strain relief function, separate from the function of sealing the cable. The assembly shall bear against a shoulder in the pump top. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall isolate gaining access through the pump top. The junction chamber containing the terminal board shall be sealed from the motor by an elastomer compression seal O-ring. Connection between the cable conductors and stator leads shall be made with threaded compressed type binding post permanently affixed to the terminal board and thus perfectly leak proof. Each pump shall be equipped with separate terminal board that totally isolates the incoming power supply from the pump motor.

C. Electrical Requirements

	GAC Feed Pumps	**GAC Backwash Pumps**	**Drain Pumps**
Rating	460V, 3 ph, 60 Hz	460V, 3 ph, 60 Hz	460V, 3 ph, 60 Hz
Max Horsepower	60[1]	50	50
Speed, rpm	1800	1800	1200
Insulation	Class F	Class F	Class F
Explosion Proof	No	No	No
Inverter Duty	Yes	Yes	Yes
Service Factor	1.0	1.0	1.0
Motor Winding Temperature Switches	Yes	Yes	Yes
RTDs	No	No	No
Cooling Jacket	Yes	Yes	Yes
(1) GAC Feed Pump motors are not required to comply with Specification 11000 2.03.A (non-overloading throughout full range). The power draw from the GAC Feed Pump motors will be limited to 60 horsepower using the VFD.			

D. The pump motor shall be a squirrel-cage induction type, housed in a watertight chamber. The stator winding and stator leads shall be moisture resistant. The use of bolts, pins, or other fastening devices requiring penetration of the stator housing shall not be allowed.

E. The motor shall be guaranteed for continuous unsubmerged duty, capable of sustaining a minimum of ten (10) starts per hour without overheating.

F. The motor shall be provided with pre-lubricated radial and thrust bearings which are designed to carry the entire load which may be imposed upon it under all operating conditions.

G. All motors shall be of nationally known manufacture, shall be housed in enclosures specifically designed for submersible pump application.

H. Moisture detector probes shall be provided in the oil-seal chamber. The pump manufacturer shall provide a moisture detection relay compatible with the probes. The relay shall be installed in the location shown on the Drawings.

2.04 SPARE PARTS

A. Spare parts shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following for each series of pumps

One (1) - set of lower and upper wearing rings
One (1) - set of motor and pump bearings
One (1) - complete mechanical seal assembly (upper and lower)
Two (2) - complete set of gaskets and O-ring seals

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions. For each series of pumps, field services shall include the following site visits:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	1
Startup and Training	2	2

3.02 SHOP TESTING

A. Shop testing shall be in accordance with Section 11000, Equipment General Provisions and with the following additional requirements:

1. Impeller, motor rating and electrical connections shall be checked.

2. A motor and cable insulation test for moisture content or defective insulation shall be made.

3. Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.

4. The pump shall be run for 30 minutes submerged, a minimum of six (6) ft. under water.

5. After the run-dry test, the insulation test shall be performed again.

6. After the run-dry test, the pump shall be run continuously unsubmerged for 2 hours under full load with no damage to the motor. During this test, the pump shall demonstrate compliance with the specified performance for flow, head, and

horsepower and shall experience a heat rise of not greater than 45°C (80°F) above ambient temperature.

- END OF SECTION -

SECTION 11133

SUBMERSIBLE SUMP PUMPS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Design/Builder shall furnish and install submersible non-clog sump pumps at the locations shown on the Drawings and as specified herein. All pumps shall be supplied by the same manufacturer.

B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions and Section 11100, Pumps - General.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

A. Sump Pump Schedule:

	Process Area Trench Sump
Arrangement	Duplex
Design Capacity (gpm)*	30
Total Dynamic Head (ft.)	20
Motor Horsepower	0.5
Max. Pump Speed (rpm)	1,800
Min. Size of Solids (in.)	2
Discharge Diameter (in.)	2
Area Classification	Unclassified
Control Panel Rating	NEMA 4X

* Capacity per pump for Duplex units.

	Elevator Pit Sump Pump
Arrangement	Simplex
Design Capacity (gpm)	60
Total Dynamic Head (ft.)	10
Motor Horsepower	0.4
Max. Pump Speed (rpm)	3,450

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Min. Size of Solids (in.)	1/2
Discharge Diameter (in.)	2
Area Classification	Unclassified
Control Panel Rating	NEMA 4X

1.03 WARRANTY AND GUARANTEE

A. All materials furnished shall be guaranteed to be free from defects in design and/or materials for a period of one (1) year following Substantial Completion. The period of such warranties shall start on the date the Performance Testing as indicated in the General Requirements have been completed and Substantial Completion has occurred. Any design and/or material (or part thereof) which is defective or showing undue wear within the correction period or not meeting performance requirements, shall be corrected, repaired or replaced with new material; furnishing all materials, labor, etc., necessary to return to the specified performance level without charge to the Owner. Where defective designs and/or materials have been repaired or replaced, the correction period for such shall be extended in accordance with the General Conditions.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The pumps shall be submersible pumps as manufactured by Hydromatic, Myers or Zoeller, or equal.

2.02 MATERIALS

A. Pump Construction - The lifting cover, stator housing, and volute casing shall be close grained cast iron conforming to ASTM A48-Class 25 through 35. All exposed nuts, bolts, washers, and other fastening devices shall be Type 304 stainless steel.

B. Casing shall be completely open from suction to discharge with no wearing rings or impeller faceplates required. All internal case clearances shall be equal to the inlet diameter so that all materials which will pass through the inlet can pass through the pump.

C. Impeller shall be of either the flow through or recessed design. The impeller shall be secured to the motor shaft per manufacturers recommendations.

D. Shafting shall be constructed of high grade carbon steel, Grade 1045 (minimum), for the pump and motor, and sufficiently large in diameter to transmit safely the maximum torque developed by the drive unit and of such a design as to provide a rigid support for the impeller and to prevent excessive vibration. The shaft shall be suitably heat-treated, turned, ground, and polished over its entire length. The shaft shall be protected from wear through the seal box by a removable hardened 416 stainless steel shaft sleeve with seal to prevent leakage under the sleeve.

E. Shaft Seal for the pump and motor shaft shall utilize a mechanical seal. The mechanical seal shall consist of carbon and ceramic seal faces running in an oil-filled chamber to provide constant lubrication, BUNA N or ethylene propylene flexible members, brass or stainless steel metal parts and 18-8 stainless steel spring.

F. Bearings shall be of the anti-friction ball or roller type. Bearings shall be heavy-duty, permanently oil lubricated which will carry all radial and axial thrust loads. Bearings shall have a minimum AFBMA B-10 life of 30,000 hours under worst possible operating conditions.

2.03 ELECTRICAL AND CONTROL REQUIREMENTS

A. All electrical appurtenances shall be rated for installation in classified areas as indicated in the Sump Pump Schedule.

B. Motors shall conform to all applicable parts of Section 15170. The pump motor shall be designed for 460 volt, 60 Hertz, three-phase operation. See sump pump schedule for motor horsepower. Motors shall be mounted on each pump and shall conform to the latest applicable NEMA, IEEE, and ANSI standards for submersible service. The motors shall be rated for continuous duty with a minimum service factor of 1.15.

1. The pump motor shall be squirrel-cage induction type, housed in a watertight chamber.

2. The stator winding and stator leads shall be moisture resistant.

3. Insulation shall be manufacturer's premium grade Class F insulation rated 155 degrees Celsius, 40 degrees Celsius ambient plus 115 degrees Celsius rise. The stator shall be dipped and baked three times in Class F varnish and shall be heat-shrink fitted into the stator housing.

4. The use of bolts, pins, or other fastening devices requiring penetration of the stator housing shall not be allowed.

5. The motor shall be guaranteed for continuous unsubmerged duty, capable of sustaining a minimum of ten (10) starts per hour without overheating.

6. The motor shall be provided with pre-lubricated radial and thrust bearings which are designed to carry the entire load which may be imposed upon it under all operating conditions.

7. All motors shall be of nationally known manufacture and shall be housed in enclosures specifically designed for submersible pump application.

C. The cable entry water seal design shall insure a watertight and submersible seal.

1. The junction chamber, containing the terminal board, shall be sealed from the motor by elastomer compression O-ring seal.

2. Connection between the cable conductors and stator leads shall be made with threaded compressed type binding post permanently affixed to a terminal board and thus perfectly leak proof.

D. Power and control cables between the pumps and the control panel shall be provided by the pump manufacturer who shall be responsible for reviewing the electrical drawings as necessary to determine the required cable length. All pumps for the same application shall be provided with the same length of cable. No splices shall be allowed unless specifically called for in the electrical drawings. Cable shall be hypalon jacketed SPC cable suitable for submersible pump applications and shall be sized according to NEC and ICEA standards. Stainless steel strain relief connectors shall be furnished for all cables.

E. Float switches shall be provided with the pump controls. Float switches shall comply with requirements specified under Division 17, Control and Information System. Float switches shall be set and shall operate according to the sump pump schematic and installation details shown on the Drawings and as specified herein. Float switches to be installed in classified areas shall be intrinsically safe and suitable for use in the classified area as specified in the Sump Pump Schedule.

2.04 CONTROL PANELS

A. Motor starters and controls for the 480 VAC, 3-phase sump pump installations shall be provided in a stainless steel control panel. NEMA rating of panel and appurtenances shall be as indicated in the Sump Pump Schedule. The control panels shall be assembled using NEMA rated components. Components designed and built to International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured and labeled in compliance with IEC standards is not acceptable.

B. Motor starters and controls for the 115 VAC, single phase pump shall be provided with package/as accessory. Panel and appurtenances shall be NEMA rated as indicated in Sump Pump Schedule. The control panels shall be assembled using NEMA rated components. Components designed and built to International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured and labeled in compliance with IEC standards is not acceptable.

C. The control panel shall include, but not be limited to, the following:

1. A single circuit breaker type lockable disconnect switch operable from outside the control panel.

2. A motor circuit protector and full voltage nonreversing magnetic starter for each pump. The motor starter shall be NEMA Size 1 (minimum) for each pump.

3. Each pump shall be provided with a Hand-Off-Auto (H-O-A) control switch on the front of the control panel with control in the automatic mode by float switches in the sump. Automatic controls for duplex installations shall also include automatic alternation of duty and standby pumps after each shutdown.

4. Control power shall be 120 VAC from an integral, fused control power transformer.

5. Each control panel for duplex installations shall include alarm/indication lights and legend plates on the front of the control panel for "high water level", "control power on", "lead pump on" and “lag pump on”. The high level float switch for "lag pump on" shall activate a remote “sump high water alarm” through unpowered auxiliary alarm contacts.

6. Each control panel for simplex installation shall include alarm/indication lights and legend plates on the front of the control panel for "high water level", “control power on”, and “pump on”. The high level float switch shall activate a remote “sump high water alarm” through unpowered auxiliary alarm contacts.

2.05 SPARE PARTS

A. Spare parts shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following for each size pump:

Two (2) - sets of seals, "O" rings
One (1) – spare pump

PART 3 -- EXECUTION

3.01 MANUFACTURER’S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions.

Service	**Number of Trips**	**Number of Days/Trip**
Installation and Testing	1	1
Startup and Training	1	1

- END OF SECTION -

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SECTION 11136

SUBMERSIBLE CHEMICAL SUMP PUMPS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Design/Builder shall furnish and install chemical-resistant submersible sump pumps as specified herein. All pumps shall be supplied by the same manufacturer.

B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions and Section 11100, Pumps - General.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

A. Provide two (2) uninstalled chemical resistant submersible sump pumps for use by the Owner.

B. Performance Requirements

Design Capacity (gpm)	30
Total Dynamic Head (ft.)	14
Motor Horsepower	0.4
Max. Pump Speed (rpm)	3,600
Temperature of Liquid Pumped	Ambient
Discharge Connection	NPT-F
Discharge Diameter (inches)	1¼

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURES

A. Pumps shall be BJM Corporation Model GF32-9N

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2.02 MATERIALS AND CONSTRUCTION

A. The pump casing shall be constructed of fiberglass reinforced Noryl. All exposed hardware (nuts, bolts, washers, and other fastening devices) shall be constructed of materials as specified below.

B. Impeller shall be constructed of fiberglass reinforced Noryl. The impeller shall be secured to the motor shaft per manufacturer's recommendations. The impeller shall be statically balanced.

C. The shaft shall be sufficiently large in diameter to transmit safely the maximum torque developed by the drive unit and of such a design as to provide a rigid support for the impeller and to prevent excessive vibration.

D. Sump Pump Materials of Construction

Hardware	316 Stainless Steel
O-Rings	Buna-N
Shafting	316 Stainless Steel
Double lip seals	Viton

2.03 ELECTRICAL AND CONTROL REQUIREMENTS

A. The pump motor shall be designed for 120VAC single-phase operation. Motor horsepower shall be as specified in the pump schedule. Motors shall conform to the latest applicable NEMA, IEEE, and ANSI standards for submersible service. The motors shall be oil filled for cooling. A thermal contactor shall be provided to stop the motor if overheating occurs.

B. The cable entry water seal design shall insure a watertight and submersible seal.

C. Sump pump cord shall be provided with a standard 120VAC grounded plug for connection to a switched receptacle.

D. Sump pump shall be supplied with an integral float switch.

PART 3 – EXECUTION (NOT USED)

- END OF SECTION -

SECTION 11153

VERTICAL TURBINE PUMPS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Provide all labor, materials, equipment, motors, anchorage systems, and incidentals necessary for the installation, testing, and placing into operation vertical turbine pumps and appurtenances.

B. For the purposes of this Section, “Manufacturer” shall mean the designer, manufacturer, supplier and tester of the pump equipment, including selection and assembly of motor. The Manufacturer shall be responsible for the design, coordination, testing, and satisfactory performance of all the components.

C. The Manufacturer shall have unit responsibility for coordinating the proper pump mounting system with the Design/Builder to ensure stable pump operation. The Design/Builder shall install, anchor, test, and align the equipment such that vibration levels are within Manufacturer’s recommended tolerances. The Design/Builder shall provide all supports, stiffeners, etc., that may be required to provide systems that operate reliably and within vibration limits specified by the Manufacturer.

D. Vertical turbine pumps shall be provided in accordance with the requirements of Section 11000 – Equipment General Provisions and Section 11100 – Pumps-General

RELATED WORK SPECIFIED ELSEWHERE

A. 01 33 00 – Submittal Procedures

B. 01 78 23 – Operations and Maintenance Data

C. 11000 – Equipment General Provisions

D. 11100 – Pumps-General

E. 15170 – Low Voltage Electric Motors

1.02 SUBMITTALS

A. Shop drawings and Operation and Maintenance Manuals shall be submitted in accordance with Section 01 33 00 – Submittal Procedures and Section 01 78 23 –

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Operations and Maintenance Data

B. Submit the following items with the shop drawings:

1. Manufacturer's literature, data sheets, fabrication information, installation instructions, assembly views.

2. Materials of construction and associated specifications (such as AISI, ASTM, SAE, etc.), including grade and type.

3. Impeller and shaft diameter, including connection details.

4. Identify each component by tag number to which the catalog data and detail sheets pertain.

5. Certified installation drawings showing all details of construction, dimensions, and anchor bolt requirements.

6. The weight of each component, and total static and dynamic loads imparted by the equipment to the supporting structure.

7. Complete motor data including size, make, type and characteristics along with wiring diagrams.

8. Description of coating system, surface preparation and shop painting, including certification that the shop paint is compatible with the finish paint.

9. Spare parts list and manufacturer recommended spare parts.

10. Complete lubrication instructions and lubricant schedule, including manufacturers of recommended lubricants. All lubricants shall be Food-Grade, NSF61 approved. Schedule shall include frequency of lubricant application, type of lubricant, and instructions regarding lubricant application.

C. Minimum submergence requirements for the pumps.

D. Submit results of factory tests, field tests, and start up reports.

E. Performance curves submitted shall be for the entire pump assembly, including efficiency corrections and losses.

1.03 WARRANTY AND GUARANTEE

A. All materials furnished shall be guaranteed to be free from defects in design and/or materials for a period of one (1) year following Substantial Completion. The period of such warranties shall start on the date the Performance Testing as indicated in the General Requirements have been completed and Substantial Completion has occurred. Any design and/or material (or part thereof) which is defective or showing undue wear within the correction period or not meeting performance requirements, shall

be corrected, repaired or replaced with new material; furnishing all materials, labor, etc., necessary to return to the specified performance level without charge to the Owner. Where defective designs and/or materials have been repaired or replaced, the correction period for such shall be extended in accordance with the General Conditions.

1.04 DEFINITIONS

A. Terms shall be as defined in ANSI / AWWA E103 Standard for Horizontal and Vertical Line-Shaft Pumps.

B. Additional terms are defined below:

1. Submergence: Vertical distance in feet between the pumping water level and the bottom of the first stage impeller.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer shall have a minimum of 10 years of experience in producing substantially similar equipment and shall be able to show evidence of at least 5 installations in satisfactory operation for at least 5 years in the continental United States.

B. Vertical turbine pumps shall be as manufactured by Flowserve, Fairbanks Morse, Patterson, Goulds, National, Peerless, or equal.

2.02 GENERAL

A. All equipment for the pumps, including motors, cans and bases, shall be provided as a complete unit by the pump Manufacturer. All pumps for same pumping application shall be provided by one manufacturer.

B. Provide guards in accordance with OSHA requirements for all rotating assemblies that would otherwise be exposed at the operating deck level.

C. All equipment shall be suitable for water treatment, continuous operation (24 hours per day, 365 days per year).

D. Provide access to couplings and oil drains.

E. Anchor bolts and baseplates shall be provided and set per the requirements of the Manufacturer. The Manufacturer shall supply templates for setting the anchor bolt layout.

F. All anchor and assembly bolts, nuts, washers, and fasteners shall be Type 316 stainless steel meeting the requirements of Section 11000 Equipment General Provisions.

2.03 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

A. When operating at the maximum output speed each pump shall have a characteristic performance curve which meets all the minimum conditions listed in the pump schedule. The pumps and drive motors shall be capable of operating satisfactorily under the full-range of speed, flow and pressure conditions as defined by the pump schedule. Pump efficiency as defined herein shall include all losses from the pump intake suction bell to the pump discharge flange. Losses through blank bowls (if any) for initial conditions shall also be considered.

B. The impeller diameter required for the specified operating conditions shall not exceed 95% of the maximum impeller diameter for the pump provided to provide flexibility in meeting specified head within required tolerance and allow increased duty for future conditions.

C. Each pumping unit and its driving equipment shall be designed and constructed to withstand the maximum turbine run-away speed of the unit due to backflow through the pump with the primary TDH specified available at the pump discharge flange. Maximum reverse run-away speed shall not exceed 130 percent of the design operating speed.

D. Design operating capacity shall be between 85% and 100% of best efficiency point (BEP).

E. Pump Operating Conditions

	Description	**Influent Pumps** Can Type	**Recharge Well Backflush Pump** Well Pump
1	Pump Identification Numbers	IP-0101 IP-0102	BKWSH-0302
2	Number of Units	2	1
3	Maximum Pump Operating Speed (rpm)	1200	1800
4	Number of Stages	As Required	As Required
5	Primary Design Point (maximum pump speed): a. Flow (gpm) b. Total Head (feet) c. Minimum Pump Efficiency (%)	 950 40 75	 1400 205 80
6	NPSH Required at Primary Operating Point at centerline of impeller of first stage (feet)	≤11.8	≤ 19
7	NSPH Available at Primary Operating Point at centerline of impeller of first stage (feet)	≥ 37.2	≥ 40

	Description	**Influent Pumps** Can Type	**Recharge Well Backflush Pump** Well Pump
8	Secondary Design Point (variable speed): a. Flow (gpm) b. Total Head (feet)	 425 20	
9	Motor Type	Hollow Shaft	Hollow Shaft
10	Fluid Pumped	Secondary Clarifier Effluent	Finished Water
11	Fluid Temperature (degrees F)	32-95	Ambient
12	Fluid Specific Gravity	1.0	1.0
13	Fluid pH range	6-9	6 - 9

F. Pump Dimensions

Dimension Description	**Influent Pumps** Can Type	**Recharge Well Backflush Pump*** Well Pump
Minimum Pump Column Diameter (inches)	8	6 Max (due to 12-inch well casing ID limitation)
Minimum Discharge Diameter (inches)	8	10
Minimum Pump Shaft Diameter (inches)	1.18	By manufacturer
Minimum Submergence (inches)	24	120
Pump Baseplate (or base flange) Elevation (feet)	16.42	(18.5)
Discharge Head Special Connections	N/A	18-inch flanged pressure-rated base with special connections (see Dwg, M-402)
Can Base Elevation (feet)	7.5	N/A
Suction Pipe Diameter (inches)	10	N/A
Suction Pipe Elevation (to Top of Pipe, buried – feet)	11.5	N/A

Min Water Surface Elevation (feet)	13.1	N/A
Well Pump Setting Depth Below Top of Discharge Head Base Flange (feet)	N/A	300
* Well Backflush Pump shall be configured for use with downhole control valve (DHCV), provide SST foot valve on suction, column centralizers every 20 ft to provide protection DHCV hydraulic lines and PVC level transducer tube for special connection on discharge head base flange. Coordinate with downhole control valve supplier.		

2.04 SUCTION AND DISCHARGE HEAD

A. The discharge head shall have bolted register or rabbet-fit connections for the motor. Discharge head shall have connections for the pump column and shall support the loadings that it imposes as well as hydrostatic and hydrodynamic heads.

B. Design columns and discharge heads for 100% of the pump discharge pressure (suction pressure plus pump differential pressure) at shutoff. Hydrostatically test columns and discharge heads at 130% of design pressure.

C. Access to the stuffing box shall be through windows placed 90 degrees from the discharge. Fit handholes or windows with stainless steel, expanded or perforated metal guards in stainless steel frames to protect the exposed shaft and coupling.

D. The pump can inlet pipe and the discharge head outlet pipe shall be Class 150 flanges, complying with ANSI B16.5. If cast iron discharge heads are specified, flange shall be Class 125.

2.05 MECHANICAL SEAL

A. Shaft sealing shall be accomplished by a single mechanical seal. The single mechanical seal shall be a split mechanical seal, Model #442 by Chesterton, or equal. Seal shall be vented to allow release of air from the seal cavity. The mechanical seal system shall be designed to require no external seal flush water. The mechanical seal shall be equipped with a spiral bushing to remove air and solids from the seal chamber. Bushing shall be Spiral-Trac, or equal. The mechanical seal shall consist of silicon carbide seal faces, ethylene propylene flexible members, and 316 stainless metal parts.

2.06 SHAFTS

A. Shafting shall be polished over its full length. Support the shafting by bearings at intervals so that the first natural frequency complies with Section 11100 – Pumps, General. Calculate the shaft diameter using the formulas given in AWWA E103 for the pump shutoff head.

B. Shafts shall be supported by no fewer than three bearings (not including stuffing box bushing). Lineshaft bearings shall be supported by bearing retainers of the material listed

in the subsection on “Pump Materials of Construction” and clamped between column pipe flanges for open lineshaft pumps.

C. Shaft couplings for shaft diameters 2 inches or larger shall be of the key and thrust-ring types or other nonthreaded design.

D. Hollow shaft motors shall be provided with a shaft adjusting nut.

2.07 BOWL ASSEMBLY

A. Each bowl assembly shall consist of the discharge bowl, impeller, impeller shafting, and a bearing above the impeller. A bearing below the first stage impeller shall be located in the suction case or bell.

B. Pump bowls shall be of the material listed under the subsection on “Pump Materials of Construction”. Bowls shall be sufficiently rigid to prevent adverse changes in bearing alignment and to maintain the running clearances of seal rings. Bowls shall be flanged with male and female rabbets for joining to the suction bell and the discharge column. Waterways and the diffusion vanes shall be smooth and free from nodules, bumps, and dips. Provide the bowls with a renewable wear ring adjacent to the impeller, made of materials as indicated under “Pump Materials of Construction”. Cast iron bowls shall be internally lined with vitreous enamel or coated with 12 mils of fusion bonded epoxy. All fusion bonded epoxy shall be heat-cured. All coatings in contact with process water shall be NSF 61 approved for use in drinking water systems.

2.08 SUCTION BELL

A. The suction bell shall have, as an integral part, vanes supporting a central hub in which the bottom bearing is carried below the impeller. The outer suction bell entrance shall be at least the size of the maximum pump bowl dimension and as much larger as is practical. Maximum entrance velocity shall not exceed 5 fps based on the outside diameter of the suction bell. The contour between the outer edge and the impeller suction eye shall be smooth, continuous, and bell shaped.

2.09 IMPELLERS

A. Pump impellers shall be of the enclosed type, cast in one piece of the material listed in the subsection on “Pump Materials of Construction”. Impellers shall incorporate a close fitting annular clearance with the case at the suction eye and be equipped with replaceable wearing rings. Impellers shall be positively secured to the shaft in such a manner that they cannot become loose under any operating condition or under reverse rotation or torque. For pumps having bowl diameters greater than 15 inches and all pumps with stainless steel impellers and shafts, impellers shall be keyed to the shaft and positively secured against axial movement. Dynamically balance impellers to the tolerances specified by ISO 1940-1, grade G-6.3. Provide for adjustment of the axial position of the impellers at the pump shaft connection to the motor shaft to obtain proper clearance between bowls and impellers.

2.10 VIBRATION

A. The maximum vibration level measured on the top of the discharge head for any speed and operating point within the Preferred Operating Region shall not exceed that shown in Figure 9.6.4.2.5.16 of the Hydraulic Institute Standards as measured on the installed pump during field testing.

B. The pump and motor assembly shall be designed so that its lateral critical speed avoids the operating speed range by a margin of 25 percent above and below the maximum and minimum speeds, respectively, assuming a rigid foundation. Manufacturer calculations that show compliance with this requirement shall be furnished with the shop drawing submittal.

C. The Design/Builder shall coordinate pump installation requirements with the pump supplier to ensure a stable installation free of abnormal vibration.

D. The pump supplier shall have unit responsibility for coordinating and fabricating the proper pump mounting design for the layout shown on the drawings. If, in the opinion of the pump supplier, the openings or other aspects of the pump mounting design must be revised to allow for vibration free, stable pump operation, the Design/Builder shall then be responsible for implementing such revisions.

2.11 PUMP CAN

A. Pump can shall be fabricated of the material listed in the subsection on “Pump Materials of Construction”. Cans shall be designed for the maximum suction pressure specified and the maximum pressure of bearing or seal water connected to the pump, if any. Cans shall also be designed to withstand full vacuum. The pressure design of the can shall meet ASME Code for Pressure Piping or Code for Unfired Pressure Vessels. The wall thickness of steel and stainless steel cans, respectively, shall not be less than that of Schedule 5S or Schedule 10S pipe of equivalent diameter.

B. Provide a flange at the top of the pump can so the pump discharge head can be bolted onto the can. Pressure rating of the pump can top flange shall be the same as the suction flange. Flanges shall have an O-ring groove and an EPDM O-ring. Flange face shall be flat within 0.15% of the nominal can diameter after installation to allow a tight seal with the discharge head.

C. Can shall be equipped with straightening vanes in accordance with the Hydraulic Institute Standard ANSI/HI 9.8 for Pump Intake Design.

2.12 DISCHARGE HEAD, CAN, AND COLUMN FABRICATION

A. Welding shall conform to the following:

1. Welding procedures and performance qualifications shall be in accordance with AWWA Standards with written certification from the manufacturer.

2. The minimum number of passes for welded joints shall be as follows:

Steel Cylinder Thickness (inch)	Minimum Number of Passes for Welds
Less than 0.1875	1
0.1875 through 0.25	2
Greater than 0.25	3

3. Welds shall be full circumferential.

B. Beveled ends for butt welding shall conform to ANSI B16.25. Remove slag by chipping or grinding. Surfaces shall be clean of paint, oil, rust, scale, slag, and other material detrimental to welding.

C. Test the seams by the dye-penetrant method per ASTM E 165, Method B.

D. Welded stainless steel components shall be pickled and passivated following fabrication. All surfaces shall be free of heat tint, scale and slag. Manufacturer shall provide written certification that passivation has been completed prior to shipment of equipment.

2.13 PUMP MATERIALS OF CONSTRUCTION

A. Materials of construction shall conform to the requirements listed below.

Component	Influent Pumps	Recharge Well Backflush Pump
Pump shafts and line shafts	Stainless steel, Type 416	Stainless steel, Type 416
Bowl wear rings	Bronze	Bronze
Bowl impellers	Aluminum Bronze ASTM B148 alloy C95200	Aluminum Bronze ASTM B148 alloy C95200
Pump bowls, discharge case, and suction bell	Cast Iron, ASTM A48 Class 30	Cast Iron, ASTM A48 Class 30
Impeller keys and thrust rings	Stainless steel, Type 416	Stainless steel, Type 416
Pump columns	Carbon Steel Pipe, ASTM A53, Sch 30*	Carbon Steel Pipe, ASTM A53, Sch 30*, epoxy coated inside and out

Component	Influent Pumps	Recharge Well Backflush Pump
Discharge heads, cans	Carbon Steel, ASTM A53 or A36	Carbon Steel, ASTM A53 or A36
Sleeve bearings	Bronze	Bronze
Lineshaft bearings	Buna-N	Buna-N
Bearing Retainers	Bronze	Bronze
Basket type suction strainer	Stainless Steel, Type 316L	Stainless Steel, Type 316L
Bolts and nuts	Bolts shall be Type 316L stainless steel conforming to ASTM A 193, Grade B8M. Nuts shall be Type 316L stainless steel conforming to ASTM A 194, Grade 8M	Bolts shall be Type 316L stainless steel conforming to ASTM A 193, Grade B8M. Nuts shall be Type 316L stainless steel conforming to ASTM A 194, Grade 8M

** or higher schedule if required to meet vibration criteria.*

B. The impeller and bowl wearing rings shall not be constructed of the same material. Impeller and bowl wearing rings materials shall have a minimum Brinell hardness difference of 50.

2.14 ELECTRICAL MOTORS

A. The motor for the pump shall be of the vertical hollow shaft fan cooled squirrel cage induction type in accordance with Section 15170 – Low Voltage Electric Motors. The motor shall be designed to accept all downthrust and upthrust loads imposed by the pump during starting and running. The maximum speed and horsepower of each motor shall be as specified. The rated horsepower shall be such that the motors will not be overloaded nor the motor nameplate horsepower exceeded when the pumps are operated at any point on the pump performance curve.

B. Motors shall be specifically designed for operation with variable frequency drive speed controls as specified in Section 15170 –Low Voltage Electric Motors and Section 16495 – Low Voltage Variable Frequency Drive Systems

C. Motor Data

Motor Data	Influent Pumps	Well Backflush Pumps
Type	Direct Coupled – Vertical	Direct Coupled – Vertical with non-reverse ratchet
Horsepower	15	100
Voltage	460	460
Phase	3	3
Frequency	60 Hz	60
Maximum Speed, rpm	1200	1800
Enclosure Type	TEFC	TEFC
Inverter Duty*	Yes	Yes
Motor Winding Temperature Switches	Yes	Yes
Motor Speed Control	Variable Frequency Drive	Variable Frequency Drive
Non-reverse ratchet	Yes	Yes
Maximum Sound at 3 feet	80 dBA	80 dBA
Space Heater	Yes, 120 V, single phase	Yes, 120 V, single phase
Miscellaneous	See Note	See Note

NOTE: Provide breathers and drains for TEFC enclosures.

* Manufacturer shall coordinate the settings of the variable frequency drive with the pump and motor to ensure proper operation. A written transmittal of the drive settings shall be sent to the DESIGN/BUILDER prior to start-up of the equipment.

D. Thrust bearings and guide bearings shall be anti-friction type and grease or oil lubricated. Bearings shall have a minimum ABMA L10 life of 100,000 hours.

E. Non-reverse ratchet shall not engage above the minimum motor speed in Motor Data Table. Non-reverse ratchets shall be able to withstand reverse torque equal to 150% of rated motor torque at nameplate HP.

2.15 SHOP PAINTING

A. Shop painting shall comply with Section 09900 Painting. All coatings shall be listed by ANSI/NSF International to be in compliance with NSF 61

2.16 SPECIAL TOOLS AND SPARE PARTS

A. Provide the following spare parts for each model of pump

Quantity	Description
One set	Impeller wear rings
One set	Bowl wear rings
Two sets	Bowl bearings
Two sets	Shaft bearings
One	Shaft coupling
Two sets	Gaskets and o-rings
Two	Mechanical Seals

B. Pack spare parts in wooden boxes; label with manufacturer's name and local representative's name, address, and telephone number; and attach list of materials contained therein.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Installation shall be performed in accordance with the requirements of Section 11000 – Equipment General Provisions and Section 11100 – Pumps-General

B. Design/Builder shall submit equipment start-up certification in accordance with Section 11000.

C. Storage and Handling

1. Protect machined surfaces and mating connections.

2. Protect bearings and gearing with shop applied corrosion prevention coating.

3. Cover all openings into gear boxes and provide vapor inhibiting and water repellent storage measures.

4. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment, and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.

5. Machined surfaces of all exposed pump openings or other exposed unpainted surfaces shall be protected by wooden blanks as appropriate, strongly built and securely bolted thereto.

6. Crate in a manner which shall prevent damage during shipment, delivery, and storage.

D. Design/Builder shall have unit responsibility for the proper coordination, sizing, and installation of the pump foundation/mounting requirements based on the manufacturer's recommendations, subject to Engineer's review and comment.

E. Manufacturer's technical representative shall perform or supervise the following activities prior to starting each pump:

1. Installation of mechanical seals

2. Alignment of pump and motor shafts

3. Impeller end clearance adjustment

F. After installation and until substantial completion, all pump shafts shall be rotated weekly.

G. For materials delivered and stored prior to installation, Design/Builder shall provide written documentation of recommendations from the pump manufacturer. Design/Builder shall ensure all recommendations are followed during storage period.

3.02 PUMP TESTS

A. Pump Tests: Each pump shall be tested in the factory in accordance with Section 11000

B. Field Tests: Design/Builder shall perform field tests on the completed pump installation in accordance with Section 11000 and Section 11100.

C. Noise measurements shall be taken in the field and shall comply with Hydraulic Institute Standards and as specified herein.

3.03 MANUFACTURER'S FIELD SERVICES

The services of a qualified manufacturer's technical representative shall be provided in accordance with Section Section11000 – Equipment General Provisions. For each unit, field services shall include the following site visits:

Service	**Number of Trips**	**Number of Days/Trip**
Installation and Testing	1	1
Startup and Training	1	2

3.04 FIELD PAINTING

A. All surface preparation, field painting, and field repairs shall conform to Section 09900 Painting. All coatings in contact with process water shall be listed by ANSI/NSF International to be in compliance with NSF 61

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SECTION 11220

IN-LINE STATIC MIXING EQUIPMENT

PART 1 -- GENERAL

1.01 SECTION INCLUDES

A. Furnish and install in-line static mixers complete with mixing elements, housing pipe with flanges, and injection quills as specified herein and indicated on the Drawings.

B. Furnish and install injector assemblies as indicated on the Drawings.

1.02 RELATED WORK

A. Division 1 - General Requirements

B. Section 09900 – Painting

C. Section 11000 – Equipment, General Provisions

D. Division 15 - Mechanical

1.03 MANUFACTURERS

A. The following manufacturers are approved for use.

1. Koflo

2. Komax

3. Chemineer - Kenics

4. Statiflo

1.04 SUBMITTALS

A. The Design Builder shall submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Detailed manufacturer's design data

2. Dimensional drawings

3. Performance data (flow vs. mixing)

1.05 WARRANTY

A. Warranty shall be as specified in Section 11000.

PART 2 -- PRODUCTS

2.01 SERVICE CONDITIONS

A. Mixer will be used to mix solutions as shown in the table below.

Settled Water Mixer			
Quantity	1		
Location	Downstream of Sedimentation Basins		
Diameter	10 inches		
Chemical(s) Added	Sodium Hypochlorite	Liquid Ammonium Sulfate	Pre-Formed Chloramines
Concentration of Chemical	12.5% (if no carrying water)	40%	0.20% NaOCl 0.03% LAS
Max. Chemical Flowrate	122 gph	1.1 gph	300 gph
Average Chemical Flowrate	31 gph	0.51 gph	120 gph
Mixer Line Min. Flow, mgd	1.00		
Mixer Line Max. Flow, mgd	1.22		
Mixer Line Max. Pressure, psi	10		
Max. Pressure Drop, psi	0.22		
Material (Mixing Elements)	316 Stainless Steel		
Material Housing (piping)	316 Stainless Steel		
Max. Mixer Length, inches	50		
No. of Flanged Ports and Injection Quills	3		
Injection Quill Material	PVC (Sodium Hypochlorite) PVC (Liquid Ammonium Sulfate) PVC (Pre-Formed Chloramines)		
Minimum No. of Mixing Elements	2		

Pre-Filter Mixer			
Quantity	1		
Location	Upstream of Biofilters		
Diameter	10 inches		
Chemical(s) Added	Sodium Hypochlorite	Sodium Hydroxide	Phosphoric Acid
Concentration of Chemical	12.5%	4%	75%
Max. Chemical Flowrate	2.1 gph	122 gph	0.070 gph
Average Chemical Flowrate	2.1 gph	62 gph	0.028 gph
Mixer Line Min. Flow, mgd	1.00		
Mixer Line Max. Flow, mgd	1.22		
Mixer Line Max. Pressure, psi	15		

Pre-Filter Mixer	
Max. Pressure Drop, psi	0.22
Material (Mixing Elements)	316 Stainless Steel
Material Housing (piping)	316 Stainless Steel
Max. Mixer Length, inches	50
No. of Flanged Ports and Injection Quills	3
Injection Quill Material	PVC (Sodium Hypochlorite) PVC (Sodium Hydroxide) PVC (Phosphoric Acid)
Minimum No. of Mixing Elements	2

Chlorine Contact Pipe Mixer			
Quantity	1		
Location	Upstream of Chlorine Contact Pipe		
Diameter	8 inches		
Chemical(s) Added	Sodium Hypochlorite	Pre-Formed Chloramines	Sodium Hydroxide
Concentration of Chemical	12.5% (if no carrying water)	0.20% NaOCl 0.03% LAS	10%
Max. Chemical Flowrate	122 gph	300 gph	126 gph
Average Chemical Flowrate	31 gph	120 gph	61 gph
Mixer Line Min. Flow, mgd	0.70		
Mixer Line Max. Flow, mgd	1.00		
Mixer Line Max. Pressure, psi	15		
Max. Pressure Drop, psi	1.6		
Material (Mixing Elements)	316 Stainless Steel		
Material Housing (piping)	316 Stainless Steel		
Max. Mixer Length, inches	54		
No. of Flanged Ports and Injection Quills	3		
Injection Quill Material	PVC (Sodium Hypochlorite) PVC (Pre-Formed Chloramines) PVC (Sodium Hydroxide)		
Minimum No. of Mixing Elements	4		

Pre-Formed Monochloramine Hypo Mixer	
Quantity	3
Location	Pre-Formed Chloramines Area
Diameter	1 inch
Chemical(s) Added	Sodium Hypochlorite
Concentration of Chemical	12.5%
Max. Chemical Flowrate	2.1 gph
Average Chemical Flowrate	1.3 gph
Mixer Line Min. Flow, gpm	2.0
Mixer Line Max. Flow, gpm	10
Mixer Line Max. Pressure, psi	60
Max. Pressure Drop, psi	2.2
Material (Mixing Elements)	316 Stainless Steel
Material Housing (piping)	316 Stainless Steel
Max. Mixer Length, inches	12
No. of Flanged Ports and Injection Quills	1
Injection Quill Material	PVC
Minimum No. of Mixing Elements	4

Pre-Formed Monochloramine Ammonia Mixer	
Quantity	3
Location	Pre-Formed Chloramines Area
Diameter	1 inch
Chemical(s) Added	Liquid Ammonium Sulfate
Concentration of Chemical	40%
Max. Chemical Flowrate	1.1 gph
Average Chemical Flowrate	0.53 gph
Mixer Line Min. Flow, gpm	2.0
Mixer Line Max. Flow, gpm	10
Mixer Line Max. Pressure, psi	60
Max. Pressure Drop, psi	2.2
Material (Mixing Elements)	316 Stainless Steel
Material Housing (piping)	316 Stainless Steel
Max. Mixer Length, inches	12
No. of Flanged Ports and Injection Quills	1
Injection Quill Material	PVC
Minimum No. of Mixing Elements	4

2.02 DESIGN

A. The mixers shall contain static mixing elements inside of the piping housing as specified in Table 11220-1. The mixers shall be the static in-line type with no moving parts.

B. Mixing shall be by stationary, rigid elements arranged to split and recombine streams. Mixer shall achieve a CoV of 0.05 or less at all listed flows at the outlet of the final mixing element.

C. The mixers shall be supplied with lined stainless steel housings complete with flanged end connections.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. The mixers shall be installed as indicated on the Drawings and as recommended by the manufacturer.

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SECTION 11310

PERISTALTIC CHEMICAL METERING PUMP SYSTEMS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The Design/Builder shall furnish, install, test, and place in acceptable operation skid-mounted peristaltic chemical metering pump systems complete with pumps, all necessary piping, valves, fittings, supports, electrical controls, and all necessary accessories, as specified herein and as indicated on the Drawings.

B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions, and Division 15.

C. Before submitting shop drawings, the Design/Builder shall verify spatial requirements to ensure that the equipment supplied will fit in the space allotted on the Drawings.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

A. Chemical Properties

	Aluminum Chlorohydrate	Sodium Hydroxide	Sodium Hypochlorite
Concentration	50%	50%	15% trade
Specific Gravity	1.34	1.525	1.20
Freezing Point	25°F	54°F	-10°F
pH	2.5-4.6	14	12-13
Viscosity	10-50 cPs	70 cPs	2.6 cPs

	Liquid Ammonium Sulfate	Phosphoric Acid	Sodium Bisulfite
Concentration	40%	75%	38%
Specific Gravity	1.28	1.575	1.30
Freezing Point	10°F	0.5°F	43°F
pH	3-5	1	4-5
Viscosity	2 cPs	20 cPs	2.8 cPs

B. Pump Performance Requirements

	Aluminum Chlorohydrate	Sodium Hydroxide
No. of Skids	1	1
No. of Metering Pumps	3	3
Pump ID	COMP-0111, -0121, -0131	CAMP-0141, -0151, -0161
Maximum Feed Rate	4.0 gph	6.5 gph
Minimum Turndown	1000:1	1000:1
Maximum Pump Speed	125 rpm	125 rpm

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Discharge Pressure	60 psig	60 psig
Pump Duty	Continuous	Continuous
Suction Connection	½" NPT Fitting	½" NPT Fitting
Discharge Connection	½" NPT Fitting	½" NPT Fitting
Maximum Motor Horsepower	½ HP	½ HP
Drive Type	Variable Speed	Variable Speed
Application Points	See Chemical Schematics	

	Sodium Hypochlorite				
No. of Skids	1			1	
No. of Metering Pumps	4			4	
Pump ID	HYMP-1011, -1012	HYMP-1013	HYMP-1014	HYMP-1015, -1017, -1018	HYMP-1016
Maximum Feed Rate	2.5 gph	8.0 gph	0.002 gph	2.5 gph	8.0 gph
Minimum Turndown	1000:1				
Maximum Pump Speed	125 rpm				
Discharge Pressure	60 psig				
Pump Duty	Continuous				
Suction Connection	½"	½"	¼"	½"	½"
Discharge Connection	½"	½"	¼"	½"	½"
Maximum Motor HP	½ HP				
Drive Type	Variable Speed				
Application Points	See Chemical Schematics				

	Liquid Ammonium Sulfate	Phosphoric Acid
No. of Skids	1	1
No. of Metering Pumps	4	2
Pump ID	ASMP-0241, -0251, -0261, -0271	PAMP-0313, -0323
Maximum Feed Rate	1.3 gph	0.10 gph
Minimum Turndown	1000:1	1000:1
Maximum Pump Speed	125 rpm	125 rpm
Discharge Pressure	60 psig	60 psig
Pump Duty	Continuous	Continuous
Suction Connection	½" NPT Fitting	½" NPT Fitting
Discharge Connection	½" NPT Fitting	½" NPT Fitting
Maximum Motor Horsepower	½ HP	½ HP
Drive Type	Variable Speed	Variable Speed
Application Points	See Chemical Schematics	

	Sodium Bisulfite
No. of Skids	1
No. of Metering Pumps	2
Pump ID	BIMP-1011, -1021
Maximum Feed Rate	0.50 gph
Minimum Turndown	1000:1
Maximum Pump Speed	125 rpm
Discharge Pressure	60 psig
Pump Duty	Continuous

Suction Connection	½" NPT Fitting
Discharge Connection	½" NPT Fitting
Maximum Motor Horsepower	½ HP
Drive Type	Variable Speed
Application Points	See Chemical Schematics

1.03 SUBMITTALS

A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01 33 00, Submittals Procedures; and Section 11000, Equipment General Provisions:

1. Submit pump manufacturer's hydraulic calculations based on the pump schedule attached in this section, including a pump characteristic performance curve showing flow rate as a function of rpm and pressure.

2. Tubing design information (chemical resistance, life cycle, wall thickness, pressure rating, etc.)

B. Shop drawings shall include all pumps and accessories and shall be submitted as a complete system. Partial submittals will be unacceptable.

1.04 WARRANTY AND GUARANTEE

A. Warranty and Guarantee shall be as specified in Section 11000.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The metering pumps shall be QDos Series as manufactured by Watson-Marlow Pumps Group, M3 Series as manufactured by Blue-White Industries, or equal.

2.02 GENERAL REQUIREMENTS

A. The metering pumps shall be motor-operated chemical metering pumps of the positive displacement, peristaltic type. Pumps shall be furnished complete with roller assembly, direct coupled motor, DC motor controller, integral tube failure detection system, tube life roller revolution counter with alarm setpoint, and flexible tubing with connection fittings as specified herein. Peristaltic pumping action shall be created by compression of the hose between the pump head rollers and track creating a vacuum that draws fluid in and subsequently displaces the fluid forward. Flow shall be in the direction of the rotor rotation, which can be reversed and shall be proportional to rotor speed. The pumps shall be self-priming to 95% vacuum and shall be capable of indefinite operation without pumped fluid without damage to pump or hose. Metering accuracy shall be ± 1%. Pumps shall be capable of suction lift of 30 feet of water. Drive and pump heads shall be 24-hour continuous duty rated.

B. The pump supplier is responsible for the coordination of corrosion-resistant materials for the chemical solutions specified. The manufacturer shall include all features as necessary

for satisfactory operation of the pumping systems for chemical solutions specified. All pumps shall be capable of handling the designated process fluids in their full commercial strengths. All pump head components in the fluid path shall be NSF 61 rated. Pumps, motors and accessories shall be fabricated of chemical-resistant materials or coated with a heavy duty protective epoxy coating resistant to the specified chemical to prevent corrosion.

C. Pump output capacity shall be adjustable over a minimum 1000:1 turndown when using a variable speed motor for pump speed adjustment.

2.03 MATERIALS AND EQUIPMENT

A. Pump Head

1. Cartridge-style pump head shall be provided, allowing pump head to be serviceable as a single replaceable component. Pump head consisting of an enclosed housing with bolted clear polycarbonate cover and roller compressor mechanism designed for operation with tube is also acceptable.

2. Pump head and tubing compression surface shall be corrosion-resistant, impact-resistant thermoplastic.

3. Suction and discharge connections shall be 180 degrees apart with bottom suction and top discharge.

4. Rotor shall be glass-filled Nylon.

5. Roller shaft shall be 316 stainless steel.

6. Two polymeric rollers with encapsulated ball bearings shall be provided for compression of the hose against the housing, and two guide rollers shall be provided. One roller shall at all times be fully engaged with hose, providing complete compression to prevent back flow or siphoning. Spring-loaded or hinged rollers shall not be used. Roller diameters and occlusion gap shall be factory set to provide the optimum tubing compression.

7. Rotor and housing shall be bolted directly to the output flange of the gearmotor, which serves to support the rotor and center the rotor assembly within the pump housing. Pump to gearbox connection shall be close coupled and self-aligning requiring no flexible couplings.

8. An integral tube failure detection system shall be provided to shut the pump down immediately upon leak detection.

B. Tube and Connections

1. Tube shall be designed specifically for use with peristaltic pumps, with working pressures as specified above. Tube shall be constructed from materials completely compatible with the specified chemicals.

2. Pump tube shall be assembled to polypropylene connection fittings which shall connect to reinforced transparent PVC interface hose. Polypropylene compression by NPT adaptors shall connect interface hose to the process line.

3. Tube sizes shall be provided so that the pump sizing does not exceed 30% of the maximum rpm of the pump while providing the maximum flow required.

2.04 ELECTRICAL AND CONTROL REQUIREMENTS

A. Motors shall comply with Section 15170, Low Voltage Electric Motors and as specified below.

B. Drive system shall be factory installed and totally enclosed in a NEMA 4X, wash-down enclosure. Drive system shall be capable of operating on any input power from 110 VAC to 240 VAC, 60 Hz, single phase supply.

C. Motor shall be reversible, brushless DC gear motor rated for continuous duty. Motor shall include overload protection. Maximum pump rpm shall be 125.

D. Enclosure shall be NEMA 4X constructed out of corrosion and impact resistant engineered plastic. A wiring compartment shall be provided for connection of input/output signal wires and alarm output loads to un-pluggable type terminal block connectors.

E. Manual Control Interface

1. Display: Backlit graphical TFT Display capable of up to 8 lines of text with up to 26 characters per line to display pump tag number, flow rate, and programming instructions. Display shall also provide visual indication of running status via screen color: Blue = Running, White = Stopped and Red = Warning.

2. Keypad: Keypad for start, stop, speed increment, speed decrement, rapid prime, and programming.

3. Flow units: Programmable in either ml/min or gallons/hour.

4. Security: Programmable keypad lock and PIN security for optional lockout of all keys except emergency start/stop.

5. Auto Restart: Feature to resume pump status in the event of power outage interruption.

6. Fluid level monitor: Programmable flow totalization to advise operator when supply tank is low.

F. Remote Control

1. Speed Control Input: Analog 4-20mA speed input with 1,600:1 turndown with incremental steps of 10 microamps.

2. Run/Stop Input: Either 5-24V industrial logic, dry contact or powered 110 VAC contacts as shown per the process and instrumentation drawings.

3. Run/Stop & General Alarm Status Outputs: Either 24VDC Open Collector, 24VDC

Status relay, or 110VAC Status Relay

4. HMI, analog connections, and mains power shall be accessible from the front or side of the enclosure.

2.05 METERING PUMP ACCESSORIES

A. The metering pump supplier shall furnish accessory equipment as specified herein and as shown on the Drawings including but not limited to the following:

1. Pressure gauges - Gauges shall be provided on the discharge of metering pumps. Gauges shall be as specified in Section 17650. Each gauge shall have a range of zero to 100 psi. Each gauge shall be provided with a diaphragm seal as specified in Section 17650 constructed of materials which are completely resistant to corrosion by the chemicals referred to in this section. Each pressure gauge shall also be provided with an isolation valve. Isolation valves shall be PVC with seals that are resistant to the chemical applications.

2. Pressure relief valves – Valves shall be supplied by the pump manufacturer and shall be completely resistant to the chemicals for which they are provided. Sizing of the valves shall be the responsibility of the manufacturer and calculations shall be submitted with Shop Drawings.

3. Antisiphon/back pressure valves - Valves shall be supplied by the pump manufacturer and shall be completely resistant to the chemicals for which they are provided. Sizing of the valves shall be the responsibility of the manufacturer and calculations shall be submitted with Shop Drawings.

4. Calibration Columns – Calibration columns shall be constructed of transparent PVC and shall be provided with threaded ends. Graduations shall be in mL and gallons. Each calibration column shall be sized such that at 50% pump capacity, the calibration column will be emptied in 60 to 90 seconds.

B. The Design/Builder shall furnish piping on the suction and discharge of each metering pump as specified in the Piping System Schedule at the end of Section 15390. Materials of construction shall be completely compatible with the specified chemical. Design/Builder shall provide transition fittings as required for dissimilar materials.

2.06 SKID-MOUNTED FEED SYSTEMS

A. Each chemical feed system shall be completely assembled, mounted, calibrated, tested, and delivered to the site on individual skids as shown on the Drawings. Components to be mounted on the skid are as indicated on the drawings and shall include the metering pumps, piping, valves, accessories, and wiring integral to the skid. The chemical metering pump manufacturer shall be responsible for providing all equipment, valves and piping within the skid boundary.

B. The skids shall be constructed of fusion welded polypropylene sheets with adequate supports for all equipment and piping and a 1” drip lip. Forklift truck cut outs shall also be provided.

C. Skid system piping and valves shall be as specified in Division 15. Skid piping shall be Schedule 80 PVC. Pipe cement shall be as recommended by the pipe manufacturer for the specified chemical service. True union ball valves with chemical-compatible seals shall be provided for isolation. Vented ball valves shall be provided for sodium hypochlorite service.

PART 3 – EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following site visits:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	2	1
Startup and Training	1	2

B. The Design/Builder shall be fully informed and shall be responsible to ensure that all Design/Builder's employees, agents, and/or subcontractors are fully informed as to the hazards and proper procedures associated with working with and around the specified chemicals.

3.02 INSTALLATION

A. The Design/Builder shall furnish and install the metering pumps and all associated equipment and accessories as required and specified herein in accordance with manufacturer's instructions and in accordance with Section 11000, Equipment General Provisions.

B. All metallic fasteners, brackets, mounting hardware, and accessories located in the storage and feed areas shall be constructed of materials completely resistant to the specified chemicals.

C. The Design/Builder shall support piping adjacent to pumps such that no weight is carried on pump casings.

3.03 TESTING, CLEANING, AND START-UP

A. All pumps shall be shop tested for capacity at rated pressure prior to shipment, with documented results provided.

B. Field testing shall be in accordance with the requirements of Section 11000, Equipment General Provision. In addition, the following tests shall be performed:

1. After all pumping equipment is installed and to satisfy the Equipment Performance Testing requirement, it is required that a witness testing of the pump by the Owner and the Engineer be conducted to insure that the pumping equipment conforms to the specified section. Testing of the pumps will be at 25%, 50%, 75% and 100% of rated speeds.

2. Should the performance not meet the standards as set in the specifications, corrective measures to meet these standards will be made by the Manufacturer which may include replacement of the units.

3. During the Facility Performance Demonstration Period, the pump will perform according to specifications without any excessive vibrations, noise or overheating.

C. The Design/Builder shall demonstrate to the Engineer that the completed systems meet the functional requirements intended and that all components of the system are properly calibrated.

D. After installation of piping and accessories but before connection of piping to the storage tank and pumps the Design/Builder shall completely flush the system to clean and remove all foreign matter from the piping system.

E. The Design/Builder shall check the functioning of all pump accessories, valves, and feed points, and instrumentation and controls, and shall repair or replace all malfunctioning or unsatisfactory components. The Design/Builder shall repair all leaking joints and malfunctioning or unsatisfactory components identified during testing, start-up, and through the guarantee period.

3.04 SPECIAL TOOLS AND SPARE PARTS

A. The Design/Builder shall furnish all special tools necessary to disassemble, service, repair and adjust the equipment.

B. The Design/Builder shall furnish the following spare parts. All of these material shall be properly package, labeled, and stored where directed by the Owner.

1. One (1) spare pump head per pump type

3.05 EQUIPMENT IDENTIFICATION

A. The equipment shall be provided with a substantial stainless steel nameplate, securely fastened in a conspicuous place and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.

- END OF SECTION -

SECTION 11311

PERISTALTIC SAMPLE PUMPS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The Design/Builder shall furnish, install, test, and place in acceptable operation peristaltic sample pumps, all necessary piping, valves, fittings, supports, electrical controls, and all necessary accessories, as specified herein and as indicated on the Drawings.

B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions, and Division 15.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

	Individual Biofilter Effluent to Analyzers	Combined Biofilter Effluent to Analyzers and Lab Sink
No. of Pumps	4	1
Pump ID	SMPBE – 1 SMPBE – 2 SMPBE – 3 SMPBE – 4	SMPBE – 5
Maximum Feed Rate	30 gph	78 gph
Minimum Turndown	10:1	10:1
Maximum Pump Speed	125 rpm	125 rpm
Discharge Pressure	10 psig	10 psig
Pump Duty	Continuous	Continuous
Suction Connection Type	NPT Fitting	NPT Fitting
Discharge Connection Type	NPT Fitting	NPT Fitting
Pumped Media	Water	Water
Drive Type	Variable Speed	Variable Speed

1.03 SUBMITTALS

A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01 33 00, Submittal Procedures; and Section 11000, Equipment General Provisions:

1. Submit pump manufacturer's hydraulic calculations based on the pump schedule attached in this section, including a pump characteristic performance curve showing flow rate as a function of rpm and pressure.

2. Tubing design information (chemical resistance, life cycle, wall thickness, pressure rating, etc.)

1.04 WARRANTY AND GUARANTEE

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A. Warranty and Guarantee shall be as specified in Section 11000, Equipment General Provisions.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The metering pumps shall be M4 or M3 Series as manufactured by Blue-White Industries, or equal.

2.02 GENERAL REQUIREMENTS

A. The sample pumps shall be motor-operated chemical metering pumps of the positive displacement, peristaltic type. Pumps shall be furnished complete with roller assembly, direct coupled motor, DC motor controller, integral tube failure detection system, tube life roller revolution counter with alarm setpoint, and flexible tubing with connection fittings as specified herein. Peristaltic pumping action shall be created by compression of the hose between the pump head rollers and track creating a vacuum that draws fluid in and subsequently displaces the fluid forward. Flow shall be in the direction of the rotor rotation, which can be reversed and shall be proportional to rotor speed. The pumps shall be self-priming to 95% vacuum and shall be capable of indefinite operation without pumped fluid without damage to pump or hose. Metering accuracy shall be ± 1%. Pumps shall be capable of suction lift of 30 feet of water. Drive and pump heads shall be 24-hour continuous duty rated.

B. All pump head components in the fluid path shall be NSF 61 rated.

C. Pump output capacity shall be adjustable over a minimum 10:1 turndown when using a variable speed motor for pump speed adjustment.

2.03 MATERIALS AND EQUIPMENT

A. Pump Head

1. Cartridge-style pump head shall be provided, allowing pump head to be serviceable as a single replaceable component. Pump head consisting of an enclosed housing with bolted clear polycarbonate cover and roller compressor mechanism designed for operation with tube is also acceptable.

2. Pump head and tubing compression surface shall be corrosion-resistant, impact-resistant thermoplastic.

3. Suction and discharge connections shall be 180 degrees apart with bottom suction and top discharge.

4. Rotor shall be Polybutylene Terephthalate (PBT) or glass-filled Nylon.

5. Roller shaft shall be 316 stainless steel or chrome plated steel.

6. Two polymeric rollers with encapsulated ball bearings shall be provided for

compression of the hose against the housing, and two guide rollers shall be provided. One roller shall at all times be fully engaged with hose, providing complete compression to prevent back flow or siphoning. Spring-loaded or hinged rollers shall not be used. Roller diameters and occlusion gap shall be factory set to provide the optimum tubing compression.

7. Rotor and housing shall be bolted directly to the output flange of the gearmotor, which serves to support the rotor and center the rotor assembly within the pump housing. Pump to gearbox connection shall be close coupled and self-aligning requiring no flexible couplings.

8. An integral tube failure detection system shall be provided to shut the pump down immediately upon leak detection.

B. Tube and Connections

1. Tube shall be designed specifically for use with peristaltic pumps, with working pressures as specified above.

2. Pump tube shall be assembled to polypropylene connection fittings which shall connect to reinforced transparent PVC interface hose. Polypropylene compression by NPT adaptors shall connect interface hose to the sample line.

3. Tube sizes shall be provided so that the pump sizing does not exceed 80% of the maximum rpm of the pump while providing the maximum flow required.

C. Accessories

1. Where indicated on the drawings, the sample pumps shall be provided with a stainless steel bracket for floor mounting.

2.04 ELECTRICAL AND CONTROL REQUIREMENTS

A. Motors shall comply with Section 15170, Electric Motors and as specified below.

B. Drive system shall be factory installed and totally enclosed in a NEMA 4X, wash-down enclosure. Drive system shall be capable of operating on any input power from 110 VAC to 240 VAC, 60 Hz, single phase supply.

C. Motor shall be reversible, brushless DC gear motor rated for continuous duty. Motor shall include overload protection. Maximum pump rpm shall be 125.

D. Enclosure shall be NEMA 4X constructed out of corrosion and impact resistant engineered plastic. A wiring compartment shall be provided for connection of input/output signal wires and alarm output loads to un-pluggable type terminal block connectors.

E. Manual Control Interface

1. Display: Multi-color VGA graphic LCD Display to display pump tag number, flow rate, and programming instructions. Display shall also provide visual indication of running status via screen color: Blue = Running, White = Stopped, and Red =

Warning.

2. Keypad: Keypad for start, stop, speed increment, speed decrement, rapid prime, and programming.

3. Flow units: Programmable in either ml/min or gallons/hour.

4. Security: Programmable keypad lock and PIN security for optional lockout of all keys except emergency start/stop.

5. Auto Restart: Feature to resume pump status in the event of power outage interruption.

F. Remote Control

1. Run/Stop Input: Either 5-24V industrial logic, dry contact or powered 110 VAC contacts.

2. Run/Stop & General Alarm Status Outputs: Either 24VDC Open Collector, 24VDC Status relay, or 110VAC Status Relay

3. HMI, analog connections, and mains power shall be accessible from the front or side of the enclosure.

PART 3 – EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following site visits:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	1
Startup and Training	1	1

If the same manufacturer provides the peristaltic chemical metering pumps and the peristaltic sample pumps, the Installation and Testing and Startup and Training trips may be combined.

3.02 INSTALLATION

A. The Design/Builder shall furnish and install the sample pumps and all associated equipment and accessories as required and specified herein in accordance with manufacturer's instructions and in accordance with Section 11000, Equipment General Provisions.

3.03 TESTING, CLEANING, AND START-UP

A. All pumps shall be shop tested for capacity at rated pressure prior to shipment, with documented results provided.

B. Field testing shall be in accordance with the requirements of Section 11000, Equipment General Provision.

C. The Design/Builder shall check the functioning of all pump accessories, valves, and feed points, and instrumentation and controls, and shall repair or replace all malfunctioning or unsatisfactory components. The Design/Builder shall repair all leaking joints and malfunctioning or unsatisfactory components identified during testing, start-up, and through the guarantee period.

3.04 SPECIAL TOOLS AND SPARE PARTS

A. The Design/Builder shall furnish all special tools necessary to disassemble, service, repair and adjust the equipment.

B. The Design/Builder shall furnish spare parts as recommended by the equipment manufacturer. All of these materials shall be properly packed, labeled and stored where directed by the Engineer.

3.05 EQUIPMENT IDENTIFICATION

A. The equipment shall be provided with a substantial stainless steel nameplate, securely fastened in a conspicuous place and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.

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SECTION 11340

WATER SOFTENING SYSTEM

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Design/Builder shall furnish, install, test, and place in acceptable operation a complete water softening system complete with chloramine removal system and all mechanical equipment, controllers, and all necessary accessories as specified herein, as shown on the Drawings, and as required for a complete and operable system.

B. The softening system shall include, but not be limited to, two media tanks complete with conditioning media, one salt storage and brine production tank, a regeneration control valve, a controller, and all required piping and valves. If required by the softening system manufacturer to maintain product warranty, a chloramine removal system shall be provided. The chloramine removal system shall include, but not be limited to, two filter media tanks complete with media, backwash controls, and all required piping and valves. The mechanical equipment shall be provided complete with all accessories, special tools, spare parts, mountings, and other appurtenances as specified, and as may be required for a complete and operating installation.

C. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

A. Water Softening System

Continuous Supply Water Flow Rate	20-30 gpm
Supply Water Pressure Range	45 – 75 psi
Supply Water Temperature Range	35 – 80°F
Maximum Supply Water Hardness	400 mg/L as $CaCO_3$
Maximum Pressure Drop Through System	5 psi
Number of Media Tanks	2
Empty Bed Volume, per tank	3.68 ft^3
Media Type	Non Solvent Cation Resin
Media Volume, per tank	2.5 ft^3
Number of Brine Tanks	1
Brine Tank Dimensions	24” diameter x 40”
Salt Capacity, per tank	500 pounds
Number of Regeneration Control Valves	1

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1.03 SUBMITTALS

A. The Design/Builder shall submit complete Shop Drawings, Operation and Maintenance Instructions and other information as specified in accordance with Section 11000, Equipment General Provisions and Section 01 33 00, Submittal Procedures.

B. The Design/Builder shall be responsible for coordinating all interfaces with related mechanical, structural, electrical and instrumentation and control work. The Design/Builder shall be responsible for providing all accessory equipment and all work associated with installation of the equipment.

PART 2 -- EQUIPMENT

2.01 MANUFACTURERS

A. The materials covered by these Specifications are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturer's recommendations.

B. The water softening system shall be Model CP 213s Softener as manufactured by Kinetico Water Systems, or equal.

2.02 GENERAL

A. Plant utility water used as solution make-up water for preformed chloramines and carrying water for caustic and sodium hypochlorite shall first pass through a water softener to reduce the potential for hardness fouling of chemical feed piping.

B. A duplex water softener system composed of two resin tanks with one brine tank shall be provided and installed as shown on the Drawings. The duplex water softener shall include controls, piping, and valves to provide continuous softened water flow with a manual auxiliary hard water bypass. The system shall not be designed to operate in overdrive. Regeneration of one resin tank shall be accomplished while the other tank is in service.

C. The regeneration cycle shall be automatic and based on water flow. The regeneration cycle shall be last a maximum of 90 minutes and consume a maximum of 142 gallons.

2.03 MEDIA TANKS

A. Media tanks shall be constructed of polyethylene and shall be reinforced with a fiberglass wrapping. Each tank shall have a 2.5” threaded top opening and shall be NSF approved.

B. Media tanks shall be designed for a maximum working pressure of 125 psi and shall be hydrostatically tested at 300 psi.

C. The upper and lower distribution systems shall be of a slot design. The distribution system shall provide even distribution for both regeneration and water collection.

2.04 CONDITIONING MEDIA

A. Each softener shall use non solvent, cation resin with a minimum exchange capacity of 60,000 grains removed per cubic foot of media when regenerated with a dose of 6 pounds of salt per cubic foot of media. The media shall be solid, of a proper particle size, and shall contain no plates, shells, agglomerates or other shapes that might interfere with the normal function of the water softener.

2.05 BRINE SYSTEM

A. Combination salt storage and brine production tank shall be manufactured of corrosion-resistant plastic. The brine tank shall have a chamber to house the brine valve assembly. The brine float assembly with adjustable salt settings shall provide for a shut-off to the brine refill. The brine tank shall include a safety overflow connection plumbed to a suitable drain.

2.06 REGENERATION CONTROLS

A. The regeneration control valve, manufactured from non-corrosive materials, shall be mounted on top of the media tank. The control valve shall not weigh more than four pounds. Control valve shall provide service and regeneration control for two media tanks. Inlet and outlet ports shall accept a quick connect, double O-ring sealed adapter. Interconnection between tanks shall be made through the regeneration valves with a quick connect adapter. Control valve shall operate using a minimum inlet pressure of 15 psi. Pressure shall be used to drive all valve functions. No electric power supply shall be required. Control valve shall incorporate four operational cycles including service, brine draw, slow rinse, and a combined fast rinse and brine refill. Service cycle shall operate in a downflow direction. The brine cycle shall operate in an upflow direction, opposite the service flow, providing a countercurrent regeneration. Control valve shall contain a fixed orifice eductor nozzle and self-adjusting backwash flow control. The control valves will prevent the by-pass of hard water to service during the regeneration cycle. Control valve shall be certified to NSF/ANSI 61.

2.07 PIPE AND FITTINGS

A. Pipe shall be Schedule 80 PVC, Type I, Grade 1 (Class 12454-B), conforming to ASTM D 1784 and D 1785. Hard water piping shall be located at a minimum of 24 inches above the softener unit for filling.

B. Short nipples shall be the same as the PVC pipe.

C. Fittings shall be made of the same material as the pipe. Flanges shall match the dimensions of ANSI B16.5, Class 150, steel flanges.

D. Unions shall have socket-type ends, Viton O-rings, and shall be Schedule 80. Material shall be Type I, Grade 1 PVC, per ASTM D2564. Unions shall be located on inlet and outlet connections of control valve to facilitate servicing.

E. Pipe and fitting joints shall be socket welded except where threaded and flanged joints are required to connect to unions, valves, and equipment.

F. Minimum drain tube size shall be ½ inch. No direct connection shall be made to the drain. An air gap at least four times the diameter of the drain pipe shall be provided between the drain piping and drain to conform to sanitation codes and permit the observation of the drain flow.

G. Solvent cement for socket joints shall comply with ASTM D 2564.

H. Gaskets for flanges shall conform to Section 15008.

I. Bolts and nuts shall be stainless steel conforming to ASTM A 914, Grade 8M.

2.08 CARBON FILTER FOR REMOVAL OF RESIDUAL CHLORAMINE

A. Design/Builder shall furnish and install an in-line carbon filter system in the service water line to the water softener for residual chloramine removal. In-line carbon filter system shall consist of a granular activated carbon filter sized to reduce the chloramine residual < 0.05 mg/L for a flow rate of 20-30 gpm. System shall include two tanks and shall not be designed to operate in overdrive. Backwash shall be automatic and based on water flow, with backwash lasting a maximum of 18 minutes and producing a maximum of 400 gallons of wash water.

B. The media tanks shall be designed for a maximum working pressure of 125 psi and hydrostatically tested at 300 psi. Tanks shall be made of polypropylene and reinforced with a fiberglass wrapping. Tanks shall have a 4” threaded top opening. Tanks shall be NSF approved. Upper diffuser system shall be of a slot design. Lower distribution system shall be of hub and lateral design. Distribution system shall provide even distribution of backwash water and collection of processed water.

C. Filter media shall be granular activated carbon media specifically provided for removal of chloramine residual and capable of operating with a nominal service flow of 8 gpm/ft2 of media and backwash at a rate of 10 gpm/ft2 of media. The media shall be solid and of a proper particle size, 12-40 mesh.

D. The backwash control valve shall be top mounted and manufactured from non-corrosive materials. Control valve shall operate using a minimum outlet pressure of 25 psi. Pressure shall be used to drive all valve functions. Control valve shall incorporate three operational cycles including service, backwash, and purge. Service cycle shall operate in a downflow direction. The backwash cycle shall be upflow and purge shall be downflow. Control valve shall provide backwash flow control.

E. The carbon filter shall be Kinetico Model HF 221cb, or equal.

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following site visits:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	1
Startup and Training	1	1

3.02 INSTALLATION

A. The Design/Builder shall install the water softening system in accordance with the manufacturer's instructions, the approved shop drawings, and Section 11000 - Equipment-General.

B. Equipment shall be installed on a concrete pad, unless otherwise shown on the Drawings. The concrete pad shall be finished smooth and level. The Design/Builder shall anchor the equipment to the pad with Type 316 stainless steel expansion bolts. All piping, valves, fittings, conduit, wiring, etc. required to interconnect system components shall be furnished and installed by the Design/Builder. Unless otherwise shown on the Contract Drawings or specified in Division 15, piping shall be constructed of PVC.

3.03 TESTING AND START-UP

A. Testing of the water softener system shall be as specified herein, and in accordance with Section 11000 - Equipment-General.

B. The system supplier and Design/Builder shall demonstrate to the Owner that the water softening system meets the functional requirements intended and that all components of the system are properly adjusted and calibrated and operate reliably.

C. The Design/Builder shall check the functioning of all system components and shall repair or replace all malfunctioning or unsatisfactory components identified during testing, start-up, and through the warranty period.

3.04 PAINTING

A. All surface preparation, shop painting, field repairs, field painting and other pertinent detailed painting specifications shall conform to applicable sections of Section 09900 - Painting.

3.05 TOOLS, SUPPLIES AND SPARE PARTS

A. The Design/Builder shall furnish all special tools necessary to disassemble, service, repair and adjust the equipment.

3.06 EQUIPMENT IDENTIFICATION

A. The equipment shall be provided with a substantial stainless steel nameplate, securely fastened in a conspicuous place and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.

- END OF SECTION –

SECTION 11400

INTEGRATED FLOCCULATION AND SEDIMENTATION SYSTEM

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Integrated Flocculation and Sedimentation System Manufacturer shall furnish, test, and place in satisfactory operation the integrated flocculation and sedimentation system including; rapid mix, flocculation, and sedimentation tank(s), rapid mixers, flocculation mixers, sedimentation plates, sludge collection system, and piping connections as specified herein.

B. The Integrated Flocculation and Sedimentation System Manufacturer is responsible for proper coordination and integration of all equipment required for installation of the tanks, plate pack assemblies, sludge collection system (excluding pumps), rapid mixers, and flocculation mixers.

C. The flocculation and sedimentation system shall be provided complete with all accessories, special tools, spare parts, mountings, anchor bolts and other appurtenances as specified and as may be required for a complete and operating installation.

D. All equipment and interior linings/coatings and materials that come into contact with water shall be NSF 61 approved materials for use in drinking water applications.

E. Valves, instrumentation, pumps, and controls, unless specified herein, are not part of the Manufacturer's scope.

F. The Integrated Flocculation and Sedimentation System Manufacturer shall be responsible for coordinating all interfaces with related mechanical and structural work.

G. Integrated flocculation and sedimentation system manufacturer shall take responsibility for all equipment furnished under this section. The work includes, but is not limited to, the following major system components:

1. Rapid Mix Tanks (Two Stage) (2)
2. Rapid Mixers (4)
3. Flocculator Tanks (Three Stage) (2)
4. Flocculator Mixers (6)
5. Sedimentation Tanks (2)
6. Sedimentation Plate Packs (varies)
7. Sludge Collection System (excluding sludge pumps) (2)
8. Access Stairs, Support Bridges, and Walkways

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1.02 RELATED WORK

A. Section 01 33 00 – Submittals

B. Section 01 91 14 – Equipment Testing and Facility Startup

C. Section 01 78 23 – Operations and Maintenance Data

D. Section 05010 – Metal Materials

E. Section 05120 – Structural Steel

F. Section 05500 – Metal Fabrications

G. Section 16100 – Major Equipment Package General Electrical Requirements

1.03 SUBMITTALS

A. The Integrated Flocculation and Sedimentation System Manufacturer shall submit complete Shop Drawings, Operation and Maintenance Instructions and relevant descriptive literature and catalogs of the equipment as specified in Section 01 33 00.

B. Certification of hydraulic design of the entire packages system. Sufficient data shall be provided to show that the equipment conforms to specification requirements, including: total and individual headlosses through each unit process, velocities through each process, and hydraulic profile.

C. The Integrated Flocculation and Sedimentation System Manufacturer shall provide copies of Shop Drawings that include the following:

1. The Integrated Flocculation and Sedimentation System Manufacturer shall submit for review, complete drawings showing installation details, materials of construction, arrangement details, loadings, elevations, for all items furnished under this Section.

2. The Integrated Flocculation and Sedimentation System Manufacturer shall submit drawings and descriptive data of the flocculation and sedimentation system for review. Sufficient data shall be provided to show that the equipment conforms to specification requirements, including:

    a. Operations and Maintenance Manual submittals will be submitted in accordance with Section 01 78 23 Operation and Maintenance Data.

    b. flow diagrams of systems showing location, elevations, and pertinent sizing of equipment, devices, and penetration/nozzle; and piping;

    c. mounting brackets, anchor bolts, fasteners, and related appurtenances

    d. elevations of weirs, troughs, and penetrations;

    e. materials of construction;

    f. pertinent manufacturer's data;

    g. head loss and hydraulic calculations;

h. design velocities including inlet velocity, velocity through plates, velocities in collection troughs,

i. structural design calculations for elevated walkway and all other structural components, sealed by Professional Engineer registered in Virginia.

3. Design calculations, complete data, and factory testing on rapid and flocculation mixers, sufficient data shall be provided to show that the equipment conforms to specification requirements, including:

a. Operations and Maintenance Manual submittals will be submitted in accordance with Section 01 78 23 Operation and Maintenance Data.

b. Dimensional drawings indicating mixer size, shaft length, impeller type, impeller speed and diameter, motor horsepower, motor speed and frame size, and gear ratio and dimensions.

c. Motor performance data sheet.

d. Calculations for gear reducer AGMA service factor. Calculations shall be sealed by a Professional Engineer. Integrated Flocculation and Sedimentation System Manufacturer shall also submit gear reducer materials of construction, efficiency, bearing ratings, and lubrication details.

e. Complete lubricant schedule, including manufacturers of recommended lubricant and a cross reference table of alternative lubricant manufacturers and brand names for each lubricant recommended. Schedule shall include frequency of lubricant application, type of lubricant, and comments / remarks regarding lubricant application.

f. Details on gear reducer output shaft, including coupling details and impeller connection details. Provide rpms at maximum motor speed, minimum required water horsepower, and maximum water horsepower at reduced speed.

g. Mixing energy imparted to fluid, including water horsepower at minimum and maximum temperatures and power number, and ratio of impeller loading to nameplate horsepower. Provide tip speed at maximum shaft speed and at the minimum required water horsepower.

h. Manufacturer's recommendations on grate openings and baseplate sizing and arrangement. This requirement applies to units that have integral pedestal supports and those that do not have this feature. Drawings for the baseplates shall be sealed by a Professional Engineer in the state in which the project is located. Support design information to be submitted shall include:

i. Weight of the complete assembly including lubricant

j. Impeller shaft and impeller weight

k. Torque load

l. Bearing life calculations.

m. Calculations supporting shaft and impeller design criteria (stresses and critical speed).

n. Shop test results.

o. A project specific CFD representation of the mixing system, confirming that adequate fluid velocities shall be achieved in order to maintain the required process result.

4. Design calculations, complete data, and factory testing on sludge collection system and drives.

a. Operations and Maintenance Manual submittals will be submitted in accordance with Section 01 78 23 Operation and Maintenance Data.

b. Where manufacturer's publications in the form of catalogs, brochures, illustrations or other data sheets are submitted in lieu of prepared Shop Drawings, such submittals shall specifically indicate the item for which approval is requested. Identification of items shall be made in red and items not pertaining to the submittal shall be crossed out in red. Submittals showing only general information are not acceptable.

c. Complete lubricant schedule shall be submitted, including manufacturers of recommended lubricant and a cross reference table of alternative lubricant manufacturers and brand names for each lubricant recommended. Schedule shall include frequency of lubricant application, type of lubricant, and comments / remarks regarding lubricant application.

d. Manufacturer's recommendations on grate openings and baseplate sizing and arrangement. This requirement applies to units that have integral pedestal supports and those that do not have this feature. Drawings for the baseplates shall be sealed by a Professional Engineer in the state in which the project is located.

e. Headloss and velocity through system.

1.04 WARRANTY AND GUARANTEE

A. All materials furnished shall be guaranteed to be free from defects in design and/or materials for a period of one (1) year following Substantial Completion. The period of such warranties shall start on the date the Performance Testing as indicated in the General Requirements have been completed and Substantial Completion has occurred. Any design and/or material (or part thereof) which is defective or showing undue wear within the correction period or not meeting performance requirements, shall be corrected, repaired or replaced with new material; furnishing all materials, labor, etc., necessary to return to the specified performance level without charge to the Owner. Where defective designs and/or materials have been repaired or replaced, the correction period for such shall be extended in accordance with the General Conditions.

PART 2 -- EQUIPMENT

2.01 ACCEPTABLE MANUFACTURERS

A. The flocculation and sedimentation system shall be the Meurer Research Inc., WesTech, or equal.

B. This specification contains requirements that may vary from the manufacturers' standards. Such modifications shall be provided at no additional cost to the Owner.

C. The equipment covered by these Specifications is intended to be of proven ability as manufactured by reputable concerns having over 15 years experience in the production of such equipment. The equipment furnished shall be designed and constructed in accordance with the best practice and methods.

2.02 GENERAL

A. All components of the equipment shall be engineered for long, continuous and uninterrupted service. Provisions shall be made for easy lubrication, adjustment, or replacement of all parts.

B. All fabricated structural steel shall conform to the requirements of AISC "Specification for Structural Steel Buildings", meeting ASTM A36 as a minimum. Steel plates shall conform to ASTM A283 Grade C.

C. All structural connections shall be 316 SST hardware.

D. All welding shall be in accordance with the latest acceptable codes of the American Welding Society ANSI/AWS D1.1.

E. Reference specification 16100 for electrical requirements for factory assembled, pre-wired equipment. All electrical equipment shall conform to the requirements of a wet process area.

2.03 SYSTEM HYDRAULICS

A. Total headloss through the system, including inlet ports, plates, orifices, launders, and weir head, shall not exceed 12 inches at maximum flows (425 gpm).

2.04 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

Design Flow (total)	850 gpm
Design Flow (per train)	425 gpm
Number of Trains	2
Number Stages per Train	6 (2 Rapid Mix, 3 Flocculation, 1 Sedimentation)
Min Temp, C°	13
Max Temp, C°	30
Rapid Mix Tanks	
Nominal Inside Basin Width, ft	2.0
Nominal Inside Basin Length, ft	2.0
Nominal Tank Depth, ft	8.0
Minimum Freeboard, ft	1.0
Average Side Water Depth, ft	7.0
Flocculation Tanks	
Nominal Inside Basin Width, ft	8.5
Nominal Inside Basin Length, ft	6.75
Nominal Tank Depth, ft	16.0
Minimum Freeboard, ft	1.0
Average Side Water Depth, ft	15.0
Sedimentation Tanks	
Nominal Inside Basin Width, ft	12
Nominal Inside Basin Length, ft	24
Nominal Tank Depth, ft	16
Minimum Freeboard, ft	1
Average Side Water Depth, ft	15
Rapid Mixing	
Minimum Detention Time @ 425 gpm, seconds	30
Velocity Gradient, sec^{-1}	0-1,000
Maximum Impeller Elevation (ft above tank floor)	1.54
Number of Impellers	1

Impeller Type	Flat Blade
Minimum Impeller Diameter, inches	8.0
Minimum Impeller RPM, rpm	337
Maximum Impeller Tip Speed, fps	26
Water Horsepower, High Speed[1]	1.5
Water Horsepower, Low Speed[1]	0.15
Drive Motor Horsepower, each	2.0
Drive Type	Variable Frequency Drive
Minimum Shaft Diameter, in.	TBD by Mixer Manufacturer
Fluid Mixing Direction	Radial
Mounting Arrangement	Baseplate
Flocculator	
Minimum Flocculation Time @ 425 gpm, mins (per stage)	15
Minimum Flocculation Time @ 425 gpm, mins (total)	45
Stage 1 and 2: Velocity Gradient Range, sec^{-1}	0-80
Stage 3: Velocity Gradient Range, sec-1	0-40
Maximum Impeller Elevation (ft above tank floor)	3.75
Number of Impellers	2
Impeller Type	3 LS Hydrofoil
Minimum Impeller Diameter, inches	35.0
Maximum Impeller RPM, rpm	62
Maximum Impeller Tip Speed, fps	8
Water Horsepower, High Speed[1]	0.45
Water Horsepower, Low Speed[1]	0.001
Drive Motor Horsepower, each	1
Drive Type	Variable Frequency Drive
Minimum Shaft Diameter, in.	TBD by Mixer Manufacturer
Fluid Mixing Direction	Axial
Mounting Arrangement	Baseplate

Settling Plates	
Minimum Effective Projected Settling Area, square feet	2,125
Maximum Effective Loading Rate, gpm/square feet	0.2
Plate Efficiency, %	80
Minimum Plate Inclination (From Horizontal)	55°
Perpendicular Spacing between plates, inches	2
Maximum maldistribution across plates, %	5

[1]Water horsepower, high speed calculated at minimum temperature. Water horsepower, low speed calculated at maximum temperature.

2.05 TANKS

A. The rapid mix, flocculation, and sedimentation tanks shall be constructed of ASTM A276 316 stainless steel plate having a minimum thickness of ¼".

B. All flanges shall be standard 150 lb. flanges.

C. The tank shall be installed plumb and level to within ± 1/8 inch.

D. The influent and effluent of each rapid mix stage shall be alternating high and low to prevent short circuiting. Manufacturer to coordinate with DESIGN/BUILDER on size and location.

E. The Manufacturer shall provide tank with lifting lugs, properly sized and placed to permit movement of the entire unit, without distortion or damage to any component or surface. The tank shall have no moving parts.

F. The rapid mix portion of the tanks shall be covered. The cover shall include a 8" x 8" hinged sampling hatch for each rapid mix stage. Integrated flocculation and sedimentation system manufacturer to coordinate with DESIGN/BUILDER on type and material for cover.

G. The sedimentation tank shall have an overflow. Integrated flocculation and sedimentation system manufacturer to coordinate with DESIGN/BUILDER on size, type, and location of overflow.

H. Each rapid mix stage will contain an apparatus to break up scum accumulation. Integrated flocculation and sedimentation system manufacturer to coordinate with DESIGN/BUILDER on type and material of scum control system.

2.06 GENERAL MIXER REQUIREMENTS

A. All mixers shall be provided by the same manufacturer. All mixers shall be manufactured by Lightnin, Philadelphia Mixers, or equal.

B. The Integrated Flocculation and Sedimentation System Manufacturer shall verify that materials of construction for the mixers are in conformance with the Specifications and will minimize corrosion of the equipment in the presence of specified chemical solutions.

C. Mixing equipment shall be specifically designed for the conditions listed in 2.04. Slight modifications to the specified mixing conditions may be considered with the DESIGN/BUILDERS' approval.

D. Gear Reducer

1. Each drive unit shall consist of a close grained cast iron, ductile iron, or fabricated steel, heavy-duty speed reducer and pedestal base. The speed reducer and pedestal base shall be stress relieved and reinforced, and shall be provided with lifting lugs or holes.

2. The basic rating of the speed reducer shall adhere to appropriate AGMA standards, and the speed reducer shall bear an AGMA nameplate, or the manufacturer shall certify, in writing, that the speed reducer is designed to the applicable AGMA standards.

3. The speed reducer shall be located above the support beam of the mounting location. The installation arrangements shall be reviewed by the manufacturer for support of the mixing equipment furnished.

4. The gear reducer shall be of horizontal design with a combination of helical and spiral bevel gearing. Worm gear or planetary gear assemblies are not acceptable.

5. All gearing must be contained in a single housing. Auxiliary gear boxes to obtain double or triple reduction shall not be accepted.

6. Gearing shall be of AGMA Quality No. 10 or better per ANSI/AGMA Standard 2000-A88. The full load operating noise levels of the mixer drives shall meet current OSHA occupational noise standards, and/or AGMA Standard 299.01, and not exceed 85 dBA at a distance of 3 feet from any part of the drive assembly.

7. All drive bearings shall be antifriction type, oil lubricated and shall have a minimum rated L-10 life of 100,000 hours when operating at full motor nameplate horsepower at design speed. The mixer supplier shall submit bearing life calculations with the Submittal Drawings.

8. The units shall be designed in accordance with AGMA requirements for 24 hr/day moderate shock loading. The minimum AGMA service factor for the drive, based upon motor nameplate horsepower shall be 1.15 for the mixers. Service factors shall not be calculated based on brake horsepower loads.

9. The thermal rating of the speed reducer shall exceed the design mechanical rating to eliminate the need for external coolers. External cooling devices are not acceptable.

10. The speed reducer shall be splash lubricated by means of gears or a slinger rotating on a horizontal shaft in an oil bath to ensure positive displacement of the oil upward for lubrication of critical bearings. Oil used shall be food grade and/or shall be NSF 61 certified for use in potable water applications. The drive shall be provided with a sight glass to observe oil level.

11. A single oil drain shall be provided at the low point of the speed reducer to allow oil drainage. All oil lubricated bearings shall be located above the top of the main lubricant drain, and at least 3 inches above the bottom of the speed reducer to prevent premature bearing wear due to sludge and metal particle accumulation in the bearings. Oil leakage down the impeller shaft shall be prevented by means of a dry well.

12. The oil drain shall be extended from the drives to prevent leakage and spillage during oil changes. No oil seals will be permitted below the operating oil level for rotating elements. The speed reducer openings below the operating oil level shall be positively sealed with compressible gaskets.

13. Each gear reducer shall be run with a polarizing, rust-inhibiting oil before shipment during the reducer spin test at the manufacturer's facility. Each unit shall receive a vapor phase inhibitor sprayed into the reducer housing interior at the factory to further guard against internal corrosion during field storage of the equipment. A specifically prepared paper treated with vapor phase inhibitor and covered with water repellent tape shall be applied to all external couplings and bearings that could be exposed to corrosion. All openings in the equipment shall be covered with the vapor phase inhibitor impregnated paper and water repellent tape. Water repellent tape and vapor phase inhibitor treated paper will be applied over any adapter sleeves, locknuts, dipsticks, breather assemblies, and other areas or openings requiring special protection.

E. Impellers

1. Each impeller shall be constructed of 316L stainless steel forming a single blade and hub structure. Bolts for the impeller shall be double nutted.

2. The impellers shall be attached to the flocculator shaft through the use of threaded locking rings, and thrust keys on the impeller hub.

3. The impellers shall be dynamically and hydraulically stable and shall not cause the equipment to overload over the specified range of liquid levels with up to the specified flow rates through the basins.

F. Shafts

1. All mixer shafts shall have a maximum operating speed of 0.7 times the natural frequency of the shaft and impeller assembly. Shaft diameter shall be determined by an analysis of torques, bending moment, thrust, pressure,

temperature, and critical speed. Calculations supporting shaft and impeller design criteria (stresses and critical speed) shall be supplied with the Submittal Drawings. The use of in-tank steady bearings is not permitted.

2. The shaft from the gear drive to the connecting flange shall be 316L stainless steel. The mixer shaft shall be supported by a thrust bearing located above the highest liquid level in the mixing tank and channel. The shaft below the connecting flange shall be constructed of 316L stainless steel.

3. The lower shaft shall be connected to the flange of the reducer output shaft by means of an AISI Type 316 stainless steel or 316L rigid rabbeted coupling within the pedestal above the basin and epoxy resin encapsulated key, or equal. An additional in tank coupling shall be provided 8 feet from the bottom of the shaft to facilitate removal. Lower shaft straightness, rigid coupling squareness, and output shaft accuracy must be such that the maximum total indicated runout at the lower end of the shaft does not exceed 1/4 inch per 10 feet of length.

4. All rotating shafts above the deck shall be provided with guards in accordance with OSHA.

G. Baseplate and Anchorage

1. The Manufacturer shall provide a steel baseplate and installation arrangement subject to review and approval by DESIGN/BUILDER for the mixers furnished. The installation arrangements and transmitted loads shall be reviewed by the tank manufacturer in order to design the support for the mixing equipment furnished.

2. The mixer manufacturer should provide vibration isolators to prevent transmission of vibration to the supports.

2.07 RAPID MIXER

A. The rapid mix assemblies shall be complete with motors, flexible couplings, speed reducers, shafts, impeller, and required appurtenances to provide an integrated mixing system.

B. The flocculation and sedimentation system manufacturer shall furnish a variable speed mechanical rapid mixer, to be installed in the rapid mix chamber. The VFD for the mixer motor shall be as specified in Section 16100 and supplied by DESIGN/BUILDER.

C. The Integrated Flocculation and Sedimentation System Manufacturer shall thoroughly review the conditions of service and installation arrangements for the proposed mixers including tank geometry, flow path, baffling requirements, freeboard, baseplate/anchorage, and support. The mixer supplied shall be entirely suitable for the proposed application. The Integrated Flocculation and Sedimentation System Manufacturer shall provide equipment that operates within recommended limits for vibration and that provides non-surging hydraulic conditions within the mixing basins.

D. It shall be possible to maintain indefinitely any velocity gradient in the range of 0 to 1000 sec-1 uniformly throughout the volume of the flocculation chamber.

E. Motor electrical requirements are as follows:

Rapid Mixer Motors	
Rating	480V, 3 ph, 60 Hz
Horsepower	2
Speed, rpm	1800
Enclosure	TEFC
Insulation	Class F
Inverter Duty Rated	Yes
Service Factor	1.15
Space Heater	Yes
Motor Winding Temperature Switches	No

F. Motors shall be built in accordance with the latest standards of NEMA, including, but not limited to MG-1 and MG-2, IEEE, and ANSI.

G. Electric motors shall be manufactured by Baldor/Reliance Electric Company; Nidec Motors; Toshiba Industrial and Power Systems, Inc.; Siemens Energy & Automation, Inc.; General Electric Company; or equal.

H. Controls for the rapid mixer shall be located as shown on the Drawings and provided by the DESIGN/BUILDER.

I. It is the responsibility of the Integrated Flocculation and Sedimentation System Manufacturer to interface with the mixer manufacturer and coordinate installation of mixers in the rapid mix chambers in order to insure that these Specifications are met.

J. Mixer impeller diameters and speeds shall be selected by the manufacturer for the pertinent condition of service. The rapid mixer impellers shall be radial flow, flat blade turbine type. All impellers shall be designed to provide high intensity mixing with a maximum transfer of available horsepower.

2.08 FLOCCULATOR

A. The flocculator assemblies shall be complete with motors, flexible couplings, speed reducers, shafts, impeller, and required appurtances to provide an integrated mixing system.

B. One vertical turbine, axial flow variable speed mixer shall be provided per flocculator stage. Mixer shaft shall be positioned on the vertical centerline of the flocculation chamber. Motor, drive and controls shall be firmly supported and easily accessible. No underwater bearings shall be permitted.

C. It shall be possible to maintain indefinitely any velocity gradient in the range specified in Section 2.04 uniformly throughout the volume of each flocculation chamber.

D. An adequate number of lifting lugs shall be properly sized and located on the mixing equipment to permit movement of the equipment without distortion or damage to any component or surface.

E. It is the responsibility of the Integrated Flocculation and Sedimentation System Manufacturer to interface with the flocculator mixer manufacturer and coordinate installation location and support of mixers in the flocculation chambers in order to insure that these Specifications are met. It is the DESIGN/BUILDER's responsibility to install the mixers.

F. The flocculator mixer shall be a variable, slow-speed unit with a VFD. VFD shall be as specified in Section 16100 and supplied by DESIGN/BUILDER. Motor electrical requirements are as follows:

Flocculator Motors	
Rating	480V, 3 ph, 60 Hz
Horsepower	1
Speed, rpm	1800
Enclosure	TEFC
Insulation	Class F
Inverter Duty Rated	Yes
Service Factor	1.15
Space Heater	Yes
Motor Winding Temperature Switches	No

G. Motors shall be built in accordance with the latest standards of NEMA, including, but not limited to MG-1 and MG-2, IEEE, and ANSI.

H. Electric motors shall be manufactured by Baldor/Reliance Electric Company; Nidec Motors; Toshiba Industrial and Power Systems, Inc.; Siemens Energy & Automation, Inc.; General Electric Company; or equal.

I. Flocculator impeller diameters and speeds shall be selected by the manufacturer for the pertinent condition of service. The flocculator impellers shall be axial flow, hydrofoil type.

2.09 Sedimentation System

A. General

1. Unless otherwise specified all steel components shall be 316 SS.

2. DESIGN/BUILDER shall coordinate with manufacturer elevations and locations of effluent piping flanges between manufacturer piping and process piping by DESIGN/BUILDER.

B. Launders/Troughs/Weirs

1. DESIGN/BUILDER shall coordinate effluent weir and trough elevations with Integrated Flocculation and Sedimentation System Manufacturer.

2. Launders and weirs shall be included as an integral part of the inclined plate settler assembly.

3. Launder system and weirs shall be constructed of Type 316 stainless steel having a minimum thickness of 3/16 inches and shall maintain a rigid cross-section. Provisions shall be provided to ensure drainage of launders when basins are empty.

4. Manufacturer to coordinate top of launders elevation with DESIGN/BUILDER to prevent basin overflow from entering launders. Launders shall be factory rigid welded.

5. Side-loaded troughs shall be provided between the plate packs.

6. The effluent troughs shall be rectangular or U-shaped and located to the side of the plate rows to ensure even flow distribution between the plate settlers at all flow rates.

7. The effluent collection troughs shall be manufactured of stainless steel. All brackets trough supports, reinforcing sections, stiffeners, flanges, weirs and fasteners shall be of stainless steel.

8. The troughs shall be designed so that an operator may walk out onto the troughs at any time, even during operation, without the need to remove any components.

9. The effluent weirs shall conform to one of the following configurations:

    a. The effluent weirs shall be of the sharp crested rectangle design. Weirs shall be adjustable without loosening bolts or nuts.

    b. An adjustable effluent weir shall be provided on the collection troughs at the water surface for control of clarified effluent. The weir shall be a steel plate with 90 degree V-notches. The weir sections shall be flat and fastened to the collection trough wall to allow vertical leveling adjustments and prevent interference of plate removal.

C. Plate Packs Structural Members and Support Frame:

1. All support beams, members and frames shall be constructed of 316 stainless steel members properly cross braced to insure rigidity. Deflection of any support member shall be limited to $1/360^{th}$ of its span.

2. The support frame members shall be continuously welded, with all welds ground smooth and provided with a satin finish.

3. Provide all plate settler support beams and launder supports including but not limited to support beams, trusses, tubes, etc.

4. Leveling adjustments shall be provided to permit adjustment of plate assemblies in the field. Elevation of highest point of plate settler assemblies shall be

coordinated between Integrated Flocculation and Sedimentation System manufacturer and DESIGN/BUILDER.

5. The top of each plate settler shall be visible for inspection.

6. The plate packs, or modules, shall be self-supporting and shall not exceed the maximum allowable deflection limits specified above.

7. The troughs shall be designed structurally for the following conditions (in addition to the water and sludge loadings):

   a. Loading of 50 lbs. per square foot live load on horizontal top surface of module.

   b. A concentrated load of 250 lbs. anywhere on the top of module or top edge of plates.

D. Inclined Plates

1. The inclined settling plates shall be a full size (measuring between 3.5' to 4' in width), 24 gauge minimum, single piece of Type 316 stainless steel material.

2. The top of each plate settler shall be visible for inspection.

3. Each plate shall be supported vertically from above by main support beams running perpendicular to the plate packs. Plates shall be reinforced vertically to provide proper rigidity and to form flow channels. FRP, textured, ribbed or corrugated sheets will not be accepted. Intermediate center spacers that may interfere with sludge migration are not allowed.

4. No structures or troughs shall be required to be removed in order to extract the plates.

5. Plate packs must be designed to allow for cleaning of the plates from the top of the basin.

6. Plate spacing shall be 2.0 inches from the face of one plate to the face of the other, measuring perpendicular to both plates.

E. Plate Settler Components

1.	Plates	316 SS
2.	Spacers	316 SS
3.	Frames	316 SS
4.	Troughs	316 SS
5.	Weir plate	316 SS

6. Nuts, bolts, fasteners 316 SS

7. Anchor bolts 316 SS

F. Sludge Collection System

1. All welds shall be continuous and brushed clean.

2. All underwater bearings shall be specifically designed for underwater use.

3. The sludge collector system will provide mechanical removal of sludge from the bottom of the tank floor and a collection system which will move sludge to a common header to be removed by means of a suction pump which will be supplied by the DESIGN/BUILDER. Siphon systems shall not be allowed.

4. The sludge collection system will include all equipment, accessories, and hardware to provide a complete installation, including but not limited to: piping, orificed headers, sensors, bottom scraper blades or mechanisms, and electric drive assemblies.

5. Flexible hoses or submerged pumps shall not be used for sludge removal.

6. Each drive assembly shall consist of a variable speed 3 Phase, 480 VAC, 60 Hz motor. The VFD for the motor shall be as specified in Section 16100 and supplied by DESIGN/BUILDER. The drive motor shall be 1800 RPM, squirrel cage, induction type and TEFC, , insulation class H, with a service factor of 1.15.

7. If drive cables are supplied they shall be fabricated Type 316 Stainless Steel with a minimum diameter of 3/16".

8. If the sludge collection system utilizes scraper blades they shall be curve wedge shape or triangular in shape.

9. All anchor bolts shall be a minimum of 1/2 inch diameter and made of type 316 stainless steel. The equipment supplier shall furnish all anchor bolts, nuts, and washers required for the equipment.

2.10 WALKWAY ACCESS

A. The Integrated Flocculation and Sedimentation System Manufacturer shall design and furnish all walkways and handrails. The walkways shall be designed and sealed by a Professional Engineer.

B. The walkway surface shall be aluminum grating.

C. Aluminum grating shall be of I-bar type and shall consist of extruded bearing bars positioned and locked by crossbars. All supports, cross members, etc. shall be aluminum. Plank clips for grating hold downs or other required attachments, shall be aluminum or stainless steel. Bolts shall be stainless steel. Provide embedded aluminum support frames for cast-in-place concrete installations.

D. The walkway surface shall be aluminum grating, stair treads shall be aluminum, and the handrail shall be aluminum.

E. Grating shall be designed for a loading of 150 psf. Grating deflection shall not exceed 1/4 inch under a uniform load of 100 psf. Minimum grating depth shall be 1-1/2 inches, unless structural requirements based on clear span require more depth.

F. The handrail system shall be designed to resist the design loads specified by both OSHA and the Virginia Uniform Statewide Building Code.

G. Field welding of handrail shall not be permitted. All handrails shall be supplied with 4-inch toe boards and shall not infringe on the minimum required walkway width.

H. Aluminum toeboards shall be extruded from aluminum alloy 6063-T6 unless otherwise noted.

I. The manufacturer shall insure that all walkways and grating are stable and fully supported from the flocculation and sedimentation tanks in a manner that will not deteriorate the performance or stability of those tanks.

J. The platforms and handrails shall be fabricated and installed in accordance with OSHA requirements.

2.11 PAINTING

A. All motors shall be sandblasted and painted at the factory.

B. The coating system shall be the product of one manufacturer. Alternate paint systems shall be preapproved by DESIGN/BUILDER.

C. Coating System shall be the following:

Stripe coating – hand-apply one coat Tnemec Series N140 PotaPox or Tnemec Series N69 Hi-Build Epoxoline to all welds and hard to reach areas to a dry film thickness of 4-5 mils. Prime coating – Tnemec Series N140 or N69 to a dry mil thickness of 4-5 mils. Intermediate coating – Tnemec Series N140 or N69 primer to a dry mil thickness of 4-5 mils. The exterior finish coat shall be Tnemec 1074 polyurethane with a dry film thickness 3.0-5.0 mils. The exterior coating color shall be selected by the Owner.

PART 3 – EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a manufacturer's technical representative, qualified to install, test, service, operate, and provide training on the flocculation and sedimentation systems, mixers, and sludge collection system, shall include the following site visits:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	3

Startup and Training	1	3

B. Installation Supervision: The DESIGN/BUILDER shall coordinate with the supplier to provide factory supervision or direction during critical phases of installation. Critical phases will include setting of equipment, setting of effluent launders, installation of rapid mixers and flocculation mixers, installation of sludge collection system, and other components critical to the successful operation of the system.

C. System Start-Up and Training

1. The Integrated Flocculation and Sedimentation System Manufacturer shall provide the services of a factory representative during start-up of the equipment. At a minimum, the equipment manufacturer's technician shall perform the following start-up functions:

a. Inspect the final installation to assure proper installation and connection of all equipment of the manufacturer's supply.

b. Start-up of the equipment in the presence of the DESIGN/BUILDER and Owner's operating personnel.

c. Training of Owner's operating personnel in proper operation and maintenance procedures, start-up/shutdown procedures, response to emergency conditions, and troubleshooting.

D. Post Start-Up Activities

1. Upon completion of his/her work, the manufacturer's field technician shall submit to the DESIGN/BUILDER, three (3) copies of a written report outlining the equipment start-up, names of owner personnel trained and a listing of any deficiencies of equipment or materials as a result of his inspection, adjustments, corrections, repairs, and start-up. The report shall include descriptions of the inspection, adjustments, corrections and repairs made, and shall certify that the equipment:

a. Has been installed per manufacturer's requirements.

b. Has been started and placed on line.

c. Has been tested per manufacturer's instructions.

d. Operator personnel have been instructed and trained.

3.02 DELIVERY AND STORAGE

A. Upon delivery of the equipment to the jobsite, the DESIGN/BUILDER shall take inventory of the shipment and immediately report to the equipment manufacturer any discrepancies between the equipment manufacturer's packing lists and shipping documents.

B. The DESIGN/BUILDER shall be responsible for offloading and protection of all equipment against damage and during on-site storage and installation.

3.03 INSTALLATION

A. The flocculation and sedimentation system equipment shall be installed in accordance with the manufacturer's recommendations, as accepted by the DESIGN/BUILDER.

B. The manufacturer's technical representative shall inspect the equipment, make necessary final adjustments and certify the equipment ready for operation. A written report verifying that the equipment has been properly installed and is ready for start-up shall be submitted to the DESIGN/BUILDER.

C. In addition, the field service representative shall instruct the Owner's personnel in the proper operation and maintenance of the equipment as specified above.

3.04 FIELD TESTING

A. General

1. After start-up and prior to final acceptance, the Integrated Flocculation and Sedimentation Manufacturer shall conduct functional and performance tests on the integrated flocculation and sedimentation system equipment in accordance with Section 01 91 14.

2. Inspection by a representative of the manufacturer who is not a direct, full time employee of the manufacturer is not acceptable.

3. The Integrated Flocculation and Sedimentation System Manufacturer shall prepare a proposed testing plan and submit to DESIGN/BUILDER for all tests describing the type of test, test procedures, instrumentation used, proposed flow rates, and other information necessary to describe the proposed testing plan.

4. Upon completion of testing, the Integrated Flocculation and Sedimentation System Manufacturer shall submit to the DESIGN/BUILDER a copy of full and complete test reports for all tests. Reports shall include description of the units tested, test procedures, test flow rates, pressures, levels, and all other data and results required to demonstrate that the items tested meet specified requirements.

5. All components shall be field tested in accordance with Section 01 91 14.

B. A Tank Leak Test shall be performed after installation of any and all equipment which requires tank wall penetration or field assembly. Tank leak test shall be performed by DESIGN/BUILDER.

1. The tank shall be filled to max operating height and maintained for 48 hours without showing any signs of leaks.

C. A Sludge Collection System Test shall be performed in a dry tank for a minimum of 4 hours before flow is allowed to enter the system. There shall be no binding, jerky, or unusual motion exhibited during this run in period. Motor amperage shall be checked at least hourly for any unusual or higher than normal figures. After the unit has successfully passed this initial test, flow shall be introduced into the tank and the same 4-hour observation test run. If the unit should fail under any of these conditions, the test shall be halted and the problem corrected. If, after several attempts, the unit does not successfully pass the field test, the faulty portion of the equipment shall be replaced and the test re-run.

D. Each mixer shall undergo a Field Vibration Test:

1. Manufacturer's field service representative shall conduct field vibration tests of equipment furnished under this Section. Submit results of tests and Manufacturer's recommended vibration limits to the DESIGN/BUILDER.

2. The entire installation shall operate within the acceptable field vibration limits as established by ANSI/AGMA for each class of equipment, on any plane at all speeds and loads within the operating ranges specified herin.

3. The Manufacturer shall make modifications that may be required to provide vibration within specified tolerances without additional cost to the DESIGN/BUILDER or Owner.

3.05 WELDING

A. All welding practices shall be in accordance with the requirements of the American Welding Society (AWS) "Welding in Building Construction". All welders shall be certified in accordance with this AWS specification for any welding work performed under this Section.

3.06 TOOLS, SUPPLIES, SPARE PARTS

A. The equipment manufacturer shall provide a recommended spare parts list to the DESIGN/BUILDER with the Shop Drawing submittal. The list shall indicate specific sizes, quantities, and part numbers of the items available.

B. The equipment manufacturer shall furnish all special tools necessary to disassemble, service, repair and adjust the equipment.

3.07 EQUIPMENT IDENTIFICATION

A. The rapid and flocculator mixer motors and the sludge collection equipment shall be provided with a substantial stainless steel nameplate, securely fastened in a conspicuous place and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.

- END OF SECTION -

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SECTION 11410

BIOFILTERS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Biofilter Manufacturer shall furnish, test, and place in satisfactory operation, biofilters with underdrain system, backwash water and air scour distribution piping, and appurtenances, complete with all necessary accessories specified.

B. The biofilters shall be provided complete with all accessories, special tools, spare parts, mountings, anchor bolts and other appurtenances as specified and as may be required for a complete and operating installation.

C. All equipment and interior linings/coatings and material that come into contact with water shall be NSF 61 approved materials for use in drinking water applications.

D. Valves, instrumentation, pumps, blowers, controls and filter media, unless specified herein, are not part of the Biofilter Manufacturer scope.

E. The Biofilter Manufacturer shall be responsible for coordinating all interfaces with related mechanical and structural work.

F. Reference specification 16100 for electrical requirements for factory assembled, pre-wired equipment. All electrical equipment shall conform to the requirements of a wet process area.

G. One filter manufacturer shall take responsibility for all equipment furnished under this section. All equipment shall be suitable for service in a reuse application. The work includes, but is not limited to, the following:

1. Biofilter Tanks (4 filters)
2. Face Piping
3. Underdrain System
4. Air Piping Manifold

32414-0000

1.02 RELATED WORK

A. Section 01 33 00 – Submittals

B. Section 01 91 14 – Equipment Testing and Facility Startup

C. Section 01 78 23 – Operations and Maintenance Data

D. Section 05010 – Metal Materials

E. Section 05120 – Structural Steel

F. Section 05500 – Metal Fabrications

G. Section 11411 – Biofilter Media

H. Section 15012 – Steel Pipe

I. Section 16100 – Major Equipment Package General Electrical Requirements

1.03 REFERENCES

A. AWWA B100 Water Treatment Filtering material latest edition

B. AWWA B604 Granular Activated Carbon latest edition

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Biofilter Manufacturer shall have a minimum of five years' experience manufacturing filter systems for reuse applications. The manufacturer shall provide evidence of at least five installations in satisfactory operation similar in scope to the application specified herein.

1.05 SUBMITTALS

A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01 33 00.

1. Biofilter Manufacturer's certification that filter media supplied is compatible for use with underdrain.

2. Complete headloss data for water flows through the underdrain header.

3. Data on clean bed headloss and flow rate versus expansion of the media during fluidization backwashing at three different temperatures (5, 15 and 25˚C). This data shall be expressed as a percentage of bed depth versus backwash flow rate (gpm per square foot of contactor surface area).

4. Design calculations showing compliance with the maximum backwash water maldistribution stipulated in paragraphs 2.02 A of this specification.

5. Details submitted shall include as a minimum, headloss data for air, water and combined air/water backwash, installation details, flow distribution calculations, certification of compatibility of the underdrain system with the filter media specified in this section, details for installing reinforcing and other items to be embedded in concrete.

6. Testing Results:
   i. Tank Leak Test
   ii. Air Scour Test
   iii. Backwash Process Test

iv. Media Loss Warranty and Testing

7. Operations and Maintenance Manual submittals will be submitted in accordance with Section 01 78 23 Operation and Maintenance Data.

8. Where Biofilter Manufacturer's publications in the form of catalogs, brochures, illustrations or other data sheets are submitted in lieu of prepared Shop Drawings, such submittals shall specifically indicate the item for which approval is requested. Identification of items shall be made in red and items not pertaining to the submittal shall be crossed out in red. Submittals showing only general information are not acceptable.

1.06 WARRANTY AND GUARANTEE

A. All materials furnished shall be guaranteed to be free from defects in design and/or materials for a period of one (1) year following Substantial Completion. The period of such warranties shall start on the date the Performance Testing as indicated in the General Requirements have been completed and Substantial Completion has occurred. Any design and/or material (or part thereof) which is defective or showing undue wear within the correction period or not meeting performance requirements, shall be corrected, repaired or replaced with new material; furnishing all materials, labor, etc., necessary to return to the specified performance level without charge to the Owner. Where defective designs and/or materials have been repaired or replaced, the correction period for such shall be extended in accordance with the General Conditions.

PART 2 - EQUIPMENT

2.01 ACCETABLE BIOFILTER MANUFACTURERS

A. The biofilter system shall be Suez, Xylem-Leopold, WesTech, Wigen or approved equal.

2.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

A. Biofilter Design Criteria

Design Parameter	**Value**
Number of Filters	4
Design Capacity of System	850 gpm
Design Flow Rate per filter (one filter always in backwash or standby mode)	283 gpm
Surface Loading Rate, gpm/ft^2 (normal operation)	**4**
Maximum Nominal Tank Depth, feet	15.5
Effective Filtration Area (Each), square feet	71
GAC Media Depth, feet	5.0
Sand media Depth, feet	1.0
Underdrain Support Gravel, feet	1.0
Loading Conditions	
Air Scour Rate, scfm/ft^2	2 – 4

Design Parameter	Value
Maximum Pressure Loss @ 4 scfm/ft^2 ,inches (air only)	5
Backwash Water Rates, gpm/ft^2	7.5 - 25
Concurrent Upflow of Backwash Water (gpm/ft^2) and Air Scour (scfm/ft^2)	5
	2 - 4
Maximum Underdrain headloss in downflow filtration mode, inches	3
Maximum Clean Bed Headloss, including underdrain and media at design surface loading rate, inches	24
Minimum Available Headloss during Filtration, ft	8
Maximum Maldistribution of Backwash Water Flow	3%
Maximum Maldistribution of Backwash Air Flow	10%

2.03 BIOFILTER TANKS AND INTERIOR CONSTRUCTION

A. Four biofilter cells shall be supplied.

B. Each biofilter chamber shall have a passive overflow, centerline to be coordinated with DESIGN/BUILDER.

C. The tank shall be fabricated from carbon steel. Painted carbon steel shall conform to Section 05120 Structural Steel, and the requirements of ASTM A36.

D. Stainless steel shall conform to Section 05120 Structural Steel and the requirements of ASTM A36.

E. The tank shall be constructed of 0.25 inch minimum carbon steel plates and shall include all nozzles, troughs, and internals for complete operation.

F. The backwash air distribution shall be separate and independent from the backwash water distribution.

G. All flanges, plates, angles, channels, beams, etc., including sideshell to head connections, shall be joined by full penetration welds, each side, continuous welding.

H. Provide 0.5 inch Sample Taps (13 required as follows):
   1. Influent individual filter (4)
   2. Effluent individual filter (4)
   3. Backwash Water individual filter (4)
   4. Filter to Waste Line (1)

2.04 BIOFILTER UNDERDRAINS

A. General Requirements

1. Two types of underdrains are approved for the filter underdrain equipment. Block underdrain types shall require 12 inches of gravel retention. Media retaining caps and/or underdrain nozzles shall not be permitted.

    a. Block Underdrain

        i. General Filter MULTIBLOCK
        ii. Leopold Type XA

2. The Biofilter Manufacturer shall coordinate with the DESIGN/BUILDER to determine final dimensions and layout of the underdrain system which shall cover the entire filter floor area. It shall be suitable for water backwash, air scour, and water/air scour concurrent and shall be designed to ensure long-term stability in its operating characteristics. The underdrain system shall be designed to resist plugging and all other effects which would in time cause loss of hydraulic efficiency or effectiveness of its operation.

3. The filter underdrains shall be furnished as a complete and integrated system by one Biofilter Manufacturer, and system shall include the underdrain laterals, header assembly, air header assembly, and angle hold-downs and installation hardware.

4. All welding performed during fabrication and installation of the underdrain system shall be performed by welders certified to ASME Section IX.

5. Materials used in the filter underdrain system shall conform to the requirements specified herein.

6. All equipment furnished shall be amply designed and constructed for the maximum stresses occurring during fabrication, erection and continuous operation. All materials shall be new and both workmanship and materials shall be of the very best quality, entirely suitable for the service to which it is to be subjected and shall conform to all applicable sections of these specifications. All parts of duplicate equipment shall be interchangeable without modification. Biofilter Manufacturer's design shall accommodate all the requirements of these specifications.

7. All grout used in installing the laterals shall be cement grout and will be installed by the DESIGN/BUILDER.

8. All exposed metals, anchor bolts, handrail bolts, washers, clips, clamps, fasteners of any type, etc. shall be constructed ASTM A36 conforming carbon steel with minimum thickness of 3/16 inch. All anchor bolts shall be a minimum of 1/2 inch diameter.

9. The filter underdrain system shall be furnished and installed to perform satisfactorily and as specified when operated under the following flow conditions:

    i. Downflow of water at up to 4 gpm/sf

    ii. Upflow of backwash water at up to 25 gpm/ft2 with total headloss not more than 60 inches of water

    iii. Air scour shall be maximum of 4 scfm/sf

10. The underdrain system shall provide uniform water backwash over the entire surface of the filter. Maldistribution of backwash water flow shall not exceed ±3 percent of average loading in gpm/ft^2. There shall be no localized areas with flow rates which would cause mounding, lateral displacement, or other disturbances in the media or media support layers.

B. Performance

1. The filter underdrain system, when installed, shall be designed to withstand a burst pressure equal to twice the maximum pressure experienced at maximum backwash rates. No credit shall be taken for the weight of the filter media. The filter underdrain system shall also be designed to withstand a net downward loading of not less 1400 psf, plus its own dead weight.

2. The underdrain system shall provide backwash flows at a maximum rate of 25 gpm/sf with a maximum total headloss through the underdrain orifices of 2 psi.

1. General Filter MULTIBLOCK

a. The underdrain shall consist of a dual compensating lateral system in each filter cell supported above the true bottom of the filter. The underdrain system shall be constructed onsite using MULTIBLOCK laterals, end caps, grout retaining strips, and anchor system.

b. The flow metering elements shall consist of an arrangement of orifices properly sized and located, between the feeder and compensatory laterals, and between the compensatory laterals and top of the blocks. The entrance, transport, and orifice losses, and the placement of the orifices shall be coordinated to produce uniform water flow throughout the filter cell at all specified flow conditions. The number and size of the orifices shall be uniform throughout the filter cell. The orifices shall be sized as required to introduce necessary metering headlosses, but shall be sufficiently large to prevent clogging.

c. The individual blocks used in the system shall be of a suitable impervious, high strength, high density, completely corrosion resistant polyethylene or plastic material having uniform smooth surfaces and all orifices properly deburred. The blocks shall have ridges and pockets for structural rigidity and to key into surrounding grout. The blocks shall be mechanically joined to form a continuous lateral equivalent to the length of the filter cell. The joints shall be sealed, and be air and water tight.

d. Filter underdrain laterals shall be installed true and level to a tolerance of plus or minus 1/8". Installing DESIGN/BUILDER shall set the laterals on a grout base of ¾" +/- for leveling. Once a lateral row is installed, the void spaces between the laterals and ends shall be filled with concrete grout.

e. Carbon steel angles shall be placed along the perimeter of the underdrain blocks and secured to the filter wall. An intermediate carbon steel angle shall be supplied to provide restraint across the midpoint of the underdrain laterals or on either side of a joint and secured to the filter wall or perimeter angles. Angles

shall be supplied by Biofilter Manufacturer. Design of the angles shall be approved by the DESIGN/BUILDER.

2. Leopold Type XA

   a. The underdrain system for the filters shall be a dual parallel lateral whereby feeder and compensating chambers are provided within the cross section of a single block. The cross section of the underdrain shall be where the feeder (or primary) chamber is adjacent and connected to the compensating (or secondary) chambers through a series of orifices.

   b. The flow metering elements shall consist of an arrangement of orifices properly sized and located, between the feeder and compensatory laterals, and between the compensatory laterals and top of the blocks. The entrance, transport, and orifice losses, and the placement of the orifices shall be coordinated to produce uniform water flow throughout the filter cell at all specified flow conditions. The number and size of the orifices shall be uniform throughout the filter cell. The orifices shall be sized as required to introduce necessary metering headlosses, but shall be sufficiently large to prevent clogging.

   c. Grout retaining strips shall be of high impact polystyrene properly keyed to the underdrain blocks to allow adjustment of lateral center-to-center distance without difficulty. Retaining strips shall be supplied by the underdrain Biofilter Manufacturer.

   d. Carbon steel angles shall be placed along the perimeter of the underdrain blocks and secured to the filter wall. An intermediate carbon steel angle shall be supplied to provide restraint across the midpoint of the underdrain laterals or on either side of a joint and secured to the filter wall or perimeter angles. Angles shall be supplied by Biofilter Manufacturer. Design of the angles shall be approved by the DESIGN/BUILDER.

2.05 BACKWASH COLLECTION SYSTEM

A. The required number of backwash collectors shall be installed in each filter cell and specifically designed to accept a sustained simultaneous air/water backwash flow without loss of media and without inhibiting the removal of suspended solids based on air and water rates specified herein. The total backwash time shall be a maximum period of 20 minutes with a simultaneous air/water backwash of 3-5 minutes.

B. Each filter shall be provided with one carbon steel wash trough for proper collection of backwash water at the previously indicated backwash rate. The washtroughs shall be sized so that there will a minimum 2 inches of freeboard at the maximum backwash rate. Cells shall be backwashed individually.

C. Simultaneous air/water backwash collection systems shall be constructed of carbon steel

2.06 AIR SCOUR SYSTEM

A. Air Header Piping

1. The air distribution system shall be covered to prevent intrusion of media or media support materials.
2. Air header piping inside the filter shall be included in the Biofilter Manufacturer scope of supply.
3. Air header piping shall provide a uniform air distribution to the filter during filter backwashing.
4. All required supports, securement hardware, and connections to the underdrain or tank shall be included carbon steel.
5. Mating flange hardware is to be supplied by the DESIGN/BUILDER. Biofilter Manufacturer and DESIGN/BUILDER to coordinate mating location.

2.07 MISCELLANEOUS COMPONENTS

A. Each filter cell shall be equipped with a passive overflow outlet.

B. Biofilter Manufacturer shall supply face piping and coordinate appropriate flange sizes and elevations/locations with DESIGN/BUILDER.

2.08 PAINTING

A. The interior and exterior of the filter shall be sandblasted and painted at the factory. Interior surfaces in contact with water shall receive NSF/ANSI Standard 61 approved coatings for potable water.

B. The coating system shall be the product of one manufacturer. Alternate paint systems shall be preapproved by DESIGN/BUILDER.

C. Surface preparation shall be in accordance with all coatings system manufacturer's recommendations. At a minimum, initial preparation shall include:

1. Interior: Sandblast to near white blast cleaning (SSPC-SP10).

2. Exterior: Sandblast to commercial blast cleaning (SSPC-SP6).

D. Coating Systems:

1. Interior: Stripe coating – hand-apply one coat Tnemec Series N140 PotaPox epoxy to all welds and hard to reach areas to a dry film thickness of 4-6 mils. Prime coating – Apply Tnemec Series N140 PotaPox epoxy primer to a dry film thickness of 6-8 mils. Second coating: Apply Tnemec Series N140 PotaPox epoxy to a dry film thickness of 6-8 mils for a total dry film thickness of 12-16 mils. . Finishing coating: Apply Tnemec Series N140 PotaPox epoxy to a dry film thickness of 6-8 mils for a total dry film thickness of 18- 24 mils. The interior coating color shall be selected by the Owner.

2. Exterior: Stripe coating – hand-apply one coat Tnemec Series N140 PotaPox or Tnemec Series N69 Hi-Build Epoxoline to all welds and hard to reach areas to a dry film thickness of 4-5 mils. Prime coating – Tnemec Series N140 or N69 to a dry mil thickness of 4-5 mils. Intermediate coating – Tnemec Series N140 or N69 primer to a dry mil thickness of 4-5 mils. The exterior finish coat shall be Tnemec

1074 polyurethane with a dry film thickness 3.0-5.0 mils. The exterior coating color shall be selected by the Owner.

E. Application coatingsshall be in accordance with all coatings system manufacturer's recommendations.

F. Holiday Testing and Touch Up: Upon delivery at the site, the equipment shall be holiday tested by the Biofilter manufacturer in the presence of the DESIGN/BUILDER. Biofilter manufacturer shall repair/repaint all holidays, scratches, blemishes, etc. in accordance with all coatings system manufacturer's recommendations.

1. Dry Film Thickness Exceeding 20 Mils: For surfaces having a total dry film thickness exceeding 20 mils: Pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.

2. Dry Film Thickness of 20 Mils or Less: For surfaces having a total dry film thickness of 20 mils or less: Tinker & Rasor Model M1 non-destructive type holiday detector, K-D Bird Dog, shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flow, shall be added to the water prior to wetting the detector sponge.

PART 3 -- EXECUTION

3.01 BIOFILTER MANUFACTURER'S FIELD SERVICES

A. The services of a qualified Biofilter Manufacturer's technical representative shall include the following site visits:

Service	**Number of Trips**	**Number of Days/Trip (not including travel)**
Installation and Testing	2	3
Startup and Training	1	3

B. Installation Supervision: The DESIGN/BUILDER shall coordinate with the filter supplier to provide factory supervision or direction during critical phases of installation. Critical phases will include installation of internals, media installation and other components critical to the successful operation of the system.

C. Media Installation: Installation of support gravel and filter media shall be under the direct supervision of an employee of the filter supplier experienced in this procedure.

D. System Start-Up and Training

1. The Biofilter Manufacturer shall provide the services of a factory representative during start-up of the filter equipment. At a minimum, the equipment Biofilter Manufacturer's technician shall perform the following start-up functions:

a. Inspect the final installation to assure proper installation and connection of all equipment of the Biofilter Manufacturer's supply.

b. Start-up of the equipment in the presence of the DESIGN/BUILDER and Owner's operating personnel.

c. Training of Owner's operating personnel in proper operation and maintenance procedures, start-up/shutdown procedures, response to emergency conditions, and troubleshooting.

D. Post Start-Up Activities

1. Upon completion of his work, the Biofilter Manufacturer's field technician shall submit to the DESIGN/BUILDER, three (3) copies of a written report outlining the equipment start-up, names of owner personnel trained and a listing of any deficiencies of equipment or materials as a result of his inspection, adjustments, corrections, repairs, and start-up. The report shall include descriptions of the inspection, adjustments, corrections and repairs made, and shall certify that the equipment:

a. Has been installed per Biofilter Manufacturer's requirements.

b. Has been started and placed on line.

c. Has been tested per Biofilter Manufacturer's instructions.

d. Operator personnel have been instructed and trained.

3.02 INSTALLATION

A. Delivery and Storage

1. Upon delivery of the equipment to the jobsite, the DESIGN/BUILDER shall take inventory of the shipment and immediately report to the equipment Biofilter Manufacturer any discrepancies between the equipment Biofilter Manufacturer's packing lists and shipping documents.

B. Installation

1. Biofilter Manufacturer's installation instructions and assembly drawings shall be submitted and approved by the DESIGN/BUILDER prior to shipment of equipment.

C. Cleaning and Protecting During Installation

2. The DESIGN/BUILDER shall thoroughly flush all backwash and air piping to remove debris prior to testing.

3. Any time the underdrain laterals are to be used as a work surface, the underdrain block systems shall be protected where necessary, to distribute the load to prevent damage to the underdrain.

3.03 FIELD TESTING

A. A Tank Leak Test shall be performed after installation of any and all equipment which requires tank wall penetration or field assembly. No equipment shall be installed into the tank until tank wall penetrations have passed the leak test.

1. The tank shall be filled to max operating height and maintained for 48 hours without showing any signs of leaks.

B. Backwash Process Test

1. DESIGN/BUILDER, Biofilter Manufacturer, and Owner shall conduct a backwash test to confirm if the air and water backwash flow rates are sufficient for an effective "collapse-pulse backwash" air and water flow rates system meets the requirement of these specifications and provide optimal cleaning of the filter media.

2. The procedure shall be as follows:

a. The filter shall be backwashed after media is installed. Prior to performing the test, the filter may be backwashed to assure uniformity of the media.

b. The filter to waste valve shall be opened to drain down to 6" above the filter media before the backwash sequence is started.

c. The DESIGN/BUILDER shall provide suitable lighting and access so that the interior of the filter may be observed during the combined air and water backwash.

d. The air and water flow rates shall be set to 3 scfm and 5 gpm/sf, respectively, or until the water level reaches the bottom of the backwash trough.

e. After 3-5 minutes have elapsed, a one-liter sample of the backwash waste shall be collected and inspected for media. Media is defined as any particle size equal to the effective size of the installed media. Media particles that are less than the effective size of the installed media will be considered fines. No media shall be present in the sample.

f. If it is determined that the system does not meet the requirements of these specifications, the Biofilter Manufacturer will be required to modify or replace the collection system as required at no cost to the owner.

g. Biofilter Manufacturer's warranty shall not begin until performance with the above procedure is verified.

C. Media Loss Warranty and Testing Procedure

1. The Biofilter Manufacturer shall guarantee that aggregate media loss from the filtration system will not exceed one vertical inch per year, when operated using the rates above. Determination of media measurement for purpose of media loss warranty shall be witnessed by both the DESIGN/BUILDER and Owner.

2. Media measurement shall be as follows:

   a. Initial baseline media levels shall be determined at time of start-up and after successful completion of the simultaneous air and water backwash test as described above. This media level and method of measurement shall be documented by the Biofilter Manufacturer and appropriately recorded in the O&M manual so that it can be reproduced.

   b. Media measurement, for purposes of media loss warranty, shall be made after at least a six-month operation by the Owner, and compared to the baseline media levels. Media losses shall then be prorated to an annual figure.

   c. All measurements shall be representative of a grid across the entire filter surface area, and shall be accurate to within 0.10 inch.

   d. In the event that the measured prorated media loss exceeds one inch per year, the filtration system Biofilter Manufacturer shall replace the lost media up to the baseline media level and shall extend the warranty for 12 months thereafter, at no cost to the owner.

   e. Six months into the extended warranty, if applicable, a second media measurement for purposes of media loss guarantee shall be made and prorated to an annual figure in accordance with steps b and c above.

   f. If in the event the second media measurement is prorated at a figure greater than the guaranteed figure, then the warranty shall be extended again and the process repeated until either: a) warranty is met, or b) useful life of the filter system has expired (20 years).

3.04 TOOLS, SUPPLIES, SPARE PARTS

A. The Biofilter Manufacturer shall provide a spare parts list to the DESIGN/BUILDER with the Shop Drawing submittal. The list shall indicate specific sizes, quantities, and part numbers of the items available.

B. The Biofilter Manufacturer shall furnish all special tools necessary to disassemble, service, repair and adjust the equipment.

C. The Biofilter Manufacturer shall furnish all special tools (one per like piece of equipment) necessary to disassemble, service, repair and adjust the equipment.

D. Spare parts shall be provided and shall include the following:

   One (1) set special tools
   One (1) set of vessel and piping gaskets
   Ten (10) underdrain o-rings (if applicable)
   Five (5) Plastic end caps (if applicable)

- END OF SECTION -

SECTION 11411

BIOFILTER MEDIA

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. New filter sand, support gravel, and GAC media shall be furnished, installed, and placed into satisfactory operation in the four filter cells. The new sand and GAC filter media shall be furnished and installed at the depths provided herein onto the inspected and tested new filters, as specified in Section 11410, following filter installation.

B. The sand and GAC filter media shall be furnished in accordance with the dimensions and layout shown in the Drawings and Specification Section 11410, and shall cover the entire filter floor area. It shall be suitable for combined air scour and water backwash. Materials used in the filter underdrain system shall conform to the requirements specified herein and shall be NSF approved.

C. Any material used in treatment of Public Water Supplies, shall meet and demonstrate conformance to all requirements for potable water usage as established by the Virginia Department of Health (VDH). All such products must conform to the requirements of the Safe Drinking Act and American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61.

1.02 RELATED WORK

A. Section 01 33 00 – Submittals
B. Section 01 91 14 – Equipment Testing and Facility Startup
C. Section 01 78 23 – Operations and Maintenance Data
D. Section 11410 – Biofilters

1.03 REFERENCES

A. AWWA – American Water Works Association Standards

1. B100 –Granular Filter Material.
2. B604 – Granular Activated Carbon

B. NSF – Standard 61 – Requirements for GAC media.
C. ASTM – American Society for Testing and Materials

1. D4607 - Standard Test Method for Determination of Iodine Number of Activated Carbon
2. D2867 - Standard Test Methods for Moisture in Activated Carbon
3. D2862 - Standard Test Method for Particle Size Distribution of Granular Activated Carbon

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1.04 SUBMITTALS

A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01 33 00.

1. Manufacturer's name, carbon manufacturing location and address, capacity of the manufacturing facility, source of coal, agglomeration/thermal process, and product name and numbers shall be submitted.

2. Manufacturer's standard product data, including Material Safety Data Sheet (MSDS).

3. Bill of material, including volume and lot numbers.

4. Complete description of sufficient detail to permit an item by item comparison with the specifications.

5. Media specifications, including gradation analysis, source of materials, details on the reagglomeration/thermal process, capacity of the manufacturing facility and installation instructions.

6. Data on clean bed headloss and flow rate versus expansion of the media during fluidization backwashing at three different temperatures (5, 15 and 25˚C). This data shall be expressed as a percentage of bed depth versus backwash flow rate (gpm per square foot of contactor surface area).

7. Notarized affidavit of compliance for the media stating GAC furnished is ANSI/NSF 61 certified and complies with applicable provisions of the latest revision of AWWA Standard B604.

8. Valid ISO 9001: 2000 certification for the plant of manufacture for the GAC.

9. Documentation regarding delivery trailer unloading procedures, information on trailer materials used that come in contact with the GAC, that these materials are U.S. Food and Drug Administration approved, and that the trailers are dedicated to the transport of potable grade GAC filter media.

10. Where manufacturer's publications in the form of catalogs, brochures, illustrations or other data sheets are submitted in lieu of prepared Shop Drawings, such submittals shall specifically indicate the item for which approval is requested. Identification of items shall be made in ink, and submittals showing only general information are not acceptable.

1.05 OPERATION AND MAINTENANCE MANUALS

A. Operations and Maintenance Manual submittals will be submitted in accordance with Section 01 78 23. The O&M Manual shall include but is not limited to the following:

1. Handling instructions.
2. Installation instructions and details of equipment to be used.
3. Manufacturer Representative’s Certificate of Proper Installation
4. Samples/Material Certification of Media

1.07 MATERIAL WARRANTY

A. Carbon shall conform to the specifications herein for a period of thirty days from the date of startup.

PART 2 -- MATERIALS

2.01 ACCEPTABLE MANUFACTURERS

A. The materials covered by these Specifications are intended to be standard products of proven reliability and as manufactured by reputable manufacturers having experience in the production of such products. The materials furnished shall be designed, manufactured, and installed in accordance with the best practices and methods and shall operate satisfactorily and operated per manufacturer's recommendations. Filter sand, gravel and GAC media shall be provided in 2,000 lb super sacks.

B. The Design/Builder shall furnish filter media as specified herein and suitable for the type of underdrain system proposed. Sand and gravel required shall be as purchased from the Northern Gravel Company, Muscatine, Iowa; Unifilt Corporation, Zelienople, Pennsylvania; Unimin Corporation; Southern Products & Silica Co. Inc., Hoffman, North Carolina; or equal. Only suppliers who regularly furnish filter sand for the municipal water treatment industry will be considered for approval.

C. Granular Activated Carbon shall be Calgon F816, or approved equal.

2.02 FILTER MEDIA

A. The filter cells shall use media as indicated below.

	Filter 1 (XA & IMS 200 Underdrains)	Filters 2 – 4 (XA Underdrains)
No. of Filters	1	3
GAC Filter Media (inches)	60	60
Filter Sand (inches)	12	12
Support Gravel (inches)	N/A	12

B. Support gravel shall be obtained from an approved source and shall consist of hard, round stone with an average specific gravity of not less than 2.6. Not more than 1 percent by weight shall have a specific gravity of 2.25 or less. The gravel shall contain not more than 2 percent by weight of thin, flat, or elongated pieces determined by hand picking from a representative sample. The gravel shall be free of shale, mica, clay, sand, dirt, loam, and organic impurities of any kind. The washed and dried gravel, when digested for a period of 24 hours in cold, strong hydrochloric acid, shall not suffer weight loss in excess of 17.5%. The Design/Builder shall arrange and pay for sieve analysis by an independent testing laboratory for each of the size ranges for gravel media.

C. The gravel media support shall be placed in six (6) layers as indicated below. The gravel shall be placed with the bottom layer adjacent to the underdrain and the top layer adjacent to the filter sand. Not more than 8 percent by weight of any layer shall be finer or coarser than specified for the layer. The layers shall be graded as follows:

3” layer – 1/8 inch to #12 – top layer
3” layer – ¼ to 1/8 inch
3” layer – ½ to ¼ inch
3” layer – ¾ to ½ inch – bottom layer

D. The filter sand shall be high-grade silica sand complying with the latest edition of the Standard Specifications for Granular Filter Material – AWWA B100. It shall be well graded. Material showing abnormal grading shall be rejected. The sand shall be washed silica and completely free from mica, dust, dirt, and foreign substances of any kind and shall have a specific gravity of about 2.65. The 10 percent size (D_{10}) or effective size shall be 0.7 millimeters. The uniformity coefficient (ratio of D_{60} to D_{10}) shall not exceed 1.40. Sand shall have an acid solubility of less than 5 percent.

E. GAC Product Specifications:

Iodine Number	900 mg/g (min)
Apparent Density	0.5 g/cc (min)
Moisture, wt %	2 % (Max)
Effective Size	1.3 – 1.5 mm
Uniformity Coefficient	<1.4
Abrasion No. (ROTAP)	75 (min)
Ash by Weight	10% (max)
Mesh Size	US Sieve Series 8 x 16
Screen Size (US Sieve), wt%	
On 8 mesh	15% (max)
Through 16 mesh	5 %(max)

C. GAC Product Qualifications:

1. The GAC shall be virgin quality.
2. The GAC shall be manufactured in the United States of America.
3. GAC shall be a re-agglomerated bituminous coal based product with petroleum or coal based pitch binders sized to a granular form prior to baking and activation. Lignite based GAC, peat, wood, coconut, recycled, used GAC media or broken pellets will not be accepted. Direct activated GAC will not be accepted.
4. GAC shall be thermally activated by steam under rigidly controlled conditions.
5. The GAC must possess superior hardness and abrasion characteristics to withstand repeated backwashes, transfers and handling without significant change in physical size or loss of GAC volume.
6. The GAC shall be capable of removing color, tastes, odors, disinfection by-products, disinfection by-product precursors, contaminants of emerging concerns, endocrine disrupting compounds, pharmaceutical and personal care products and other organic contamination from water previously pretreated by conventional water treatment processes.
7. The GAC shall contain no soluble inorganic or organic substances in quantities capable of producing deleterious or injurious effects upon the health of those consuming the water or that would otherwise render the water treated by the GAC unfit for public use. The GAC shall not impart to the water any contaminant that exceeds the maximum limits as defined by the Safe Drinking Water Act Public Law 93-523 or any of its amendments, or NSF 61 standards.

D. Gravel and Filter Sand Testing

1. The initial test for the gravel sand filter media shall be provided for review to the Design/Builder before shipping to the site. Testing shall include sieve analysis, effective size, uniformity coefficient, specific gravity, acid solubility, and loss on ignition for gravel and filter sand media. One shall be performed by an independent laboratory and the test results shall be sent to the Design/Builder for approval. The supplier shall provide an Affidavit of Compliance stating that the filter material provided complies with applicable provisions in the latest revision of AWWA B100. No media shall be shipped until the corresponding samples are analyzed and approved by the Design/Builder. Test results shall include a statement certifying that the material for shipment is equal in quality and gradation characteristics to the sample submitted. No plus tolerance shall be allowed on uniformity coefficients. The materials testing cost shall be borne by the Design/Builder.

2. A second round of testing shall be performed on each bag after arrival to the site. Samples for testing shall be submitted in clean, dust-tight containers plainly marked with the name and address of the supplier, the bag or semi-bulk container from which the sample was taken and the size or grade of the contents. Testing for filter sand shall include parameters specified above. No plus tolerance shall be allowed on uniformity coefficients. Testing shall be performed by an independent laboratory and all results shall be sealed by a registered Professional Engineer. Sampling, testing and reporting shall be performed in accordance with the latest revision of AWWA B100. Results of second round testing shall be submitted to the Design/Builder following installation for review and approval.

E. GAC Media Testing

1. Sampling shall be in accordance with the latest revision of AWWA B604. The initial testing and reporting of results by the certified independent testing laboratory shall be in accordance with the latest revision of AWWA B604, and results shall be submitted to the Design/Builder for approval prior to shipment. Test results shall include a statement certifying that the material for shipment is equal in quality to the sample submitted. Analyses shall be performed to confirm gradation, effective size, uniformity coefficient, iodine number, ash content, abrasion number, and apparent density. No plus tolerance shall be allowed on uniformity coefficients. The materials testing cost shall be borne by the Design/Builder. Sampling shall be performed by the Biofilter Media Supplier.

2. Samples after arrival to site: A second round of testing shall be performed on the each supersack after arrival to the site. Samples for testing shall be submitted in clean, dust-tight containers plainly marked with the name and address of the supplier, the supersack from which the sample was taken and the size or grade of the contents. One composite sample will be made from portions of each supersack sample and sent to the lab for initial sampling. All samples shall be sealed in airtight, moisture proof glass containers and delivered as described above. Each sample container shall be labeled to identify it, and the label shall be signed by the sampler. Analyses shall be performed to confirm gradation, effective size, uniformity coefficient, iodine number, ash content, abrasion number, and apparent density.

3. Sample test reports shall include raw data, graphical results, computation of the effective size, uniformity coefficient, and other parameters specified in Paragraph

2.01 C, and shall be sent directly from the certified independent laboratory to the Design/Builder.

4. If the GAC does not meet the requirements of this specification or of AWWA B604, a notice of nonconformance will be provided to the Design/Builder within five days after receipt of results from the independent lab. The results of the test shall prevail unless the Design/Builder requests a re-test to the Owner within five (5) working days of the notice. Upon receipt of the request for a retest, the Owner shall forward to the Design/Builder one of the duplicate sealed samples taken. The Design/Builder must notify the Owner within 12 days after receipt of the duplicate sealed sample if Design/Builder retesting reveals that the material complies with specifications. In the event that the retest indicates compliance of the media with the specifications and AWWA B604, then the other sealed sample shall be forwarded, unopened, to a neutral laboratory agreed upon by both parties for analysis. The results of the neutral laboratory analysis shall be accepted as final. The cost of the neutral laboratory analysis shall be paid by the Biofilter Media supplier if the neutral laboratory analysis shows that the material does not meet this standard.

F. If the GAC does not meet the requirements of this specification or of AWWA B604, a notice of nonconformance will be provided to the Media Supplier within five days after receipt of results from the independent lab. The results of the test shall prevail unless the Media Supplier requests a re-test to the Design/Builder within five (5) working days of the notice. Upon receipt of the request for a retest, a duplicate sealed samples shall be forwarded to the Media Supplier. The Media Supplier must notify the Owner within 12 days after receipt of the duplicate sealed sample if retesting reveals that the material complies with specifications. In the event that the retest indicates compliance of the media with the specifications and AWWA B604, then the other sealed sample shall be forwarded, unopened, to a neutral laboratory agreed upon by both parties for analysis. The results of the neutral laboratory analysis shall be accepted as final. The cost of the neutral laboratory analysis shall be paid by the Biofilter Media supplier if the neutral laboratory analysis shows that the material does not meet this standard.

G. All bags or containers of media delivered to the site shall be tagged and numbered for control purposes. All bags or containers from which media samples are tested shall be labeled and reported with test results.

PART 3 -- EXECUTION

3.01 GENERAL

A. The media (sand and GAC) shall be installed and field tested in accordance with the instructions and drawings of the Manufacturer and as described herein.

B. The services of a qualified service person shall be furnished with at least three years of experience who is regularly involved in the inspection, installation, start-up, troubleshooting, testing, maintenance, and operation of filter underdrain systems and filter media as specified in Sections 11410 and herein.

C. New media shall not be installed until the filter underdrain has been installed, inspected and tested by the qualified service person and all deficiencies have been repaired.

D. GAC media shall not be installed until the filter underdrain, piping, filter sand, and all other appurtenances have been disinfected.

E. Precautions shall be taken as required to prevent breakage or warpage of any stored or installed underdrain component. Units damaged before final completion of the work shall be removed and replaced with undamaged units without additional expense to the Owner.

3.02 DELIVERY, STORAGE, AND HANDLING

A. Media. Shipment shall be made 2,000 lbs supersacks. All shipping and delivery charges shall be included and be paid by the Biofilter Media supplier. All deliveries shall be accompanied by a legible bill of lading or other evidence suitable to the Design/Builder, indicating the gross, tare and net weight of shipment, the name of carrier, and other pertinent information. This evidence shall be presented to the Design/Builder before or at the time of delivery.

B. It shall be the Design/Builder's responsibility to clean up, to the Owner's satisfaction, any GAC spills at the site and to repair any damage resulting from the GAC delivery or unloading operations.

C. Design/Builder shall follow storage precautions in accordance with AWWA B604.

3.03 NEW FILTER MEDIA INSTALLATION AND TESTING

A. Gravel, Sand and GAC filter media shall be transported, delivered, and placed in a careful manner to exclude all dust, dirt, or deleterious material and to prevent physical damage to the particles. An area on site shall be designated, with the approval of the Design/Builder and Owner, for storage of new sand and GAC filter media. Storage and handling of all filter media shall be in accordance with the latest revision of AWWA B100 and AWWA B604. As a minimum requirement, bagged material shall be stored on pallets and covered with plastic for protection from the weather and sunlight. Each size and type of media shall be stored separately. All containers shall be tagged and numbered upon arrival at the site for control purposes. Under no circumstances shall material be removed from the bags prior to placement in the filter, except for sampling. All media shall be handled and stored to prevent contamination from foreign matter. In the event any such material, equipment, and supplies are lost, stolen, damaged, or destroyed prior to final inspection and acceptance, the same shall be replaced without additional cost to the Owner.

B. Installation and the preparation of the filter for service shall be in accordance with the latest revision of AWWA B100 and AWWA B604 unless specifically noted otherwise herein.

C. The filter underdrain shall be thoroughly cleaned before any media is placed and shall be kept clean throughout the operation.

D. The Design/Builder shall exercise caution in installing gravel to avoid damage to the filter underdrain system. Any damage shall be repaired. Each layer shall be completed before the layer above is started. The bottom layer shall be placed carefully by hand to avoid damage to the underdrain system and to ensure a free passage of water from the orifices. Workmen shall not stand or walk directly upon the gravel, but upon boards or staging so that the weight of the workmen will not displace the gravel. Any gravel which becomes mixed shall be removed and replaced after installation,

E. After all of the gravel has been placed, it shall be backwashed successively until all dust and dirt has been washed out. Gravel shall be backwashed at the maximum available rate but not to exceed 25 gpm/sq. ft. Backwashing shall be repeated as often as necessary to the satisfaction of the Design/Builder.

F. New filter sand media shall be installed in a uniform thickness with the top surface brought to a true level plane. The elevation of the top surface of each filter media layer shall be checked by filling the filter with water to the level line previously marked on the inside of the filter.

G. After the new sand has been placed, the media shall be washed and scraped or skimmed to remove any excess fine material. Wash water shall be slowly admitted upward through the underdrain system until the entire bed is flooded. The bed shall be allowed to stand for as long a period as deemed necessary before initial wash. The wash rate shall be increased gradually during the initial wash to remove air from the bed. During each backwash, the water shall be applied at an initial rate of not more than 2 gpm/ft^2 of filter area. The backwash rate shall then be increased gradually over a period of 3 minutes. The filter bed shall be backwashed for a total period of not less than 30 minutes in order to stratify the bed and to wash out dirt. This process will require several separate backwashes, but not less than 3 backwashes at 10 minutes each at a bed expansion of not less than 30 percent followed by a slow closing of the wash water valve. Following each backwash, the top layer of media shall be removed such that after the last backwash a total of 1-inch of media shall be removed and discarded, and the final surface leveled. The depth of filter media, as specified herein, shall be measured in place after the backwashing and skimming process is complete.

H. After the new sand has been washed, the filter tank, underdrains, trough, sand media, and all filter internals shall be disinfected.

I. After the new sand has been placed, leveled, washed, scraped, and disinfected the new GAC media shall be placed, leveled, washed, and scraped in accordance with AWWA Standard B604.

J. The depth of each type of filter media shall be measured in place after backwashing and filtering. Any media lost during backwashing and beyond the scraping allowance shall be replaced at no additional cost to the Owner.

K. Any temporary equipment or facilities necessary to complete installation of the filter media shall be provided at no additional cost to the Owner.

L. Potable water shall be furnished by the Owner and used for washing of dirt and fines from the filter media in the filters. Filter media backwashes shall be scheduled with the Owner.

M. Filters shall not be placed into service until filter structure, troughs, underdrain, air header, media, piping, and valves have been disinfected.

N. The services of an independent testing laboratory shall be employed and paid to perform filter media testing. The laboratory shall maintain a Professional Engineer on staff to review testing services. Laboratory selected shall be subject to approval by the Design/Builder and the Owner. The testing procedure shall be in accordance with the latest revision of AWWA B100 and B604. The tests shall be performed as specified in Section 2.02 of this specification.

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SECTION 11415

GAC ADSORPTION SYSTEM

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The GAC Adsorption System Manufacturer shall furnish, test, and place in satisfactory operation the GAC Adsorption System.

B. The GAC Adsorption System Manufacturer shall provide all equipment as described herein, from the Contactors to the required flanges for interconnecting process piping (i.e. the combined influent and effluent piping flanges). The GAC Adsorption System Manufacturer shall be responsible for providing the carbon transfer piping, manifold piping, sample lines, and ports as described herein.

C. All equipment and interior linings/coatings and materials that come into contact with water shall be NSF 61 approved materials for use in drinking water applications.

D. Valves, instrumentation, and GAC media, unless specified herein, are not part of the GAC Adsorption System Manufacturer's scope.

E. The GAC Adsorption System Manufacturer shall be responsible for coordinating all interfaces with related mechanical and structural, work.

F. GAC Adsorption System Manufacturer shall take responsibility for all equipment furnished under this section. All equipment shall be suitable for service in a reuse application. The work includes, but is not limited to, the following major system components:

1. 12' Diameter GAC Contactor (Two)
2. GAC Piping Manifold (One Complete System)
3. Carbon Transfer Piping (Two, one per contactor)
4. Underdrain System (Two, one per contactor)
5. Overdrain System (Two, one per contactor)

1.02 RELATED WORK

A. Section 01 33 00 – Submittals
B. Section 01 91 14 – Equipment Testing and Facility Startup
C. Section 01 78 23 – Operations and Maintenance Data
D. Section 05010 – Metal Materials
E. Section 05120 – Structural Steel
F. Section 05500 – Metal Fabrications
G. Section 11416 – GAC Contactor Media
H. Section 15012 – Steel Pipe
I. Section 16100 – Major Equipment Package General Electrical Requirements

1.03 QUALITY ASSURANCE

32414-0000

A. Manufacturer's Qualifications: GAC Adsorption System Manufacturer shall have a minimum of five years' experience manufacturing GAC Contactors for municipal drinking water treatment and reuse applications. The manufacturer shall provide evidence of at least five installations in satisfactory operation for the 40,000 pound size vessel, both individual and system installations, similar in scope to the application specified herein.

1.04 REFERENCE

A. ANSI – American National Standards Institute.
B. NIOSH – National Institute for Occupational Safety and Health.
C. AWWA – American Water Works Association Standards.
    a. B604 – Granular Activated Carbon
D. NSF – Standard 61 – Requirements for GAC media.
E. ASTM – American Society for Testing and Materials

1.05 SUBMITTALS

A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01 33 00.

    a. Dimensioned layout and section drawings showing Contactors and all piping, ports, and appurtenances, including GAC supply, GAC treated water, GAC backwash waste/vessel-to-waste, and GAC backwash supply as well as GAC exchange piping and pipe connection locations. Drawings shall also indicate the normal GAC media bed depth and GAC media volume, available height for media bed expansion during backwash.

    b. Catalog information (cut-sheets) with equipment information, materials of construction, pressure vessel construction, and pressure vessel lining and coating.

1. System weights, including empty pressure vessel weight, pressure vessel weight after installation of GAC, and maximum pressure vessel weight after installation of GAC and filling Contactors with water.

2. Hydraulic calculations indicating normal operating pressure range, pressure drop at design flowrate, and required backwash flow, pressure, and maximum backwash pressure drop.

3. Manufacturer's recommended field installation procedures, size and location of anchors and loading data such that the DESIGN/BUILDER can specify anchor embedment depth.

4. Data on clean bed headloss and flow rate versus expansion of the media during fluidization backwashing at three different temperatures (5, 15 and 25˚C). This data shall be expressed as a percentage of bed depth versus backwash flow rate (gpm per square foot of contactor surface area).

5. List of recommended spare parts.

B. Operation and maintenance data in accordance with Section 01 33 00.

C. GAC Adsorption System Manufacturer shall provide a certification that the GAC Adsorption System and appurtenances have been installed properly.

D. Where manufacturer's publications in the form of catalogs, brochures, illustrations or other data sheets are submitted in lieu of prepared Shop Drawings, such submittals shall specifically indicate the item for which approval is requested. Identification of items shall be made in red and items not pertaining to the submittal shall be crossed out in red. Submittals showing only general information are not acceptable.

1.06 WARRANTY AND GUARANTEE

A. All materials furnished shall be guaranteed to be free from defects in design and/or materials for a period of one (1) year following Substantial Completion. The period of such warranties shall start on the date the Performance Testing as indicated in the General Requirements have been completed and Substantial Completion has occurred. Any design and/or material (or part thereof) which is defective or showing undue wear within the correction period or not meeting performance requirements, shall be corrected, repaired or replaced with new material; furnishing all materials, labor, etc., necessary to return to the specified performance level without charge to the Owner. Where defective designs and/or materials have been repaired or replaced, the correction period for such shall be extended in accordance with the General Conditions.

PART 2 – MATERIALS

2.01 ACCEPTABLE MANUFACTURERS

A. The GAC Adsorption System shall be Calgon Carbon, WesTech, or approved equal.

2.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

A. The GAC Adsorption System shall be designed, fabricated, and installed to meet the following design criteria:

Demonstration Facility	1 mgd
GAC System Design Capacity	1 mgd
Design Flow per GAC Contactor	700 gallons per minute
Number of GAC Contactors	2
Design Empty Bed Contact Time (EBCT) at Design Flowrate per Contactor at Design Flowrate	15.3 minutes
Minimum GAC Capacity of each Contactor	40,000 lbs
Minimum Total System GAC Capacity	80,000 lbs
Maximum Contactor Height	27 feet
Contactor Diameter	12 feet
Maximum Pressure Drop across Adsorption System including face piping at the design flowrate	20 psi
Backwash Loading Rate	5-15 gpm/sf

B. The GAC Adsorption System shall be designed such that the GAC Contactors are capable of operating in parallel, series, individual, and upflow modes.

2.03 DETAILS OF CONSTRUCTION

A. General: The GAC Adsorption System shall be provided as a single system with piping manifold. An underdrain system shall be provided to collect the treated water and retain the GAC in the bed. The treated water shall be discharged from the GAC Contactors through the treated water effluent orifice.

B. Each Contactor shall be furnished at a minimum with flanged outlets for the following services and sizes:

1. (1) GAC influent/Backwash Waste – 8 inch

2. (1) GAC effluent/Backwash Supply – 8 inch

3. (1) Carbon slurry in (top) – 4 inch

4. (2) Carbon slurry out (bottom) – 4 inch

5. (3) Sample Ports – 2 inch

6. (1) Air Relief – 2 inch

7. (1) Pressure Relief Port – 3 inch

C. GAC Contactors: GAC Contactors shall be vertical cylindrical pressure vessels with elliptical top and bottom heads. Straight side shell lengths shall be sufficient to allow for a minimum of 30% GAC bed expansion during backwash. Pressure vessel bottoms and appurtenances shall be designed for complete removal of spent GAC and for even distribution of treated water. The vessels shall be designed with a safety factor of four and fabricated in accordance with the ASME Code (latest revision) for pressure vessels. The vessels shall be designed for a pressure rating of 60 psig at 140 degrees Fahrenheit. Each pressure vessel shall be constructed of carbon steel, conforming to Section 05120 and shall have all welds and any other sharp edges ground smooth, and all imperfections such as skip welds, delaminations, scabs, slivers, and slag corrected prior to abrasive blasting. All surfaces shall be degreased prior to sandblasting. The Contactors shall be equipped with lifting lugs, tailing lugs, and support legs suitable for rigging and anchoring the Contactors.

Manway Access: The Contactors shall be equipped with two manways. Each vessel shall have permanently marked or mounted safety warnings at all entry locations indicating the safety risks of entry. GAC depletes oxygen from air and can be hazardous in a confined situation.

1. One minimum 14 x 18 inch diameter manway located on the bottom head of pressure vessel below the underdrain system.

2. One minimum 14 x 18 inch diameter manway located on the top head of the pressure vessel.

D. Contactor Ports and Nozzles: All port and nozzle connections shall be flush on the inside of the shell and provided with 150-pound full face flanges on the outside. Steel flanges shall conform to AWWA C207 for steel ring flanges, Class B. Bolts shall conform to ASTM A 307, Grade A or B. Gaskets shall have full-face, of best quality natural or synthetic rubber, 1/8-inch thick.

E. Underdrain Collection System: GAC Adsorption System Manufacturer shall select and provide one of the following two configurations.

1. Internal cone bottom (30 degree angle) underdrain system with 304 stainless steel underdrain nozzles to provide a minimum of one (1) septa nozzle for every nominal square foot of vessel cross section as provided by Calgon Carbon.

2. 30 degree conical false bottom. The false bottom shall consist of a strainer plate constructed from 5/16 inch (minimum) steel plate. The underdrain will allow the placement of 304 stainless steel media retaining nozzles on a maximum spacing of 8 inch centers as provided by WesTech.

F. Overdrain Collection/Influent Distribution System: GAC Adsorption System shall be furnished with a 304 SS overdrain system which shall be designed to effectively distribute the raw water and to collect backwash water.

G. GAC Transfer Piping: GAC fill and GAC drain piping to and including the shut-off valve and fittings shall be Type 304L stainless steel as specified in Section 15012. Stainless steel ball valves for GAC fill and drain lines shall be provided by the GAC Adsorption System Manufacturer. Ball valves shall be manufactured by Apollo Ball Valve Division of Conbraco Industries, Inc., Pageland, SC., or DESIGN/BUILDER approved equal. GAC Adsorption System Manufacturer shall coordinate with DESIGN/BUILDER to determine size and location of discharge lines.

H. GAC Manifold Piping. GAC contactor interconnecting piping shall be supplied as 8" carbon steel. The interconnecting piping and valves shall allow for series, parallel, or individual feeding in upflow modes and filter to waste operation. Valves shall be furnished by the DESIGN/BUILDER. GAC Adsorption System Manufacturer shall factory assemble piping, include valves which shall be furnished by DESIGN/BUILDER. Pipe openings shall be protected for shipment. GAC Adsorption System Manufacturer shall coordinate with DESIGN/BUILDER the location of combined process influent and effluent flanges to system.

I. Transfer Hose Connectors: The GAC transfer piping shall be fitted with hose connectors such that GAC transfer to and from the Contactors can be facilitated with transfer hoses. These connectors shall be 4-inch quick disconnect adapters constructed of Type 304 stainless steel and supplied by the GAC Adsorption System Manufacturer

J. Transfer Hoses: The GAC Adsorption System Manufacturer shall provide three 20 foot length sections of 4-inch flexible transfer hose to facilitate GAC transfers from delivery truck to vessel and from vessel to delivery truck. Hose type and end connections shall be coordinated with GAC media supplier.

K. Flush Connections: The GAC Adsorption System Manufacturer shall supply a minimum of one flush connection on each GAC fill and GAC drain line. Connections shall be welded into steel pipe or supplied in solid polypropylene "spacers" for lined pipe.

L. Pressure Gauges: The manifold piping and vessels shall be equipped with pressure gauge ports. A minimum of three pressure gauge locations shall be provided to indicate influent, inter-stage, and effluent pressures. Pressure gauges furnished shall be suitable for their intended use and shall be furnished by the DESIGN/BUILDER. The GAC Adsorption System Manufacturer shall coordinate with the DESIGN/BUILDER on the location and size of ports

M. Pressure Transmitter: The interconnecting process piping shall be equipped with differential transmitter ports. Pressure transmitters shall be provided by DESIGN/BUILDER. This transmitter shall provide the differential pressure drop across the media, shall be 24 VDC loop powered and shall provide a 4-20 mA signal output. The GAC Adsorption System Manufacturer shall coordinate with the DESIGN/BUILDER on the location and size of ports

N. Air Release Valves: Air release valves shall be furnished by DESIGN/BUILDER. GAC Adsorption System Manufacturer to coordinate with DESIGN/BUILDER to determine location and size of air release valve ports on manifold piping.

O. Sampling Ports: Contactors shall be outfitted with stainless steel sampling ports and piping as indicated below. Sample ports shall include stainless steel ball valves. Ball Valves shall be supplied by the GAC Adsorption System Manufacturer. Ball valves shall be manufactured by Apollo Ball Valve Division of Conbraco Industries, Inc., Pageland, SC., or DESIGN/BUILDER approved equal. Sample port discharge tubing shall be turned downward and extend down to three feet above finished floor. Caution shall be taken by the GAC Adsorption System Manufacturer to ensure protection from the carbon steel and stainless steel materials causing corrosion.

    a. On the Contactors at 25%, 50% and 75% through the media bed

P. Pressure Relief Port: Each vessel shall have a 3 inch flange connection for a burst disk. The GAC Adsorption System Manufacturer shall coordinate with the DESIGN/BUILDER on the location of port.

Q. Reference specification 16100 for electrical requirements for factory assembled, pre-wired equipment. All electrical equipment shall conform to the requirements of a wet process area.

2.04 PAINTING

A. The interior and exterior of the equipment shall be sandblasted and painted at the factory. Interior surfaces in contact with water shall receive NSF/ANSI Standard 61 approved coatings for potable water.

B. Coating systems shall be the product of one manufacturer. Alternate paint systems shall be preapproved by DESIGN/BUILDER.

C. Surface preparation shall be in accordance with all coatings system manufacturer's recommendations. At a minimum, initial preparation shall include:

    1. Interior: Sandblast to white metal blast cleaning (SSPC-SP5).

2. Exterior: Sandblast to commercial blast cleaning (SSPC-SP6).

D. Coating Systems:

1. Interior lining system shall be PLASITE 4110 by Carboline applied in 2 to 3 coats to a maximum dry film thickness of 45 mils. Where supports, brackets, clips, and similar items of stainless steel are attached to the interior of the Contactors, lining shall extend a minimum of 1 inch onto the backup plate from the pressure vessel wall. Prior to placing the lining in service it shall be force cured at 200 F metal temperature for 4 hours.

2. Exterior: Stripe coating – hand-apply one coat Tnemec Series N140 PotaPox or Tnemec Series N69 Hi-Build Epoxoline to all welds and hard to reach areas to a dry film thickness of 4-5 mils. Prime coating – Tnemec Series N140 or N69 to a dry film thickness of 4-5 mils. Intermediate coating – Tnemec Series N140 or N69 primer to a dry film thickness of 4-5 mils. The exterior finish coat shall be Tnemec 1074 polyurethane with a dry film thickness 3.0-5.0 mils. The exterior coating color shall be selected by the Owner.

E. Application of paint shall be in accordance with all coatings system manufacturer's recommendations.

F. Holiday Testing and Touch Up: Upon delivery at the site, the equipment shall be holiday tested by the GAC Adsorption System manufacturer in the presence of the DESIGN/BUILDER. GAC Adsorption System manufacturer shall repair/repaint all holidays, scratches, blemishes, etc. in accordance with all coatings system manufacturer's recommendations.

a. Dry Film Thickness Exceeding 20 Mils: For surfaces having a total dry film thickness exceeding 20 mils: Pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.

b. Dry Film Thickness of 20 Mils or Less: For surfaces having a total dry film thickness of 20 mils or less: Tinker & Rasor Model M1 non-destructive type holiday detector, K-D Bird Dog, shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flow, shall be added to the water prior to wetting the detector sponge.

PART 3 – EXECUTION

3.01 EQUIPMENT DELIVERY AND STORAGE

A. Throughout shipment, all pressure vessel ports and pipe ends shall be sealed with watertight caps or blind flanges/plates that remain in place until installation of the equipment and completion of all piping connections.

B. DESIGN/BUILDER shall store equipment in accordance with the manufacturer's instructions.

3.02 EQUIPMENT INSTALLATION

A. DESIGN/BUILDER shall install GAC Adsorption System and appurtenances in accordance with manufacturer's standards and recommendations. Contactors shall be installed level according to manufacturer's recommended tolerances.

B. All piping shall be supported independent of the GAC Contactors.

3.03 CLEANING, PRESSURE TESTING, AND DISINFECTION

A. Owner will provide potable water supply connection for flushing and disinfection.

B. Cleaning: DESIGN/BUILDER shall clean the interior of each GAC pressure vessel by removing all visible dirt and debris that may have entered the GAC pressure vessel during construction/installation. DESIGN/BUILDER shall also flush all piping and valves appurtenant to the GAC Adsorption System with potable water.

C. Hydrostatic Pressure Testing: After cleaning, DESIGN/BUILDER shall pressure test the GAC Contactors and appurtenant piping as a system. Test pressure shall be 60 psig for a minimum of two hours. All leaks, failures, and malfunctions detected during the testing shall be immediately repaired. Testing shall be repeated until the treatment system can maintain the required pressure for the specified duration without any leakage, failures, or malfunctions.

D. Disinfection: After completion of hydrostatic pressure testing, DESIGN/BUILDER shall disinfect GAC Adsorption System and appurtenant piping.

3.04 PROTECTION

A. The DESIGN/BUILDER shall protect the pressure vessel and GAC filter media after installation but prior to functional testing by DESIGN/BUILDER. The DESIGN/BUILDER shall remove all protective means installed in order to complete the functional testing of the GAC Adsorption System.

3.05 START-UP AND ACCEPTANCE TESTING

A. After installation of the GAC media in each GAC pressure vessel, the DESIGN/BUILDER, GAC Adsorption System Manufacturer's factory-trained field representative, and GAC media Manufacturer's factory-trained field representative shall assist Owner's operating personnel in initial system start-up, including initial operation in the pressure vessel-to-waste and backwashing modes, in accordance with manufacturer's recommendations, for removal of fines from the newly installed GAC beds.

3.06 MANUFACTURER'S SERVICES

A. The services of a qualified manufacturer's technical representative shall include the following site visits:

Service	Number of Trips	Number of Days/Trip (not including travel)
Installation	1	2
Media Installation, Start-Up, and Testing	1	3
Operator Training	1	2

B. Installation Supervision: The DESIGN/BUILDER shall coordinate with the GAC Adsorption System Manufacturer to provide factory supervision or direction during critical phases of installation. Critical phases will include installation of internals, media installation and other components critical to the successful operation of the system.

C. The GAC Adsorption System Manufacturer shall inspect the installation prior to testing, disinfection, GAC media installation, and initial start-up.

D. Media Installation: Installation of filter media shall be under the direct supervision of an employee of the GAC Adsorption System Manufacturer.

3.07 FIELD QUALITY CONTROL

A. Inspection. DESIGN/BUILDER shall notify and coordinate with the GAC Adsorption System Manufacturer in a timely manner in order for them to their required inspections, testing, and instruction as required by this specification section.

B. Potable water shall be used for all field tests in this section.

3.08 ADJUSTING GAC PRESSURE VESSEL SYSTEM

Test Results. If the results of the field tests do not show successful operation of the pressure vessel equipment, then the GAC Adsorption System Manufacturer shall repair, adjust, modify, or replace the equipment until the equipment and systems are operating as required and the tests are successfully completed.

- END OF SECTION -

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SECTION 11416

GAC ADSORPTION SYSTEM MEDIA

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. This specification covers virgin Granular Activated Carbon (GAC) for use as an adsorption media of dissolved organic contaminants in a reuse application. Design/Builder shall be responsible for coordination of all interfaces with GAC Adsorption System Manufacturer, and GAC Media supplier to achieve the required operation.

B. The GAC Media Supplier shall provide all labor, material, and equipment required to furnish, install and place into satisfactory operation, the GAC Media in a total of two pressure vessel GAC Contactors complete and as shown on the drawings and as specified herein. The Contactors are dimensioned as shown on the contract drawings and shall consist of 40,000 (min) pounds of dry GAC Media for each pressure vessel as specified herein.

C. Any material used in treatment of Public Water Supplies, shall meet and demonstrate conformance to all requirements for potable water usage as established by the Virginia Department of Health (VDH). All such products must conform to the requirements of the Safe Drinking Act and American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61.

1.02 RELATED DOCUMENTS

A. Section 01 33 00 – Submittals
B. Section 01 91 14 – Equipment Testing and Facility Startup
C. Section 01 78 23 – Operations and Maintenance Data
D. Section 11415 – GAC Adsorption System

1.03 REFERENCES

A. ANSI – American National Standards Institute.

B NIOSH – National Institute for Occupational Safety and Health.

C. AWWA – American Water Works Association Standards.

1. B100 –Granular Filter Material.
2. B604 – Granular Activated Carbon

D. NSF – Standard 61 – Requirements for GAC Media.

E. ASTM – American Society for Testing and Materials

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1. D4607 - Standard Test Method for Determination of Iodine Number of Activated Carbon
2. D2867 - Standard Test Methods for Moisture in Activated Carbon
3. D2862 - Standard Test Method for Particle Size Distribution of Granular Activated Carbon

F. Quality. All media shall be installed in accordance with manufacturer's instructions and recommendations.

1.04 SUBMITTALS

A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01 33 00.

1. Manufacturer's name, carbon manufacturing location and address, capacity of the manufacturing facility, source of coal, agglomeration/thermal process, and product name and numbers shall be submitted.

2. Manufacturer's standard product data, including Material Safety Data Sheet (MSDS).

3. Bill of material, including volume and lot numbers.

4. Complete description of sufficient detail to permit an item by item comparison with the specifications.

5. Media specifications, including gradation analysis, source of materials, details on the reagglomeration/thermal process, capacity of the manufacturing facility and installation instructions.

6. Data on clean bed headloss and flow rate versus expansion of the media during fluidization backwashing at three different temperatures (5, 15 and 25˚C). This data shall be expressed as a percentage of bed depth versus backwash flow rate (gpm per square foot of contactor surface area).

7. Notarized affidavit of compliance for the media stating GAC furnished is ANSI/NSF 61 certified and complies with applicable provisions of the latest revision of AWWA Standard B604.

8. Valid ISO 9001: 2000 certification for the plant of manufacture for the GAC.

9. Documentation regarding delivery trailer unloading procedures, information on trailer materials used that come in contact with the GAC, that these materials are U.S. Food and Drug Administration approved, and that the trailers are dedicated to the transport of potable grade GAC filter media.

B. Operations and Maintenance Manuals. Submit O&M manuals in accordance with Section 01 78 23 Operations and Maintenance Data of these specifications prior to delivery of the equipment. The O&M Manual shall include but is not limited to the following:

1. Handling instructions.
2. Installation instructions and details of equipment to be used. Photographs of site specific conditions and equipment shall be included.
3. Manufacturer Representative's Certificate of Proper Installation
4. Samples/Material Certification of Granular Activated Carbon

1.05 MATERIAL WARRANTY

A. Carbon shall conform to the specifications herein for a period of thirty days from start-up.

PART 2 – MATERIALS

2.01 ACCEPTABLE MANUFACTURERS

A. GAC media shall be Calgon F400M, or approved equal.

B. The materials covered by this Specification is intended to be a standard product of proven reliability and as manufactured by reputable manufacturers having experience in the production of such products. The materials furnished shall be designed, manufactured, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturer's recommendations. GAC media shall be provided in bulk truck shipments.

C. All GAC supplied under this contract shall be manufactured by the same company, GAC from multiple manufacturers will not be acceptable. GAC media under this Section shall be the product of a firm regularly engaged in supplying this type material.

2.02 GAC MEDIA

A. General. The GAC shall be placed inside the GAC pressure vessels in a uniform manner as stated herein and as shown on the Drawings. The pressure vessels are 12 foot diameter.

B. GAC Product Specifications.

Iodine Number	1000 mg/g (min)
Typical Apparent Density	0.54 g/cc
Typical Backwashed and Drained	0.459 g/cc
Moisture, wt %	2 % (Max)
Effective Size	0.55 – 0.75 mm
Uniformity Coefficient	<1.9
Abrasion No. (ROTAP)	75 (min)

Ash Content	11% (max)
Mesh Size	US Sieve Series 12 x 40
Screen Size (US Sieve), wt%	
On 12 mesh	5% (max)
Through 40 mesh	4%(max)

C. GAC Product Qualifications

1. The GAC shall be virgin quality.
2. The GAC shall be manufactured in the United States of America.
3. GAC shall be a re-agglomerated bituminous coal based product with petroleum or coal based pitch binders sized to a granular form prior to baking and activation. Lignite based GAC, peat, wood, coconut, recycled, used GAC media or broken pellets will not be accepted. Direct activated GAC will not be accepted.
4. GAC shall be thermally activated by steam under rigidly controlled conditions.
5. The GAC must possess superior hardness and abrasion characteristics to withstand repeated backwashes, transfers and handling without significant change in physical size or loss of GAC volume.
6. The GAC shall be capable of removing color, tastes, odors, disinfection by-products, disinfection by-product precursors and other organic contamination from water previously pretreated by conventional water treatment processes.
7. The GAC shall contain no soluble inorganic or organic substances in quantities capable of producing deleterious or injurious effects upon the health of those consuming the water or that would otherwise render the water treated by the GAC unfit for public use. The GAC shall not impart to the water any contaminant that exceeds the maximum limits as defined by the Safe Drinking Water Act Public Law 93-523 or any of its amendments, or NSF 61 standards.

D. GAC Media Testing

1. Sampling shall be performed by the Media Supplier. Sampling shall be in accordance with the latest revision of AWWA B604. The initial testing and reporting of results by the certified independent testing laboratory shall be in accordance with the latest revision of AWWA B604, and results shall be submitted to the Design/Builder for approval prior to shipment. Test results shall include a statement certifying that the material for shipment is equal in quality to the sample submitted. Analyses shall be performed to confirm gradation, effective size, uniformity coefficient, iodine number, ash content, abrasion number, and apparent density. No plus tolerance shall be allowed on uniformity coefficients. The materials testing cost shall be borne by the Design/Builder.

2. Samples after arrival to site. Each of the bulk truckloads of media delivered to site shall be sampled. For media in bulk trucks, a composite sample will be obtained by taking a vertical cross section sample at each access hatch to result

in at least 10 pound gross sample. The gross sample, weighing at least 10 pounds, shall be mixed thoroughly and divided to provide three 1 pound samples, one sample shall be sent to the label for initial testing. All samples shall be sealed in airtight, moisture proof glass containers and delivered as described above. Each sample container shall be labeled to identify it, and the label shall be signed by the sampler. Analyses shall be performed to confirm gradation, effective size, uniformity coefficient, iodine number, ash content, abrasion number, and apparent density. The materials testing cost shall be born by the Design/Builder..

3. Sample test reports shall include raw data, graphical results, computation of the effective size, uniformity coefficient, and other parameters specified in Paragraph 2.02 B, and shall be sent directly from the certified independent laboratory to the Design/Builder.

4. If the GAC does not meet the requirements of this specification or of AWWA B604, a notice of nonconformance will be provided to the Design/Builder within five days after receipt of results from the independent lab. The results of the test shall prevail unless the Design/Builder requests a re-test to the Owner within five (5) working days of the notice. Upon receipt of the request for a retest, the Owner shall forward to the Design/Builder one of the duplicate sealed samples taken. The Design/Builder must notify the Owner within 12 days after receipt of the duplicate sealed sample if Design/Builder retesting reveals that the material complies with specifications. In the event that the retest indicates compliance of the media with the specifications and AWWA B604, then the other sealed sample shall be forwarded, unopened, to a neutral laboratory agreed upon by both parties for analysis. The results of the neutral laboratory analysis shall be accepted as final. The cost of the neutral laboratory analysis shall be paid by the Design/Builder if the neutral laboratory analysis shows that the material does not meet this standard and by the Owner if it does meet this standard.

E. If the material does not meet the requirements specified in this standard, the Design/Builder shall remove it from the plant site when so ordered by the Owner. At the Owner's option, the media may be accepted subject to an agreed price adjustment.

PART 3 -- EXECUTION

3.01 GENERAL

A. Site Verification of Conditions. Verify that GAC pressure vessels and piping and valves have been installed properly to receive GAC filter media. GAC Media shall not be installed until each GAC pressure vessel has passed inspection for watertightness and any and all leaks in connecting piping and valves have been repaired, and have been disinfected.

B. Beginning the installation means the installer accepts that the pressure vessels and piping/valve systems are acceptable for installation

3.02 DELIVERY, STORAGE, AND HANDLING

A. General. The delivery, storage, and handling of the contactor equipment shall be in accordance with Section 11415 and the manufacturer's instructions. Media shall be transported, delivered, and placed in a careful manner to prevent contamination or physical damage to the GAC Media particles.

B. Delivery

1. Media. Shipment shall be made via bulk trailer. All shipping and delivery charges shall be included and be paid by the GAC Media supplier. All deliveries shall be accompanied by a legible bill of lading or other evidence suitable to the Design/Builder, indicating the gross, tare and net weight of shipment, the name of carrier, and other pertinent information. This evidence shall be presented to the Design/Builder before or at the time of delivery.

2. Bulk Shipment: Shipment shall be delivered to the Nansemond Treatment Plant in totally enclosed dry bulk material trailers. Trailers shall be equipped with hatches to permit inspection.

3. Prior to shipment, Design/Builder shall inspect the facilities for unloading to make certain that these facilities will accommodate the type of trucks intended to be used.

4. At the site, water will be added to the bulk contents of the trailers prior to pneumatically pressurizing the tanks for transfer of the GAC. The Design/Builder shall provide all equipment, connections, hoses, piping and adapters necessary to utilize existing plant potable water supply. The GAC is to be transferred in slurry form from the trailer to the GAC Contactors. Supplemental water may be added to the trailer discharge manifold to make the slurry more flowable and less subject to attrition.

5. GAC Media supplier shall furnish compressed air and accessories as required to pneumatically pressurize the tanker for transfer of the GAC to the pressure vessels at the Nansemond Treatment Plant.

C. Handling

1. It shall be the Design/Builder’s responsibility to clean up, to the Owner’s satisfaction, any GAC spills at the site and to repair any damage resulting from the GAC delivery or unloading operations.

2. Handle the GAC Media at all times in a safe manner and as recommended by the manufacturer and AWWA standards. GAC depletes oxygen from air and can be hazardous in a confined situation. Design/Builder shall be responsible for worker’s safety and follow all pertinent local, state and federal guidelines. Any media that becomes contaminated or dirty (i.e. contains more than 0.5% of foreign material by weight) either before or after it has been placed in the GAC Contactors shall be removed and replaced with clean media at no cost to the Owner.

3.03 INSTALLATION

A. Method of Installation

1. The Design/Builder shall provide potable water supply connection for GAC transfer and flushing/rinse water. Design/Builder shall coordinate with Manufacturer to provide all necessary hoses, site glasses, piping, and appurtenances for installing GAC Media into pressure vessel. Hoses shall be carefully positioned to reduce headloss and to provide a smooth hydraulic flow path for GAC transport from the tanker truck to the GAC Contactor(s).

2. GAC Media shall be transferred into GAC Contactor(s) as water slurry only, using air pressure via compressed air system as the motive force. GAC Media supplier shall coordinate for the rental or acquisition of required air compressor for transferring GAC Media. Use of a pump or educator to transfer the GAC Media from the trailer into the GAC Contactor(s) will not be allowed. Bag loading or dry loading of GAC Media into the GAC Contactor(s) is prohibited.

3. Design/Builder shall be responsible for cleanup of all GAC Media and slurry spills that may occur during the GAC transfer operation.

4. GAC Media supplier shall coordinate with the Owner for training of plant staff on GAC Media filling operation procedures during initial installation of virgin GAC media.

5. GAC Media supplier shall deliver GAC Media in manufacturers' bulk trailers used solely for transport of GAC for potable use. GAC will be loaded into the GAC Media supplier's trailers at the supplier's production or storage facility prior to shipment to the project site. Trailers shall be thoroughly cleaned prior to filling with GAC Media and shall be lined or constructed with materials suitable for transporting GAC Media that will be in contact with potable water. Trailer hatches shall bear dated seals affixed by supplier upon loading of GAC Media into trailers, and seals shall be intact and undisturbed upon arrival at the project site. Weight tickets for all GAC Media supplied shall be provided to the Owner for the actual GAC Media delivered. A continuous chain of custody shall be maintained between the manufacturer and the Owner during GAC production, storage, loading, shipment, and installation of GAC Media into GAC Contactor(s).

B. Placing GAC Filter Media

1. Preparation.

a. Cleaning and Testing. Contactor shall be leakage tested, and disinfected prior to media placement. Keep each pressure vessel cell clean throughout installation operations. All equipment used in placing GAC Media shall be cleaned and disinfected in accordance with AWWA C653. All workers shall use boots and gloves which have been disinfected in accordance with AWWA C653.

b. GAC Media shall be installed in GAC Contactors by the GAC Media supplier after the Design/Builder and GAC Adsorption System Manufacturer complete cleaning, testing, and disinfection of GAC Adsorption System and appurtenant piping to the satisfaction of the Design/Builder. In no case shall GAC Media be installed in the GAC

Contactors prior to Design/Builder's acceptance of hydrostatic pressure testing results and bacteriological testing results.

c. Installation and preparation of the GAC Contactor(s) for service shall be in accordance with the latest revision of AWWA B604 unless specifically noted otherwise.

2. Placement

a. Caution in Installing Material. Carefully place GAC Media to avoid damage to the pressure vessel and underdrain system.

b. The pressure vessel shall be filled with water prior to adding GAC Media, as recommended by the GAC Media supplier. The entire contents from the bulk tanker truck shall be directed into a single GAC Contactor.

3. GAC Filter Media Washing.

a. GAC Media shall be completely submerged below the water surface level in the GAC Contactor. The GAC filter bed shall be allowed to soak in a submerged condition for a length of time recommended by the Manufacturer to allow the carbon pores to fill with water.

b. Backwash

(1) After ensuring the GAC Media is completely wetted as recommended by the Manufacturer and approved by the Design/Builder, the filter media shall be backwashed at a reduced rate (< 5 gpm/sq. ft) for a minimum of 5 minutes to remove carbon fines and entrapped air from the filter bed.

(2) After the water is clear of carbon fines, increase the wash rate gradually over a period of at least 10 minutes to achieve media expansion between 30%. The backwash water flow rate may be increased in 5 gpm/sf increments while then holding for approximately 1 minute before increasing another 5 gpm/sf or until the desired bed expansion has been achieved.

4. Once the proper media expansion has been achieved, the bed shall be backwashed for a period of not less than 20 minutes in order to stratify the bed and to wash out fines.

5. Following the backwash at the 30% bed expansion, the backwash water flow rate shall then be reduced by reversing the steps used to reach the maximum backwash water flow rate. When the backwash water has been stopped, the wash water supply valve shall slowly be closed. The backwash rate shall be decreased gradually over a period of 3 minutes to 5 minutes at the end of the backwash cycle. The operational carbon bed height and resulting volume shall then be measured and determined. The volume shall be in compliance with the

proper GAC Media volume as recommended by the GAC Adsorption System and GAC Media Manufacturers.

6. This backwash process will require several separate backwashes, but not less than 2 backwashes at an expansion of not less than 30 percent to ensure the GAC bed is effectively segregated and stratified for operation.

7. Following backwashing, GAC Media shall be added to obtain the GAC filter bed depth specified and recommended by the Manufacturer. The media depth shall be measured after each addition of GAC media until the specified GAC media depth is provided. GAC filters shall not be scraped to remove fines. Care should be taken to avoid overfilling or underfilling the pressure vessel with GAC filter media.

8. The water level in GAC Contactors shall be maintained above the GAC Media level at all times, including when the pressure vessels are removed from service during installation and start-up functions, in order to prevent oxygen adsorption. When exposed to air, wet GAC will rapidly adsorb oxygen and create an oxygen deficient environment. GAC Media shall be covered with water and workers shall follow safety precautions before entering enclosed spaces containing wet activated carbon.

C. Cleaning and Disposal

1. Water for Testing and Backwashing. The Design/Builder shall supply all water for testing from potable water onsite.

2. Disposal. The Design/Builder shall remove from the job site, and if necessary safely dispose of, all excess material and debris as a result of the work completed under this Section, including testing procedures. Dispose of heavily chlorinated water in accordance with AWWA C653-03, Appendix A.

3.04 MANUFACTURER'S SERVICES

A. The manufacturer shall provide a qualified direct employee of the manufacturer to serve as an onsite-representative with at least five years of experience for the complete installation of GAC Media in each GAC Contactor. The qualified service person must be regularly involved in the inspection, installation, start up, troubleshooting, testing, maintenance, and operation of GAC Adsorption Systems and GAC Media installation. The representative shall be present during the initial backwashing of the media in each GAC Contactor.

1. The service person shall:

a. Provide installation training as necessary.

b. Witness and check installation of media.

c. Assist the Design/Builder in conducting field tests and preparing a written report as specified below.

d. Witness and check start-up of the system. Assist with operator training.

B. The services of a qualified manufacturer's technical representative shall shall include the following site visits:

Service	Number of Trips	Number of Days/Trip (not including travel)
Installation and Testing	1	5

C. Installation Supervision: The Design/Builder shall coordinate with the GAC Media supplier to provide supervision or direction during critical phases of installation. Critical phases will include setting of equipment, installation of internals, media installation and other components critical to the successful operation of the system.

D. The GAC Adsorption System Manufacturer shall inspect the installation prior to testing, disinfection, GAC Media installation, and initial start-up.

E. Media Installation: Installation of GAC Media shall be under the direct supervision of an employee of the GAC Adsorption System Manufacturer and the GAC Media supplier experienced in this procedure.

3.05 FIELD QUALITY CONTROL

A. Inspection. Design/Builder shall notify and coordinate with the GAC Media supplier and the GAC Adsorption System Manufacturer in a timely manner in order for them to provide supervision of the GAC Media installation, instruct the Design/Builder on the installation of the controls and equipment, conduct their required inspections, testing, and instruction as required by this specification section.

B. Field Tests. The Design/Builder shall conduct all testing specified herein and recommended by the Manufacturer, and shall furnish all material, instrumentation, temporary pumps, personnel, etc. for conducting tests as specified herein. Potable water shall be used for all field tests in this section.

- END OF SECTION -

SECTION 11500

UV DISINFECTION EQUIPMENT

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Manufacturer shall furnish, test, and place in satisfactory operation a skid-mounted ultraviolet light (UV) disinfection system with all necessary accessories in compliance with the Contract Documents.

B. Only USEPA validated UV disinfection systems shall be accepted.

C. The UV disinfection equipment shall be provided complete with all accessories, special tools, spare parts and other appurtenances as specified and as may be required for a complete and operating installation. The DESIGN/BUILDER shall be responsible for providing mountings, anchor bolts, and other devices required to secure the UV disinfection equipment and appurtenances to support structures.

D. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions.

1.02 RELATED WORK

A. Section 01 33 00 – Submittals

B. Section 01 78 23 – Operation and Maintenance Data

C. Section 01 91 14 – Equipment Testing and Facility Startup

D. Section 05010 – Metal Materials

E. Section 05120 – Structural Steel

F. Section 05500 – Metal Fabrications

G. Section 16100 – Major Equipment Package General Electrical Requirements

H. Section 17126 – Operator Interface Unit – Graphics Standards

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1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Institute of Electrical and Electronic Engineers (IEEE).

1. IEEE 802.3, Ethernet
2. IEEE 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power System.

B. National Institute of Standards and Technology (NIST).

C. National Electrical Manufacturers Association (NEMA).

D. UV Disinfection Guidance Manual (UVDGM).

E. American National Standards Institute (ANSI).

F. Instrument Society of America (ISA).

1.04 SUBMITTALS

A. The following items shall be submitted with the Shop Drawings.

1. The Manufacturer shall submit Working Drawings, which shall consist of the following:

a. Equipment specifications and data sheets, with identification of all materials used and methods of fabrication.

b. Complete assembly, layout, installation and coordinated shop/working drawings, with clearly marked dimensions, tolerances, jointing and anchoring details, and critical clearance requirements, and location of connections to other work.

c. Equipment cross-section drawings.

d. Weights of equipment component parts, assembled weight of equipment, total skid shipping weight, and operating weight.

e. Power and control interconnection diagrams, wiring diagrams, control panel layout and schematics, and overall electrical design for the UV system.

f. Complete conduit and grounding block diagram, wiring and control diagrams, and the overall electrical design of the UV system (both control and power).

g. Panel construction and panel layout drawings with complete dimensions.

h. The Manufacturer shall submit information on the UV lamps being proposed, including, but not limited to: number of lamps, lamp manufacturer, lamp output efficiency as a factor of lamp intensity, lamp aging curve and table indicating percent lamp output (as a function of original lamp output) versus guaranteed lamp lifetime in hours.

i. The Manufacturer shall submit the design and programming of the Control System for the UV system and cleaning system.

j. The Manufacturer shall furnish complete information on all electrical equipment, including but not limited to:

i. Schematic diagrams showing the actual wiring within a complete electrical system or enclosure with wires and terminals numbered and identified.

ii. Interconnection diagrams shall be furnished for the complete UV system. The diagrams shall depict field wiring required between the UV system's components. Each wire and its respective terminal points within the UV disinfection system and within other complete systems and other isolated units or power sources shall also be identified.

iii. Logic diagrams.

2. National Institute of Standards and Technology (NIST) traceable measurements report or equivalent approved by the Engineer on UV intensity sensors. The Manufacturer shall also submit the following information on the UV Intensity Sensors:
    a. Acceptance angle
    b. External dimensions
    c. Working range in mW/cm2
    d. Spectral response
    e. Measurement uncertainty
    f. Environmental requirements
    g. Linearity and temperature stability
    h. Data and calculations showing how the total measurement uncertainty of the sensor is derived from the individual sensor properties.
    i. Sensor certificates verifying National Institute of Standards and Technology (NIST) traceable measurements or equivalent approved by the Engineer.
3. Detailed information, including any available test data, to support the Manufacturer's statements regarding the proposed equipment's ability to handle voltage drops and/or voltage fluctuations/oscillations without interrupting lamp power.
4. Summary and Detailed Validation Test Reports as outlined in the latest version of the UV Disinfection Guidance Manual (UVDGM). The validation report shall include, but not be limited to, the operating ranges, hydraulic conditions over which the validation was performed, a description of the UV dose control strategy, and complete headloss data for all test runs.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The UV disinfection system furnished under this contract shall utilize Low-Pressure amalgam or medium pressure units as manufactured by Trojan Technologies, Wedeco-Xylem Inc., or Calgon Carbon Corporation.

2.02 GENERAL

A. Each of the UV disinfection units provided under this specification shall be of closed vessel design and shall include, but not be limited to: a UV shell, lamps, lamp sleeves, UV intensity sensors, and all related equipment specified needed for a complete installation. The UV disinfection equipment Manufacturer shall determine the unit design, including but not limited to the number of lamps installed in the shell, based on the design operating conditions specified herein.

B. The complete UV disinfection system shall include, but not be limited to: lamp ballasts and assemblies, UVT monitoring, control panel/power supply units, transformers, displays, operator interface terminals, electrical cables from ballasts

to UV lamps, programming of the operator interface needed for a complete and functional installation.

C. The UV disinfection reactors, control/power panels, sensors/monitors, and cleaning system components are to be entirely installed on the same factory assembled and wired equipment skid as the reactors. The equipment skid shall fit entirely within a 14' x 10' footprint.

D. The UV disinfection reactors shall be validated for a four (4) log inactivation of Virus per the UV Disinfection Guidance Manual (2006) at the design flow rate, minimum influent temperature, design UVT, with lamp output adjusted to account for the lamp degradation factor to simulate the end of lamp life condition of a 90% sleeve fouling factor and a 90% lamp aging factor.

E. Each reactor furnished by the Manufacturer shall be validated per the recommendations in the 2006 edition of the UVDGM. The design conditions specified herein shall be covered within the envelope of validated conditions. Extrapolation of test conditions during validation shall not be allowed. At no time under these conditions shall the system fail to achieve the design UV dose.

2.03 WARRANTY AND GUARANTEE

A. All materials furnished shall be guaranteed to be free from defects in design and/or materials for a period of one (1) year following Substantial Completion. The period of such warranties shall start on the date the Performance Testing as indicated in the General Requirements have been completed and Substantial Completion has occurred. Any design and/or material (or part thereof) which is defective or showing undue wear within the correction period or not meeting performance requirements, shall be corrected, repaired or replaced with new material; furnishing all materials, labor, etc., necessary to return to the specified performance level without charge to the Owner. Where defective designs and/or materials have been repaired or replaced, the correction period for such shall be extended in accordance with the General Conditions.

2.04 QUALITY ASSURANCE

A. Component Supply and Compatibility

1. The equipment specified in Specification shall be obtained from a single UV disinfection equipment Manufacturer. The Manufacturer shall be responsible for the integration and compatibility of all equipment components provided under this Specification.

2. All components shall be specifically manufactured for the specified service and shall be integrated into the complete system by the UV disinfection equipment Manufacturer. All such equipment shall be assembled and fitted together at the Manufacturer's facility.

3. All parts and components of the equipment furnished shall be designed and built for interchangeability so that replacement parts may be installed without any additional fitting or machining.

2.05 DEFINITIONS

A. The following definitions of these terms shall be in accordance with USEPA's UV Disinfection Guidance Manual.

1. UV Dose: the energy per unit area incident on a surface, typically in units of mJ/cm2 or J/m2.
2. UV Transmittance (UVT): a measure of the fraction of incident light transmitted through a 1 cm water column. The UVT is the ratio of the light entering the water to that exiting the water.
3. UV Intensity: the power per unit area passing through an area perpendicular to the direction of propagation. UV intensity is used to describe the magnitude of UV light in a UV unit.

2.06 DELIVERIES

A. The Manufacturer shall be responsible for delivering the equipment to the Nansemond Treatment Plant site. Unloading of delivered equipment shall be by the DESIGN/BUILDER.

B. On-site storage, if required, shall be performed according to the Manufacturer's recommendations.

2.07 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

A. UV Equipment

Parameter	**Value**
Number of Reactors	2
Reactor Shape	"L" shape
UV Unit Validated Flow Rate (gpm) per Reactor	350
Virus Inactivation – Log Inactivation	4.0
Influent Water Temperature (°F)	
Min – Max (range)	55 - 90
Influent Turbidity (NTU)	
Min – Max (range)	0.001 – 0.3
UV Transmittance (UVT) at 254 nm (%)	
Design Value	85
Total Hardness (mg/L as $CaCO_3$)	
Min – Max (range)	60 - 100
pH (standard units)	
Min – Max (range)	6.0 – 7.4
Iron – Dissolved (mg/L as Fe)	
Min – Max (range)	0.07 – 0.29
Iron – Total (mg/L as Fe)	
Min – Max (range)	0.09 – 2.12
Manganese – Dissolved (mg/L as Mn)	

Parameter	Value
Min – Max (range)	0.03 – 0.11
Manganese – Total (mg/L as Mn)	
Min – Max (range)	0.03 – 0.11
Total Dissolved Solids (mg/L)	
Min – Max (range)	497 - 929
Note: Water quality parameter ranges provided above are based on Nansemond Water Treatment Plant effluent. Actual water quality at UV reactors will vary due to upstream treatment processes.	

2.08 MATERIALS

A. UV Reactors

1. All wetted metal components shall be 316 stainless steel. All wiring exposed to UV light shall be Teflon coated. All materials exposed to UV light shall be 316 stainless steel, Type 214 quartz, Teflon, Viton, as appropriate or other suitable long-term UV resistant material.
2. The UV units shall be designed so when properly installed and operated there is no possibility of direct operator exposure to UV light.
3. A stainless steel drain port shall be provided.
4. Each reactor shall be furnished with a mechanical cleaning system that can be manually and automatically controlled. The cleaning system shall incorporate a mechanical wiping mechanism that travels along the quartz sleeve to remove foulants. The wiping mechanism shall be as described in 2.03.E.
5. The inlet and outlet ends of the UV unit shall be flanged, with the bolt pattern as required to mate to the upstream and downstream piping. Once connected to the system piping, the flange connections shall be water and light tight. All flange gaskets shall be constructed of EPDM.
6. Each UV unit shall be furnished with a grounding lug suitable for grounding of the UV unit shell by the DESIGN/BUILDER.
7. The UV unit shells shall be rated for a maximum design pressure of 10 bars or 145 psi.

B. Equipment skid

1. Skid shall be constructed of painted mild carbon steel, meeting the requirements of ASTM A36 and be capable of safely supporting and handling the specified equipment.

C. Lamps

1. Lamps shall be low-pressure high-output (LPHO) mercury vapor type or medium pressure.
2. The mercury in LPHO lamps shall be in a solid state (amalgam) while the lamps are off.
3. Lamp housings shall be made of quartz material.

4. Each lamp shall be rated to produce no ozone. Any output below 250 nm shall be prevented by using lamp housings of doped quartz material or other means as recommended by the manufacturer and approved by the Engineer. The manufacturer shall certify that the lamp is rated to produce no ozone.
5. UV output energy of the lamps shall be variable over a minimum range of 60 – 100 percent of rated lamp output. The lamps shall maintain a UV-C output proportional to the variable power settings from the ballast.
6. Maximum cool-down period of UV lamps (prior to restart) shall be 10 minutes in the event of a short-term UV system power failure.
7. The number of lamps and lamp orientation shall be as determined by the Manufacturer. However, the angle of lamp removal shall not exceed a five-degree vertical angle from the horizontal plane on the lamp removal side(s) of the UV unit shell. Lamps shall be protected from contact with the water by Type 214 or synthetic quartz sleeves. Lamps shall be removable from the side of the shell without draining the shell or removing the quartz sleeves.
8. The electrodes and filament of the lamps shall be designed to withstand shock and vibration.
9. The lamp bases shall be constructed of materials resistant to UV light, ozone, and chlorine.
10. The lamp and sleeve assembly design shall allow disconnection of the lamp power cable and removal of the lamp and sleeve from the UV unit to be easily achieved by a plant operator for maintenance purposes.

D. Lamp Sleeves

1. Lamp sleeves shall be provided around each lamp to prevent the lamps and electrical connections from coming in contact with the water being treated.
2. The lamp sleeves shall be rated for a minimum UV transmittance (at 254 nm) of 92%, and shall not be subject to solarization over the duration of its guaranteed life (as defined in paragraph 1.04.A.4).
3. Each lamp sleeve shall be a fabricated one piece, Type 214 or synthetic fully annealed, clear fused quartz circular tubing. No Teflon coating will be allowed.
4. Each lamp shall be enclosed in an individual quartz sleeve with one end closed and the other end sealed, or both ends sealed by a UV resistant lamp end seal and compressed, UV resistant O-rings. The seal on either end of the lamp sleeve shall ensure the following: a) the lamp is isolated from the UV unit frame and all other lamps in the UV unit, and b) the lamp sleeve shall not come in contact with any stainless steel in the UV unit shell.
5. The quartz sleeve shall not come into contact with any metal surface in the UV unit.
6. The quartz sleeve shall be designed such that sleeve removal only occurs during sleeve replacement.
7. The sleeves shall be designed so that one operator can safely change the sleeves.

8. The sleeve and lamp assemble design shall allow the removal of the lamp power cable, the lamp power cable and lamp, or the lamp power cable and entire lamp assemble (including lamp) independent of all other associated equipment.

E. UV Intensity Sensors

1. Each UV unit shall have intensity sensors to measure the germicidal portion of the light emitted by the lamps as measured from 250 to 280 nm. The UV sensors shall meet the requirements of the UVDGM.
2. A minimum of one UV intensity sensor shall be provided per row of lamps for LPHO UV systems.
3. One UV intensity sensor shall be provided per lamp for medium pressure UV systems.
4. The location of sensors in each UV unit shall be as required by the UVDGM.
5. The UV intensity sensors shall provide National Institute of Standards and Technology (NIST), or equivalent as approved by the Engineer, traceable measurements with an uncertainty of +/- 15 percent or less at an 80 percent confidence level.
6. The intensity sensor shall not degrade after prolonged exposure to UV light.
7. The UV intensity sensor shall be removable from the UV unit without draining the unit or removing the sensor well.
8. The UV intensity measured by each active UV monitor shall be continuously transmitted and displayed on the control/power panel.
9. The UV intensity sensor shall have a 316L stainless steel housing with Teflon, Viton or EPDM “O” rings and a quartz window over the monitor site hole, or equivalent components that are resistant to UV light.
10. The intensity sensor shall be unaffected by static, electromagnetic fields, or short wave radio emissions.
11. If the intensity sensor port contains a monitoring window separate from the sensor, specifications of the window material, thickness, and UV transmittance shall be furnished.
12. The intensity sensor in each unit shall be easy to remove and replace with the reference sensor for routine calibration.
13. The linearity of UV unit and reference sensors in the working range must be within five percent.
14. The stability of sensors must be such that sensitivity does not deviate by more than five percent within the specified working temperature range and over a specified operating period of at least 9,000 hours.
15. The acceptance angle of all UV unit intensity sensors and reference sensors must be uniform.

F. Wiping System

1. The mechanical wiping device shall be fully operational without requiring the reactor or lamps to be placed out of service.

2. The wiping mechanism shall consist of a pneumatically or hydraulically driven or electrically actuated ring that passes over each of the quartz sleeves, and shall maintain uniform wiping tension and cleaning over the complete wiping length of the quartz sleeve.
3. The portion of the ring in contact with the quartz sleeve shall not scratch or damage the quartz sleeve or sensor in any way.
4. The cleaning system shall maintain full efficiency throughout its life, with no deterioration in quality of cleaning.
5. The wiping system shall be controlled on the local control panel. The cleaning cycle interval shall be field adjustable by plant operations personnel using the operator interface terminal on the face of the individual UV reactor control/power panel.

G. Ballasts

1. Ballasts shall be provided by the UV disinfection equipment Manufacturer and located in the control/power panels as specified in paragraph 2.11. The Manufacturer shall provide the necessary interconnecting cable required to connect the ballasts to lamps for a fully functioning UV system.
2. The UV control system shall detect lamp failure.
3. Ballasts shall incorporate a filament pre-heat circuit to minimize lamp failure on start up.
4. The ballasts shall include automatic overload protection with automatic reset, or slow blow fuses. Ballasts shall be high power factor/power factor corrected type.
5. The ballasts shall include standard non-proprietary connectors for ease of troubleshooting and replacement of individual ballasts. Designs that require removal of multiple ballasts for service shall not be acceptable.

H. UV Transmittance Monitor:

1. The Manufacturer shall furnish a minimum of one (1) UV transmittance (UVT) spectrophotometer for the entire system suitable for measurement of the transmittance of the UV system influent (GAC Contactor effluent) at a wavelength of 253.7 nm. The unit(s) shall be suitable for continuous on-line measurement. UVT Monitor shall be HACH UVAS sc Probe with sc200 controller and LZX450 flow through cell, or equal.
2. The Manufacturer shall provide a ½″ sample line, ½″ drainage line and with a ½″ needle valve in the sample line for flow adjustment.
3. The UVT monitoring system shall include the sensor, sensor cable, flow through cell and transmitter with integral display. The UVT monitoring system shall be shipped loose and installed by the Design/Builder.
4. Local indication of the transmittance between 70 to 100 percent with an accuracy of ± 1 percent of actual value shall be provided. The UVT reading shall update once every 2 minutes, at a minimum.
5. The UVT monitoring system shall be furnished with analog output that shall be wired to the UV manufacturers control panel. Output characteristics to be field verified and coordinated by Manufacturer.

6. The calibration of UVT monitoring equipment shall be in accordance with the UVT equipment manufacturer's recommendations.

I. UV System Accessories

1. The UV Manufacturer shall provide any and all additional reactor-mounted monitoring equipment or accessories required for a fully functional UV disinfection system.
2. The Design/Builder shall furnish and install separately a combination air valve and a level switch on the reactor or system piping to ensure UV reactor is maintained full of water during operation.

2.09 ELECTRICAL AND CONTROL PANEL REQUIREMENTS

A. The power and control wiring between the UV lamps and ballasts, and between the UV unit manufacturer provided instrumentation and control devices and the manufacturer provided control/power panels shall be assembled and wired to the greatest extent possible from the factory. The UV lamp cable assemblies shall be labeled to designate a specific lamp assembly to specific ballast. The incoming power supply, conduit and field terminations up to the skid mounted junction boxes provided by the manufacturer shall be the responsibility of the DESIGN/BUILDER.

B. Reference specification 16100 for electrical requirements for factory assembled, pre-wired equipment. All electrical equipment shall conform to the requirements of a wet process area.

C. Control/power panel enclosures shall be complete with integral disconnect, overload protection, short circuit protection, ground fault protection, surge protection, and transient protection. Signal interfacing inside and outside the UV disinfection system shall be through terminal blocks. Loose cable connections are not allowed.

D. A transformer panel shall be provided by the manufacturer to step down the incoming 480V service to 120 V, 1 phase for ancillary devices and control voltage (e.g., on-line UV transmittance monitors).

E. Electrical Requirements

Parameter	**Value**
System Rating	480V, 3 phase Wye, 60 Hz

F. The UV reactor, as presented by the equipment to the electrical service as measured at the input to the equipment, shall be a minimum of 0.95 leading and 0.95 lagging per IEEE 519 standards.

2.10 CONTROL SYSTEM

A. System Controls:

1. One main System Control Panel with a programmable logic controller (PLC) shall be provided to control the UV units, manufacturer supplied instrumentation, and external devices as specified herein.

B. PLCs supplied by individual equipment suppliers shall be integrated into the existing Emerson Ovation Plant Distributed Control System (DCS). The manufacturer-supplied PLC shall be furnished and programmed by the manufacturer. The PLC shall continuously monitor and control the associated system and at the same time shall provide all the required alarms, indications of system parameters, equipment status, etc. to the DCS. The following local control panel PLC, OIU, Ethernet switch and uninterruptable power supply (UPS) components shall be provided. No substitutions or exceptions shall be allowed.

1. PLC shall be an Allen Bradley Model 1769 Compact Logix with a minimum L32E processor module or approved equal. The PLC shall utilize Allen Bradley Ethernet driver to communicate to DCS.
    a. Discrete Inputs:
        i. All discrete inputs to equipment and PLCs, from field devices, starters, panels, etc. shall be unpowered (dry) contacts in the field device or equipment, powered from the PLC, unless specified otherwise.
        ii. Sensing power (wetting voltage) supplied by manufacturer-supplied PLCs may be either 24 VDC or 48 VDC. Sensing power may NOT be 120 VAC. Equipment manufacturer shall provide a listing of all discrete inputs from the DCS that require interposing relays.
    b. Discrete Outputs:
        i. All discrete outputs from local control panels or PLCs to field devices, starters, panels, etc. shall be 24 VDC via relay outputs and powered (sourced) from power supplies within the PLC.
        ii. PLC discrete outputs shall energize 24 VDC pilot relay coils in the field devices, starters, panels, etc. which in turn open or close contacts in the associated control circuit. The 24 VDC relay coil, contacts and associated control circuitry shall be furnished integral with the field device, starter, panel, etc. by the supplier and DESIGN/BUILDER furnishing the field device, starter or panel. The 24 VDC pilot relays MAY NOT be located within the PLC enclosure. Equipment manufacturer shall provide a listing of all discrete outputs to the DCS that require interposing relays.
        iii. Where required or specified, discrete outputs from PLC equipment to field device, starters, panels motor operated valves, etc. shall be dry contact or relay outputs.

C. Operator Interface Unit shall be Allen-Bradley PanelView Plus 7 1500 color touch screen with a 15” LCD display. Maple HMI HMI5150 XL touch screen with 15” LCD display, or approved equal.

D. Din rail mounted Cisco IE3000 managed Ethernet switch. No substitutions or exceptions shall be allowed.

E. Uninterruptable Power Supply:

a. UPS by Liebert or APC with 30 minute back up with full load.

b. UPS's shall be true on-line, double conversion type. Each UPS shall be sized to match the maximum power requirements of the associated digital equipment, control panel power supplies and accessories.

c. A status monitoring and control panel shall be provided and shall include the following:

1) Status indicating lights for both normal and abnormal conditions.

2) Individual alarm contacts that shall close upon loss of the AC line, low battery level or UPS failure. Contacts shall be wired to the closest discrete input subsystem. All required interface software and hardware shall be provided.

F. All shared data between the UV PLC and the Ovation DCS system shall be set up in a manner that facilitates read/write access to/from the DCS via the Allen Bradley Protocol. DCS shall be programmed by the Owner to provide layered security access to the manufacturer PLC.

G. The operator interface for control of each individual system shall be performed by a local operator interface unit as specified above or by individual pilot devices on the equipment local control panel, as specified in the associated equipment specification section.

H. The DESIGN/BUILDER, equipment supplier and Owner shall coordinate testing and startup of the equipment provided by the equipment supplier with the plant control system, including but not limited to the following tasks:

I. Provide assistance with control system testing of inputs, outputs, and control strategies as needed.

J. Provide support or interface work necessary to perform physical checkout and field testing to the final field devices. The schedule may require the instrumentation subDesign/Builder and equipment manufacturer personnel to perform loop checks simultaneously, as directed by the Engineer.

K. Coordinate and assist as needed to maintain I/O connectivity throughout the system.

L. Ensure personnel safety while equipment is exercised via the DCS.

M. Ensure that process, instrumentation, and control equipment are not damaged while equipment is exercised via the future control system.

N. Provide temporary modifications to field devices and their terminations, if needed.

O. Providing labor and supervision, which may include, but is not limited to, the following: electricians, instrument technicians, manufacturer's representatives, and individual(s) knowledgeable about process startup and operation.

P. Operation of process equipment for verification of each DCS input and output.

Q. Graphic Displays

1. The graphic displays shall incorporate the detail as shown on the vendor supplied P&ID's along with dynamics and variables available from the vendor supplied instrumentation.

2. Custom graphics shall incorporate, but not be limited to, the following features and functions:
    a. The instrument tag numbers and equipment numbers shall be as assigned by the Owner.
    b. Process lines and equipment shall be color-coded. The color scheme shall be proposed to the Owner for approval.
    c. Process lines shall have directional flow arrows and shall enter and leave the related graphics displays at approximately the same screen location (from display to display).
    d. Process lines shall have a description depicting line origin and destination.
    e. Process lines shall be "targeted" where they enter and leave the graphics page so that the operator can select the target and call up the related graphics display, giving the effect of flowing between displays.
    f. The operator shall have full control and functionality, from the custom graphics display, of any point appearing within the display. This includes, but is not limited to, set point changes, mode changes, controller tuning, alarm set point adjustment and similar point features.
    g. The operator shall be able to acknowledge active alarms from the display.
    h. Schematic displays shall be logically arranged and connected so that the operator can move from display to display by using targets, or selectable points, on the graphics.
    i. The operator shall be able to access the control graphic displays related to the detail graphic system schematic directly from the graphics display.
3. Detailed graphic display development shall incorporate, but not be limited to the features and functions as described in Section 17126.

R. The UV System Control Panel shall constantly regulate the UV lamp output to achieve a operator-entered target UV dose (within the turndown limit of the equipment) based on the flow, UV Transmittance, and UV Intensity measurements for each reactor.

S. At a minimum, the UV System Control Panel shall monitor the following.
1. UV intensity sensors for each reactor
2. Status of each UV unit (On/Off/Fault)
3. Status of each UV wiper (On/Active/Fault)
4. Status of each UV lamp (On/Off/Fault)
5. Lamp age (hours) for each lamp
6. UV Transmittance

T. At a minimum, the UV System Control Panel shall monitor the following equipment associated with the UV treatment system that will be furnished by the DESIGN/BUILDER.
1. UV Reactor Flow – Each reactor
2. UV Influent Isolation Valves (Open/Close) – One (1) valve per reactor

3. UV Effluent Isolation/Flow Control Valves (Modulating) – One (1) valve per reactor
    a. The UV unit control/power panel shall adjust the position of the UV Effluent Flow Control valves to provide equal distribution of flow between the reactors.

U. At a minimum, the UV System Control Panel shall include the following alarms
1. Low UV intensity (adjustable)
2. Individual lamp fault
3. Low UV transmittance (adjustable, initially set at 85%)
4. Wiper Fault
5. Low UV Dose

V. At a minimum, the UV System Control Panel shall include the following controls.
1. UV unit on/off control
2. UV unit reset control
3. UV unit local/remote control

W. All monitoring and alarms shall be indicated by specific address. The address shall specify the UV unit and lamp as appropriate.

X. Sufficient deadband (adjustable) shall be provided in the PLC algorithm to ensure that a UV Unit does not go into an alarm condition on momentary signal surges.

2.11 SPARE PARTS

A. Spare parts shall be identical and interchangeable with original parts.

B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. Spare parts shall be delivered at the same time as the equipment to which they pertain.

D. Spare parts shall include the following:

Two (2) lamps
Two (2) sleeves
Two (2) sets of O-rings and seals
Two (2) wiper service kits
Two (2) fuses of each size provided

2.12 SHOP TESTING

A. The UV disinfection reactors supplied under this contract shall be shop hydrostatic tested with the sleeves installed without the lamps. The unit shall be pressurized with water to 1.3 times the maximum design pressure and will be held at that

condition for 2 hours. Inspect the unit for visible signs of leakage. No leakage should be visible over the test period. The UV unit shall be inspected by the Manufacturer for visible signs of leakage. If leakage is observed, correct the condition to the satisfaction of the Engineer and re-test.

B. Prior to installation in the field, the Manufacturer shall perform functional testing at the factory for each of the new reactor/control panel combinations furnished under this specification.

1. Functional testing shall be performed on a completely assembled UV unit including local control panels utilizing all the same components as shall be assembled in the field for that unit.

2. Operate the unit flooded with water at a nominal flow rate as required for proper cooling. Operate unit continuously for 4 hours. Operate the unit throughout the range of lamp settings (on/off and output level). Simulate changes in input signals to the control/power panel for UVT and UV sensor readings to verify unit response.

3. Confirm the automatic and manual operation of the following:

   a. UV lamps, UV intensity sensor, and lamp wiper

   b. Operating sequence and control logic for the unit

   c. Simulate all alarm conditions.

PART 3 – EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The Manufacturer shall arrange for the services of a qualified Technical Representative who is regularly involved in the inspection, installation, start-up, troubleshooting, testing, maintenance, and operation of the specified equipment. The Manufacturer shall include the cost of these services in their bid price. Unless otherwise authorized by the Engineer, the Manufacturer's representative shall be a direct employee of the Manufacturer, with at least three (3) years of experience in the installation, testing and start-up of equipment of the type provided under this Specification.

B. The manufacturer's Technical Representative shall provide the following services.

1. Installation: The Technical Representative shall inspect the installed equipment to verify that installation is in accordance with the manufacturer's requirements, and shall supervise the installation of the equipment as required.

2. Testing: After installation of the equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the Technical Representative shall inspect, operate, test, and adjust the equipment as required to prove that the equipment is in proper condition for satisfactory operation under the conditions specified. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for startup and that nothing in the installation will render the manufacturer's warranty null and void. The report shall include date of final acceptance field test, as well as a listing of all persons present during tests.

3. Startup: The Technical Representative shall start up the equipment for actual service with the help of the DESIGN/BUILDER. In the event that equipment or installation problems are experienced, the Manufacturer and the representative shall provide the necessary services until the equipment is operating satisfactorily and performing according to the specifications at no additional cost to the DESIGN/BUILDER or the Owner. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.

4. Training: The Technical Representative shall instruct the Owner's operating personnel in correct operation and maintenance procedures. The instruction shall demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment. Such instruction shall be scheduled at a time arranged with the Owner at least 1 week in advance of the training and shall be provided while the respective Technical Representative's equipment is fully operational. The Manufacturer shall have submitted the O&M Manuals prior to commencement of training. Training shall be provided to the Owner's personnel between the hours of 8:00 A.M. and 5:00 P.M. as necessary.

C. The services of the Manufacturer's technical representative shall include the following site visits:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	3
Startup	1	3
Training	1	1

D. The times specified are exclusive of travel time to and from the facility. Startup and training shall be coordinated with the Owner, and the Owner shall have final approval authority for the scheduled date(s).

E. Any additional time required to achieve successful installation and operation shall be at the Manufacturer's expense. The Manufacturer's services shall be provided until such time as the equipment and system have been finally accepted. The Manufacturer's representative shall sign in and sign out at the DESIGN/BUILDER's office each day he/she is at the project site.

F. A written report covering the representative's findings and installation approval shall be mailed directly to the DESIGN/BUILDER. The report shall cover all inspections and shall outline in detail any deficiencies noted and corrective measures taken or recommended.

3.02 FIELD PERFORMANCE TESTING

A. Before the beginning of the performance test period, an electronic copy of complete Operation and Maintenance manuals shall be submitted. The manuals shall include documentation of all programming and instructions for adjusting all adjustable control set points. Operating and troubleshooting instructions covering all of the process equipment, controls, and instruments shall be furnished. These instructions

shall cover the operation, lubrication, cleaning and maintenance of all equipment, and shall include Manufacturer's bulletins covering equipment and control devices.

B. Upon final installation the UV system shall undergo a performance test and be operated throughout the range of design conditions to assess the mechanical operation and process performance of the UV disinfection system as a whole. At a minimum, performance testing shall include the following:

1. Operation of each UV unit in automatic mode.
2. Observation of operation, including periods of off-specification operation, due to power quality problems, and other alarm conditions.
3. Verification of UV intensity sensor operation.

C. During the performance test, the equipment shall be operated for at least six (6) consecutive hours. No major changes in equipment or apparatus will be permitted during this period. However, minor adjustments of equipment that would normally be expected during regular operation of the equipment may be made.

D. The DESIGN/BUILDER will furnish all utilities and operating personnel necessary to perform the performance tests.

E. Upon completion of the performance tests, the Manufacturer shall submit a written report to the DESIGN/BUILDER containing the test results.

F. Upon approval of the acceptance test results, the Manufacturer shall submit both a hard copy and electronic copy of the final control and alarm settings, I/O schedules, etc.

3.03 PAINTING

A. Coating of ferrous metal surfaces

1. Prime coating – apply one coat epoxy polyamide primer to a dry film thickness of 4 – 6 mils. Second coating – apply one coat epoxy polyamide to a dry film thickness of 4 – 6 mils. Finish coating – apply one coat aliphatic polyurethane to a dry film thickness of 3 – 5 mils.
2. All ferrous metal surfaces, except stainless steel, shall be shop cleaned by sandblasting or equivalent, conforming to the paint Manufacturer's recommendation. All mill scale, rust, and contaminants shall be removed before shop primer is applied.
3. The total paint system shall be the product of and be applied in accordance with the recommendations of one manufacturer.
4. Repaint or refinish all damaged surfaces prior to acceptance of equipment. OSS shall provide DESIGN/BUILDER with one pint of paint of all types of coating materials used in new sealed containers, for each color used by the OSS for this job.

3.04 EQUIPMENT IDENTIFICATION

A. Each UV disinfection reactor and reactor control/power panel shall be provided with a substantial stainless steel nameplate, securely fastened in a conspicuous place

and clearly inscribed with the Manufacturer's name, year of manufacture, serial number, principal rating data, and tag number.

- - END OF SECTION - -

SECTION 11501

CHEMICAL INJECTION ASSEMBLIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Design/Builder shall furnish and install chemical injector assemblies as shown on the Drawings and/or as specified herein.

B. Each injector assembly shall be specifically designed for the particular chemical service for which it is being supplied. The materials of construction for the injector assemblies shall be compatible with the chemicals being fed.

C. Equipment shall be provided in accordance with Section 11000, Equipment General Provision, and Division 15.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

A. Chemical Injection Assemblies

Service	**Filter-Aid Polymer**	**Sodium Hypochlorite**	**Sodium Bisulfite**
No. of Assemblies	1	1	1
Type of Feed Device	Injector	Injector	Injector
Maximum Solution Concentration	1%	15%	38%
Solution Pipe Diameter, in	1/2	1/2	1/2
Solution Pipe Material	PVC	PVC	PVC
Maximum Feed Rate of Solution, gph	15	4	1
Max Solution Pressure, psi	75	60	60
Receiving Pipe Diameter, in	10	10	10
Receiving Pipe Material	DI or Steel	DI or Steel	DI or Steel
Max Receiving Pipe Pressure, psi	150	150	150
Max Receiving Pipe Velocity, fps	5	5	5
Application Point	Filter Influent	Filter Backwash Supply	Ozone Contactor Effluent

1.03 SUBMITTALS

A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to, the submittal requirements specified in Section 01 33 00, Submittal Procedures, and Section 11000, Equipment, General Provisions:

1. Equipment specifications and data sheets, with identification of all materials of construction.

2. Complete assembly, layout, installation and shop drawings, with clearly marked dimensions, tolerances, jointing and anchoring details.

3. Equipment cross-section drawings.

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4. Weights of equipment component parts.

5. Chemical resistance data for wetted parts

PART 2 -- PRODUCTS

2.01 GENERAL

A. The chemical injection assemblies shall be Saf-T-Flo retractable injection quills as manufactured by Martin Special Products Company, Inc, or equal.

2.02 CONSTRUCTION AND MATERIALS

A. Each injector assembly shall be specifically designed for the particular chemical service and the receiving pipe for which it is being supplied. The materials of construction for the assemblies shall be compatible with the chemicals being fed and receiving pipes, and the assemblies shall be suitable for the pressure in the chemical solution line and receiving pipe, the maximum velocity in the receiving pipe, and the insertion length. All equipment in the fluid path shall be manufactured of NSF 61-approved components.

B. The injector assemblies shall be furnished with a brass corporation stop, self-sealing coupling, PVC solution tube assembly including ball check valve, self-sealing poppet valve, elastomeric check valve to prevent clogging of the tip of the solution tube, locking device, and safety chain. The locking device shall connect the solution tube to the corporation stop on the receiving pipe to prevent accidental withdrawal of the solution tube. The stainless steel safety chain shall prevent the solution tube from being withdrawn past the corporation stop. Safety chain length shall be determined by the manufacturer of the equipment.

C. The assemblies shall be sized to match the pump discharge line or injection flow rate and shall be of the same diameter as the solution piping. The injector assembly solution tubes shall penetrate into the pipe a distance equivalent to 1/3 to 1/2 of the pipe diameter into which the chemicals are being injected.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. The Design/Builder shall furnish the chemical injectors and all associated equipment and accessories as required and specified herein in accordance with the manufacturer's instructions and in accordance with Section 11000, Equipment General Provision.

B. Mounting racks shall be provided for chemical feed piping, valves, and appurtenances as shown on the Drawings and/or as specified herein. The racks shall be constructed of fiberglass channel members, and shall allow valves and appurtenances to be mounted such that they are readily accessible by plant operations personnel for operation and maintenance. The mounting racks shall be as specified in Section 15020, Pipe Supports.

- END OF SECTION -

SECTION 11511

LIQUID POLYMER PREPARATION SYSTEMS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The Design/Builder shall furnish, install, test, and place in acceptable operation complete liquid polymer preparation systems complete with neat polymer pumps, polymer mixing chambers, all necessary piping, valves, fittings, supports, electrical controls, and all necessary accessories, as specified herein and as indicated on the Drawings.

B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions, and Division 15.

C. Before submitting shop drawings, the Design/Builder shall verify spatial requirements to ensure that the equipment supplied will fit in the space allotted on the Drawings.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

A. Polymer Preparation Systems for Flocculation-Aid Polymer

Number of Skid-Mounted Systems	3
Type of Neat Polymer Feed Pump	Diaphragm or Peristaltic
SWIFT Demonstration Facility Flow Rate, mgd	0.63 to each Rapid Mix Basin
Polymer Dose, Avg and Max, mg/L	0.75, 2.0
Maximum Neat Polymer Feed Rate, gph	0.05
Polymer Solution Concentration, %	0.1 – 1.0
Maximum Dilution Water Flow Rate, gph	60
Polymer Mixer Motor, HP	0.5
Power Requirement	120V, 1 ph, 60 Hz, 20 Amp
Signal Connection	4-20 mA
Polymer Pump Connection Size, in	1/2
Dilution Water Connection Size, in	1/2
Dilution Water Minimum Pressure, psi	40
Solution Connection Size, in	1/2

B. Polymer Preparation Systems for Filter-Aid Polymer

Number of Skid-Mounted Systems	2
Type of Feed Pump	Diaphragm or Peristaltic
SWIFT Demonstration Facility Flow Rate, mgd	1.3
Polymer Dose, Avg and Max, mg/L	0.1, 0.3

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Maximum Neat Polymer Feed Rate, gph	0.015
Polymer Solution Concentration, %	0.1 – 1.0
Maximum Dilution Water Flow Rate, gph	15
Polymer Mixer Motor, HP	0.5
Power Requirement	120V, 1 ph, 60 Hz, 20 Amp
Signal Connection	4-20 mA
Polymer Pump Connection Size, in	1/2
Dilution Water Connection Size, in	1/2
Dilution Water Minimum Pressure, psi	40
Solution Connection Size, in	1/2

1.03 SUBMITTALS

A. Shop Drawings shall be submitted in accordance with Section 01 33 00, Submittal Procedures and Section 11000, Equipment, General Provisions.

1.04 WARRANTY AND GUARANTEE

A. Warranty and Guarantee shall be as specified in Section 11000.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The liquid polymer preparation system shall be UGSI Chemical Feed PolyBlend Polymer Feed Systems, ProMinent Fluid Controls ProMix S/C Polymer Blending Systems, or equal.

B. The materials covered by these Specifications are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturer's recommendations.

C. The liquid polymer feed system manufacturer shall specialize in manufacture, assembly, and field service of liquid polymer feed systems with a minimum of ten years' experience. The manufacturer shall have at least ten (10) U.S. installations of the type and approximate size being proposed, each with a minimum of five (5) years of satisfactory service.

2.02 GENERAL REQUIREMENTS

A. The polymer systems shall be automatic liquid polymer preparation systems each to include mixing chamber, dilution water rotameter and control valve, neat polymer metering pump, dilution water solenoid valve, polymer check valve, pressure switch for loss of water flow, calibration column, equipment skid, and control panel, as described herein and shown on the Drawings. All equipment in the fluid path shall be manufactured of NSF 61-approved components.

B. The liquid polymer preparation systems together with all necessary piping, valves, elevated platforms and appurtenances shall be skid mounted. The liquid polymer preparation system frame shall be of rugged 304 stainless steel construction. The skid and frame assembly shall be constructed of 3/16" angle or structural stainless steel tubing. The back plate supporting the control panel shall be a minimum 12-gauge thickness. Vertical frame members shall be gusseted to the base. Alternately, the structural frame shall be polypropylene/polyethylene construction. The skid shall be designed for fork-lifting and shall have holes for mounting to concrete pad. All pipe supports shall be stainless steel. Piping and valves shall be mounted with rigid pipe clamps.

C. All piping of the liquid polymer feed system shall be constructed of Schedule 80 PVC, in compliance with Section 15008, unless otherwise specified or shown on the Drawings.

2.03 MIXING CHAMBER

A. Polymer and water shall be mixed in an activation chamber designed to create sufficient mixing energy. This design shall include a motor driven impeller that will create high fluid shear. The solution shall undergo a tapered mixing intensity slope as it exits the initial shear zone and passes through a second and third zone, isolated by baffles. The polymer activation efficiency shall be consistent over the dilution water range.

B. The mixing chamber shall be constructed of PVC and acrylic. The mixing chamber shall have a rated pressure of at least 125 psi.

C. The impeller shall be driven by a 1/2 HP, 120 VAC washdown duty motor. Motor shall be TEFC. The motor shall conform to the applicable requirements of Section 15170 – Low Voltage Electric Motors. The impeller speed shall be 1725 rpm. The motor shall be direct-coupled to the impeller shaft and provided with VFD control to vary mixing energy, if required by the manufacturer's design.

D. In order to quantify the mixing intensity in the mix chamber, the applied horsepower shall be defined by measuring the difference in torque when the mix chamber is empty versus being full of water. This value shall be the basis of determining the mixing intensity defined as "G" value. The G-value in the high shear mixing zone shall exceed 4,600 sec^{-1} to effectively disperse polymer gels to prevent fisheye formation. The G-value in the low shear mixing zone shall be lowered to 1,200 sec^{-1} to prevent damaging polymer chain.

E. The liquid polymer feed system shall be supplied with a neat polymer injection valve designed to isolate the neat polymer from the dilution water upstream of the mixing chamber. The valve shall be designed with an open, unobstructed path to the valve seat. Valve construction shall be PVC, stainless steel, and Viton. The valve shall be readily accessible for cleaning and maintenance. The check valve shall not be installed within the mixing chamber assembly or require mixing chamber disassembly for maintenance and servicing.

2.04 DILUTION WATER ASSEMBLY

A. A FNPT 304 stainless steel dilution water inlet connection shall be provided.

B. The dilution water flow rate shall be monitored by a rotameter type flow meter with unions provided at the inlet and outlet connections to allow easy removal for cleaning. A manual flow control valve shall be provided.

C. Unit shall have an electric solenoid valve with NEMA 4X rated coil for on/off control of dilution water flow.

D. A calorimetric or differential pressure flow switch shall be provided and mounted in the dilution water line. The switch shall be rated NEMA 4X.

E. A 2-1/2" stainless steel liquid filled pressure gauge shall be provided to monitor dilution water inlet pressure.

2.05 NEAT POLYMER FEED PUMP

A. Pump shall be either positive displacement diaphragm type or peristaltic.

1. Diaphragm type pumps shall be microprocessor controlled solenoid driven diaphragm metering pump. Pump liquid end shall be high viscosity type with spring loaded check valves. Polymer pump head shall be fabricated of clear acrylic and shall have a priming port. All pump functions shall be accessible via an illuminated LCD screen and a membrane style keypad. The pump shall be programmable so that the stroking speeds can be modified to accommodate various polymer viscosities. Polymer pump shall accept a 4-20mA signal for speed control. Pump will also accept a 0-10 VDC or pulse input for speed control. The pump shall be equipped with a fault annunciating relay which will be monitored by the system controller. The pump shall supply a Pump Running feedback signal which will be monitored by the system controller. Power supply shall be 115 VAC, 60 Hz, 1 Ph.

2. Peristaltic pumps shall have an internal diameter of the pump tubing of 5.0 or 8.0 mm. Pump monitor shall stop unit in the event of pumping tube breaks, empty chemical supply or other polymer supply interruptions. Pump shall accept a 4-20mA signal for speed control. Pump shall also accept a 0-10 VDC or pulse input for speed control. Pump shall have a built in tube failure detection system that senses chemical in the pump head, shuts off the pump and activates a 1 amp alarm relay (dry contact closure). Power supply shall be 115 VAC, 60 Hz, 1 Ph.

3. The system shall have the provision to mount the neat polymer pump in either a flooded suction or suction lift configuration depending on the application requirements.

B. A poppet-type check valve shall be installed in the pump discharge line to disperse liquid polymer into the mixing chamber.

C. One calibration column shall be supplied in the suction piping to calibrate metering pump, and pump discharge line shall be provided with a pressure relief valve.

D. Isolation valves shall be included on metering pump suction and discharge for maintenance.

E. A pressure gauge shall be installed in the pump discharge piping as specified in Division 17. Each gauge shall have a range of zero to 100 psi. Each gauge shall be provided with a diaphragm seal as specified in Division 17 constructed of materials which are completely resistant to corrosion by the chemicals referred to in this section. Each pressure gauge shall also be provided with an isolation valve.

2.06 SOLUTION DISCHARGE ASSEMBLY

A. A 304 stainless steel solution discharge connection shall be provided.

B. A pressure gauge shall be provided to monitor system discharge pressure as specified in Division 17. Each gauge shall have a range of zero to 100 psi. Each gauge shall be provided with a diaphragm seal as specified in Division 17 constructed of materials which are completely resistant to corrosion by the chemicals referred to in this section. Each pressure gauge shall also be provided with an isolation valve.

C. A check valve of PVC construction with union shall be furnished by the manufacturer to prevent backflow of polymer solution or process water, etc. into the mixing chamber or dilution water piping. The valve shall be shipped loose for installation by the Design/Builder.

2.07 ELECTRICAL AND CONTROL REQUIREMENTS

A. A control panel integral to the system's frame shall be provided. The enclosure shall be rated NEMA 4X and constructed of FRP or polycarbonate. The control panel shall consist of all digital displays, potentiometers, switches, lights, relays, and other control devices required for a complete operable system. The control panel and all components shall be industrial duty. All skid mounted electrical components interconnected to the control panel shall terminate at numbered and labeled terminal blocks. The terminal blocks shall be sized for 14 ga. wire. Wires shall be neatly run through wire race-way and numbered with adhesive type labels. The control panel shall be built and labeled according to UL 508A standards. Systems without a UL labeled panel will not be acceptable.

B. The system shall be controlled through an ON-OFF-REMOTE circuit controlled by a three-position switch and a two position switch that will determine the source (Local or Remote) for the controlling 4-20mA signal. The controls shall include a menu driven LCD display to allow for custom configuration of the system.

1. When the On-Off-Remote switch is in the Remote switch position, the unit shall accept a run signal. Unit is manually controlled in the On position.

2. The system shall accept a 4-20 mA analog signal to pace the polymer metering pump.

3. The unit shall provide hand or remote status indication via dry contact output.

4. The unit shall provide a running status indication via dry contact output.

5. A dilution water flow sensor shall detect the loss of water flow, and the unit shall provide a loss of water flow alarm via dry contact output. Upon sensing that water flow has been interrupted for any reason, the controller will place the polymer pump and mix chamber on standby and will restart it automatically when flow is restored.

6. The systems shall incorporate automatic chamber flush controls that will be initiated upon system shut down. Timing for flush and the ability to disable the flush cycle shall be part of the custom programming options. The system shall also allow the ability to manually initiate a chamber flush cycle.

7. The controller shall offer the ability to adjust the following control parameters:

   a. Chamber water fill time

   b. Chamber water flush time

   c. Wait for dilution water flow time

   d. Calibration and scaling of the incoming control 4-20mA signal

   e. Calibration of the outgoing 4-20mA signal

   f. Fail state due to the loss of the incoming control 4-20mA signal

C. Voltage shall be 120 VAC, single phase, 60 Hz, 20 amps.

PART 3 – EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following site visits:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	2	1
Startup and Training	1	1

3.02 INSTALLATION

A. The Design/Builder shall furnish and install the polymer system and all associated equipment and accessories as required and specified herein in accordance with manufacturer's instructions and in accordance with Section 11000, Equipment General Provisions.

B. All metallic fasteners, brackets, mounting hardware, and accessories located in the storage and feed areas shall be constructed of materials completely resistant to the specified chemicals.

3.03 TESTING, CLEANING, AND START-UP

A. All systems shall be shop tested for capacity at rated pressure prior to shipment, with documented results provided.

B. Field testing shall be in accordance with the requirements of Section 11000, Equipment General Provision. In addition, the following tests shall be performed:

   1. After all equipment is installed and to satisfy the Equipment Performance Testing requirement, it is required that a witness testing of the pump by the Owner and Engineer be conducted to insure that the pumping equipment conforms to the

specified section.

2. Should the performance not meet the standards as set in the specifications, corrective measures to meet these standards will be made by the Manufacturer which may include replacement of the units.

3. During the Facility Performance Demonstration Period, the systems will perform according to specifications without any excessive vibrations, noise or overheating.

C. The Design/Builder shall demonstrate to the Engineer that the completed systems meet the functional requirements intended and that all components of the system are properly calibrated.

D. After installation of piping and accessories but before connection of piping to the polymer tanks, the Design/Builder shall completely flush the system to clean and remove all foreign matter from the piping system.

E. The Design/Builder shall check the functioning of all pump accessories, valves, and feed points, and instrumentation and controls, and shall repair or replace all malfunctioning or unsatisfactory components. The Design/Builder shall repair all leaking joints and malfunctioning or unsatisfactory components identified during testing, start-up, and through the guarantee period.

3.04 SPECIAL TOOLS AND SPARE PARTS

A. The Design/Builders hall furnish all special tools necessary to disassemble, service, repair and adjust the equipment.

B. The Design/Builder shall furnish the following spare parts. All of these materials shall be properly packed, labeled, and stored where directed by the Owner.

1. Mixing chamber o-rings for each system

2. Spare polymer check valve for each system type

3.05 EQUIPMENT IDENTIFICATION

A. The equipment shall be provided with a substantial stainless steel nameplate, securely fastened in a conspicuous place and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.

- END OF SECTION -

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SECTION 11520

CHEMICAL TANK SCALES

PART I -- GENERAL

1.01 THE REQUIREMENT

A. The Design/Builder shall furnish, install, test, and place in acceptable operation chemical tank scales for chemical drums and totes, complete with all mechanical equipment, indicator/transmitters, and all necessary accessories as specified herein, as shown on the Drawings, and as required for a complete and operable system.

B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions.

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

A. Chemical tank scales shall be suitable for use in the chemical service specified herein. The Design/Builder is responsible for the coordination and selection of corrosion resistant materials for the chemical solutions specified herein and shall guarantee the suitability of the materials used in manufacturing the equipment.

B. Chemical Properties

Chemical	Ammonium Sulfate	Sodium Bisulfite	Polymer	Phosphoric Acid
Concentration	40%	38%	100%	75%
Specific Gravity	1.28	1.30	1.05	1.575
pH	3-5	4-5	8	1

C. Performance Requirements

Chemical	Ammonium Sulfate	Sodium Bisulfite	Polymer	Phosphoric Acid
No. of Scales	2	2	2 Floc-Aid 2 Filter-Aid	1
Type of Scale	IBC Tote	IBC Tote	Drum	Drum
Tank Volume	330 gal	330 gal	55 gal	55 gal
Tank Dims	40” x 48”	40” x 48”	24” dia	24” dia
Platform Dims	54” x 54”	54” x 54”	28” x 28”	28” x 28”
Capacity	5,000 lb	5,000 lb	800 lb	800 lb
No. of Indicators	1	1	1	1
Platform Mat’l	Steel with Chemical- and Impact-Resistant Coating			

1.03 SUBMITTALS

A. The Design/Builder shall submit complete Shop Drawings, Operation and Maintenance Instructions and other information as specified in accordance with Section 11000, Equipment General Provisions and Section 01 33 00, Submittal Procedures.

B. The Design/Builder shall be responsible for coordinating all interfaces with related mechanical, structural, electrical and instrumentation and control work. The Design/Builder shall be responsible for providing all accessory equipment and all work associated with installation of the equipment.

1.04 RESPONSIBILITIES AND GUARANTEE

A. Warranty and Guarantee shall be as specified in Section 11000

PART 2 -- EQUIPMENT

2.01 MANUFACTURERS

A. The materials covered by these Specifications are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturer's recommendations.

B. The chemical tank scales shall be Tote Bin Scales and Drumm Scales with electronic SOLO G2 Indicators as manufactured by Force Flow, or equal.

2.02 CHEMICAL TOTE BIN SCALES

A. Chemical tote (IBC Type) scale shall be provided as indicated in Section 1.02 and shall be of the digital readout/electronic load cell type. Scale platform shall be sized to accept a 40” by 48” tote. The low profile platform shall be a maximum height of 3 inches and include an adjustable backstop to accommodate easy loading and unloading of chemical tote bins. Platform scale shall be manufactured of steel and provided with 80-mil thick coating resistant to chemicals, abrasion, and impact.

B. Scale shall be of the single load cell design. Weight shall be transferred via a pivoted platform to a single, NTEP approved load cell of the shear beam strain gauge type. Flexible cable shall connect load cell to indicator to allow easy remote installation of the readout. Cable length shall be 20 feet.

2.03 CHEMICAL DRUM SCALES

A. Chemical drum scales shall be provided as indicated in Section 1.02 and shall be of the digital readout/electronic load cell type. Scale platform shall be sized to accept an 18" to 24" diameter drum. The low profile platform shall be a maximum height of 2 inches to accommodate easy loading and unloading of chemical drums. Platform scale shall be manufactured of steel and provided with 80-mil thick coating resistant to chemicals, abrasion, and impact.

B. Scale shall be of the single load cell design. Weight shall be transferred via a pivoted platform to a single, NTEP approved load cell of the shear beam strain gauge type. Flexible cable shall connect load cell to indicator to allow easy remote installation of the readout. Cable length shall be 20 ft.

2.03 SCALE INDICATOR/TRANSMITTERS

A. Each scale shall be provided with an individual or shared indicator/transmitter. Indicator shall monitor one or two channels, as indicated in Section 1.02. The remote mounted LCD indicator shall carry CE marking and shall be housed in a NEMA 4X, UL approved enclosure. All operations shall be keypad operated & menu driven in order to avoid compromising the NEMA 4X seal at any time. The alphanumeric LCD readout shall have backlighting for readability in low light conditions. Power requirement shall be 110 VAC.

B. A 6 digit numerical display shall give operator the ability to monitor chemical by weight or volume. A bar graph display shall read 0-100% for the net contents. A dual mode TARE key shall allow user to enter the tare weight of the vessel or enter the net weight of the chemical depending on application needs. A diagnostics menu shall allow recalibration without the need to apply field test weights. A user adjustable filter function shall stabilize display in the event of vibration from pumps or mixers in the immediate vicinity of the scale.

C. Indicator shall output net weight via a 4-20mA signal and full scale output shall be user adjustable via the keypad. Indicator shall have four adjustable set points to display low or high level conditions on the indicator.

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following site visits:

Service	**Number of Trips**	**Number of Days/Trip**
Installation and Testing	1	1
Startup and Training	1	1

3.02 INSTALLATION

A. The Design/Builder shall install the chemical tank scales in accordance with the manufacturer's instructions, the approved shop drawings, and Section 11000 - Equipment-General.

B. Equipment shall be installed on a concrete pad, unless otherwise shown on the Drawings. The concrete pad shall be finished smooth and level. The Design/Builder shall anchor the equipment to the pad with expansion bolts suitable for the chemical environment. All piping, valves, fittings, conduit, wiring, etc. required to interconnect system components shall be furnished and installed by the Design/Builder.

3.03 TESTING AND START-UP

A. Testing of the equipment shall be as specified herein, and in accordance with Section 11000 - Equipment-General.

B. The system supplier and Design/Builder shall demonstrate that the chemical tank scales meet the functional requirements intended and that all components of the system are properly adjusted and calibrated and operate reliably.

C. The Design/Builder shall check the functioning of all system components and shall repair or replace all malfunctioning or unsatisfactory components identified during testing, start-up, and through the warranty period.

3.04 PAINTING

A. All surface preparation, shop painting, field repairs, field painting and other pertinent detailed painting specifications shall conform to applicable sections of Section 09900 - Painting.

3.05 TOOLS, SUPPLIES AND SPARE PARTS

A. The Design/Builder shall furnish all special tools necessary to disassemble, service, repair and adjust the equipment.

3.06 EQUIPMENT IDENTIFICATION

A. The equipment shall be provided with a substantial stainless steel nameplate, securely fastened in a conspicuous place and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.

- END OF SECTION -

SECTION 11550

POSITIVE DISPLACEMENT BLOWER PACKAGES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Manufacturer shall furnish, test, adjust, and place in satisfactory operation positive displacement blower systems for installation indoors in acoustical enclosures complete with all accessories including motors, steel bases, inlet filters, inlet silencers, discharge silencers, relief valves, check valves, flexible connectors, V-belt drive, guards, vibration isolation, and other components required for a complete and operable blower system as specified herein.

B. Equipment and manufacturer's services shall be provided in accordance with the requirements of Section 11000 – Equipment General Provisions.

1.02 RELATED WORK

A. Section 01 33 00 – Submittal Procedures

B. Section 01 91 14 – Equipment Testing and Facility Startup

C. Section 01 78 23 – Operations and Maintenance Data

D. Section 09900 – Painting

E. Section 11000 – Equipment General Provisions

F. Section 15030 - Piping and Equipment Identification Systems

1.03 SUBMITTALS

A. In addition to the submittal requirements specified in Section 01 33 00 – Submittal Procedures and Section 11000 - Equipment General Provisions, submit the following:

1. Blower package performance data sheets showing the following, at a minimum:
   a. Package model name
   b. Bare blower model name
   c. Design conditions as listed in this section
   d. Air flow in ICFM and SCFM for design conditions listed
   e. Discharge pressure
   f. Motor size
   g. Brake horse power required for both blower and motor
   h. Bare blower speed with percentage of its maximum speed
   i. Process air connection size.

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j. Operating Voltage required for both main motor and enclosure ventilation fan.
k. Sound pressure and power levels
l. Dimensions
m. Package weight
n. Pressure relief valve set point
o. Discharge temperature
p. Accessories being supplied

2. Installation data sheets

3. Manufacturer's standard performance curve showing blower rpm, pressure differential, capacity in ICFM, blower shaft horsepower, temperature rise at standard conditions.

4. Blower package drawing showing all important details required for installation including dimensions, anchor bolt locations, size and location of connections to other works and weight of equipment.

5. Motor manufacturer's data sheet showing at least the following:
   a. Motor manufacturer's name and model number
   b. Efficiency class and %
   c. Efficiency at ½, ¾, and full load
   d. Amp draw
   e. Motor RPM
   f. Code letter
   g. Motor frame

6. Electrical connection diagram for motor, enclosure ventilation fan, and any blower accessory requiring an electrical connection.

7. Inlet filter documentation

8. Data sheets for supplied instrumentation and accessories

9. Spare parts overview drawing

10. Recommend spare parts list

11. Paint specification for blower package

12. Maintenance overview

13. Blower startup check list

14. Lubrication requirements

15. MSDS sheet (oil)

16. Warranty information

17. Manufacturer's standard for equipment standards

18. Compliance with Machinery Standards for sound and performance certificate

19. Copies of certified shop test reports.

20. Field test results.

21. Blower performance curves including capacity/pressure/speed curves and horsepower/pressure/speed curves at standard conditions of 14.5 psia inlet pressure, 68°F inlet temperature, and 0% relative humidity per ISO/CAGI.

1.03 OPERATION AND MAINTENANCE MANUALS

A. In addition to the submittal requirements specified in Section 01 78 23 Operation and Maintenance manuals and Section 11000 - Equipment General Provisions, submit the following:

1. Technical Data for the blower package
2. Safety and Responsibility
3. Design and Function
4. Installation and Operating Conditions
5. Installation
6. Initial Start-up
7. Operation
8. Fault Recognition and Rectification
9. Maintenance
10. Spare parts, Operating Materials, Service
11. Decommissioning, Storage and Transport
12. Annex with Drawings and Diagrams

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The blower packages shall be Model GM 10S as manufactured by Aerzen, Model 41P CB 131 C by Kaeser, or equivalent by Dresser Roots.

2.02 PERFORMANCE REQUIREMENTS

A. Operating conditions and performance requirements are provided in the table below. The blowers shall be capable of providing the specified blower capacity at the design discharge pressure at the package discharge flange at the maximum temperature, coincident relative humidity and minimum barometric pressure specified below. The discharge pressure specified below is the required pressure at the blower package discharge flange. The ICFM specified below is the required airflow at the inlet to the package and excludes any internal blower package losses (inlet filter, inlet piping, silencer, etc.). The blower package

manufacturer shall account for all inlet losses (inlet filter, inlet piping, silencer, etc.) and all discharge losses (silencer, check valve, etc.) within the blower package in determining the total differential pressure to be provided by the blower. The maximum allowable pressure loss through inlet and discharge piping and components located within the blower package shall be 0.80 psig including the allowance for dirty air filters. The blower manufacturer shall provide inlet and discharge losses at the specified design point in the shop drawing submittal prior to DESIGN/BUILDER approval.

	Blowers
Number of Units	2
Site / Operating Conditions	
Elevation, feet above MSL	16.5
Barometric Pressure, psia	14.5
Maximum Inlet Temperature, °F	100
Minimum Inlet Temperature, °F	60
Maximum Relative Humidity, %	90
Performance Requirements at the Design Point	
Design Inlet Temperature, °F	100
Design Inlet Relative Humidity, %	90
Design Minimum Inlet Pressure, psig	14.50
Maximum Blower Capacity at Design Inlet, scfm	284
Minimum Blower Capacity at Design Inlet, scfm	57
Discharge Pressure at Package Discharge Flange, psig	7
Maximum Power Draw/Blower at Blower Shaft at Maximum Design Capacity and Pressure, horsepower	13.5
Blower Maximum Speed at Design Capacity, rpm	3924
Blower Minimum Speed at Minimum Capacity, rpm	1309
Maximum Pressure Capability, psi	12
Acoustic Enclosure Type	Close Fitting
Sound Level 3' from Enclosure, dBA	72
Maximum Motor Horsepower Each Unit, horsepower	25

B. Blower speed shall not exceed 85% of the recommended maximum speed for the blower.

2.03 BLOWER CONSTRUCTION

A. A welded steel fabricated base or combination base frame and discharge silencer shall be provided for mounting the blower, electric drive and driver base. The base shall be of a rigid box section shape. The box section shall be properly stiffened and present large bearing areas for carrying the load on the foundation. The base shall be rigid to prevent deflection during start-up and normal operation that would affect alignment. Resilient isolation pads shall be provided between the concrete mounting or bottom of the blower enclosure and the base of the blower unit. Positioning pins and jackbolts shall be provided to facilitate motor alignment when motor is coupled directly to blower. The base shall support the blower and a pivoting motor base. The motor shall be mounted on the pivoting base. The weight of the motor, in conjunction with (2) springs (if needed) shall provide 100% maintenance free automatic belt tensioning. Installation shall conform to recommendations of the blower and V-belt component manufacturers including motor, V-

belt drive, guard, controls, and all necessary items. V-belts shall be of the stretch resistant type with an adjustable belt tensioning mechanism.

B. The blower casing shall be of one piece with separate headplates, and shall be made of close-grained cast iron suitably ribbed to prevent distortion under the specified operating conditions. Outlet shall be an ANSI Class #125 flanged connection. The casing shall incorporate a proven means of pulsation cancellation such that the sound pressure level measured 3 feet from the front and side panels of the blower package does not exceed the value specified in Paragraph 2.02. The vibration level as measured at the blower casing, in the X/Y planes of the bearings, shall not exceed 0.55-inch/sec RMS when operating at the specified maximum operating pressure and speed in the actual blower package.

C. Each lobe shall be made from a ductile iron casting. Shafts shall be alloy steel forgings. Alternatively the lobe and shaft shall be of one piece construction that is machined together. The lobes shall be of the straight, tri-lobe involute type and shall operate without rubber or liquid seals or lubrication and shall be positively timed by a pair of accurately machine heat-treated alloy steel, helical tooth timing gears. The timing gears shall be carbon steel. The timing gears shall be mounted on the lobe shafts with a press fit and keyed or mounted by hydraulic expansion onto the blower shafts with a tapered interference fit. One gear shall be equipped with a hub and a gear to facilitate accurate and easy timing. Each lobe/shaft shall be supported by cylindrical roller bearings sized for a minimum of 100,000 hours B-10 life.

D. The lube oil system shall be supplied with a sight glass and ample oil reservoir capacity. Piston ring oil seal shall be provided at each bearing, designed to prevent lubricant from leaking into the air stream. Rotary piston ring shaft seals shall be provided at the point where the shaft passes through the head plate (air seal). A total of 16 piston ring seals shall be provided for each blower. Further provision shall be made to vent lubricant to the impeller side of the oil seal to atmosphere to eliminate any possible carryover of lubricant into the air stream. Lip seals inside the blower shall not be acceptable. Lip seal is allowed at the drive shaft only, complete with wear sleeve.

E. The timing gears and the bearings shall be splash oil lubricated from oil slingers mounted on the driven shaft and dipping in oil. Grease lubricated bearings shall not be acceptable. Each bearing shall be equipped with an oil deflector disc if necessary to further reduce oil leaks.

F. Blower package shall be designed to allow ease of access to oil drain plugs.

G. Maximum dimensions of each blower shall be 53.25” L x 46.25” W x 50” H

2.04 BLOWER ACCESSORIES

A. Each blower shall be supplied with one combination inlet filter silencer. The inlet filter silencer shall be mounted directly to the inlet flange of the blower. Filter element shall be washable by maintenance personnel as a preventative maintenance procedure.

B. Each blower shall be supplied with one combination base frame and discharge silencer or separate structural steel base and conventional discharge silencer. The silencer shall feature a single or double shell of pressure vessel quality steel with continuous welds.

The temperature rating shall be 300°F. The design of the silencer must accommodate being bolted directly to the blower discharge flange with no intermediary pieces, and shall be designed to assure that there will be no disturbing pipe beating noise or pipe harmonics whether one blower or multiple blowers are running. The discharge silencer and acoustic enclosure shall be designed to reduce the sound pressure level emitted by the blower packaged such that it does not exceed the value specified in Paragraph 2.02 over the entire range of operation measured 3 feet from the front, back and at two locations opposite each side panel in free field conditions. The blower manufacturer shall supply a stainless steel grounding lug fully welded to the base or shall ground the base to the sound enclosure through a ground wire.

C. Each blower package shall be connected to the plant piping via flexible connector(s) located downstream of the discharge silencer. The flexible connectors shall be suitable for the maximum operating temperature and pressure ratings of the equipment in the air stream.

D. Each blower shall be supplied with a V-belt drive and belt guard that shall be of the high capacity type, oil and heat resistant. Drive shall be designed for a minimum service factor of 1.4 times the maximum blower horsepower. Belt tensioning shall be easily adjustable for maintaining proper tension. Sheaves shall be dynamically balanced regardless of the operating speed.

E. Each blower shall be supplied with vibration isolating mounts. Blower manufacturer shall be responsible for attenuating noise and vibration in the blower package.

F. The blower manufacturer shall provide a pressure release valve consisting of a spring loaded-type pressure relief valve located inside the enclosure and installed at the factory by the blower manufacturer. The valve shall be field adjustable, spring loaded type and have a proportional operating characteristic with respect to the pressure set point. Initial setting of the spring loaded-type relief valve shall be as required by the manufacturer to protect the blower from exceeding its maximum rated pressure capacity. Initial setting shall be not more than 14.25 psi. The spring loaded PRV shall be sized to pass 110% of the design flow.

G. The blower manufacturer shall provide an automatic, mechanically operated start unloading valve located inside the enclosure and installed at the factory by the blower manufacturer. The unloading valve shall require no electrical connections. The start unloading valve shall be installed upstream of the check valve for each unit.

H. Check valves shall be provided on the discharge of each blower unit within the acoustic enclosure. Check valve shall be ductile iron with 316 SST shaft, plate, and springs, and EPDM sealing member suitable for 300°F or shall be of the full-bore low pressure drop, flapper type design with an aluminum or steel body and steel flap embedded in EPDM with full contact seal all suitable for 300°F.

I. Provide a liquid-filled pressure gauge for each blower discharge and suction equal to Type 1009, Grade 1A (1.0% F.S.) as manufactured by Ashcroft or equal.

    1. Range: 0 to 15 psig (discharge); 0 to 10 inches water gauge (suction).

    2. Accuracy: ±1% of full scale.

3. Dial: 4-1/2” diameter; 270° scale; heavy gauge aluminum with white background and black markings; 0.25 psig/0.20 inches WC minor divisions.

4. Case: Stainless steel.

5. Bourdon Tube and Socket: 316 Stainless Steel

6. Connection: ¼” NPT.

7. ¼” stainless steel pressure snubber.

8. Pressure gauges shall be mounted to the sound enclosure wall.

J. Provide a liquid filled bimetal thermometer for each blower discharge as manufactured by Ashcroft or equal.

1. Range: 50 to 300°F Series EL discharge and - 40 to 160°F inlet.

2. Accuracy: ±1% full span.

3. Dial: 3 diameter; 270° scale; heavy gauge stainless steel with white background and black markings; 5°F minor divisions.

4. Case: Stainless steel.

5. Ring: Stainless steel.

6. Movement: Stainless steel.

7. Actuating Element: Type 304 stainless steel, precision rolled, fully annealed tubing.

8. Compensation: Bimetal compensator to offset ambient temperature changes in case area.

9. Temperature gauge shall be mounted to the sound enclosure wall.

K. A high temperature switch shall be provided for each blower as manufactured by Ashcroft or equal with an opening range of 150° to 270°F. The maximum temperature capability shall be 400°F. Sensor is to be capillary type with remote 3-3/4” brass bulb. Design/Builder shall provide 1/2” FPT in discharge piping near blower for thermostat well. Piping under 4 inches will require a tee with bushings to mount the well. Piping 4 inches and over may be drilled and tapped. The temperature switch shall be provided by the blower manufacturer to be installed on the discharge piping and wired by the Design/Builder.

L. A high pressure switch shall be provided for each blower as manufactured by Ashcroft, Type 400 in NEMA 4X enclosure, B4 Series or equal. The pressure switch operating range shall be from 1 to 15 psig. The actuator seal shall be Viton. Pressure switches shall have adjustable deadband, hermetically sealed switching element and 316 stainless

steel pressure port. The pressure switch shall be provided by the blower manufacturer to be installed on the discharge piping and wired by the Design/Builder.

M. A filter maintenance indicator gauge shall be provided for each blower. The indicator gauge shall be differential pressure gauge Type Magnehelic Series 2000 as manufactured by Dwyer or equal. The filter maintenance indicator gauge shall be mounted to the sound enclosure wall.

N. Each blower shall receive its initial oil filling at the factory. Oil requirements shall be such that the oil shall be available from a local source.

2.05 BLOWER MOTORS

A. The blower manufacturer shall be responsible for furnishing a 25 horsepower motor for each blower. The process air blower motor shall be inverter duty. The manufacturer shall be responsible for the proper selection, testing, installation, and operation of the motors and for coordinating the motors with the blower equipment. Motors shall be as manufactured by U. S. Motors or equal. Motors shall be new and both materials and workmanship shall be of the very best quality. Motors shall be premium efficiency motors.

B. Motors shall be horizontal squirrel cage induction motors designed in accordance with the latest ANSI, NEMA, and IEEE standards. Motors shall be 460 volts, 3-phase, 60 Hz. Motors shall be designed and manufactured for continuous duty for operation under the following conditions:

1. Elevation of 15 feet above mean sea level.

2. Ambient temperature ranging -10 degrees F -to 105 degrees F.

3. Voltage variations of ±10 percent.

4. Frequency variation of ±5 percent.

5. Combined voltage and frequency variation of ±10 percent with frequency variation not exceeding ±5 percent.

C. Inverter duty motors shall have a minimum service factor of 1.0 and non-inverter duty motors shall have a service factor of 1.15. Motor horsepower shall be equal to or greater than the load over the full range of operating conditions. Motor speed shall not exceed 3,600 rpm.

D. Motor torque characteristics shall be at least 20 percent greater than the maximum full load torque requirements over the full range of operating conditions from start-up to full load.

E. Motor enclosure shall be TEFC corrosion protected. Motor shall be designed for quiet operation. Motor sound pressure shall not exceed 77 dBA at 3 feet from the motor.

F. Motors shall provide premium efficiencies and power factors throughout their operating range. The power factors specified shall be achieved without the use of power factor

correction capacitors. Motors shall provide minimum efficiencies and power factors as specified in NEMA-MG1

G. Efficiencies and power factors for each motor shall be verified by submittal of certified test reports for similar motors.

H. Motor insulation shall be Class H for inverter duty motors. However, temperature rise shall be limited to that of Class B insulation. Manufacturer's premium grade insulation shall be used.

I. The stator shall be assembled from high grade electrical sheet steel laminations adequately secured together. Stator windings and end turn connections shall be fully braced to withstand all mechanical, electrical, and thermal stresses. The shaft shall be made of high grade machine steel or forged carbon steel and of size and design adequate to withstand the load stresses. The rotor shall be fabricated of high grade electrical sheet steel laminations adequately fastened together and to the shaft.

J. Bearings shall be grease lube ball bearings. Split bearing housings shall be used such that bearings can be inspected or replaced without disturbing alignment.

K. Motor leads shall be suitably marked and identified. Each motor shall be provided with an oversized terminal box with space for connections and shall be constructed of cast iron or fabricated steel, neoprene gasketed and bolted.

L. Motors shall be designed and manufactured for operation in the direction required for the blowers. The phase sequence shall be marked permanently and plainly inside the stator lead junction box.

M. Motors shall have breather and drain plugs to allow for drainage of any moisture from inside.

N. Each motor shall be provided with normally closed motor winding temperature switches (2 per phase).

O. Motors shall be supplied with space heaters for 120V operation.

P. Motors shall comply with Section 15170, except where modified herein.

2.06 ACOUSTICAL ENCLOSURE (CLOSE-FITTING TYPE)

A. Each blower shall be supplied with a sound enclosure designed for outdoor installation covering the entire blower package including the drive motor, the inlet silencer, and the discharge silencer. The sound enclosure must be designed for easy inspection and maintenance of all blower package components.

1. Panels shall be made of steel sheet, externally coated with a premium coating system. Sound enclosure acoustic material as a minimum shall comply with UL 94 or UL 723 for fire-retardant, self-extinguishing, non-dripping materials. Materials with a lesser rating shall not be acceptable.

2. A grounding strap shall be installed between the blower base and the package skid to bypass any vibration isolating mounts.

3. Quick release panels, each less than 50 lbs. shall provide easy and quick access for routine maintenance of the blower and the package components. For panels heavier than 50 lbs., hinged doors shall be supplied, with the appropriate frame, reinforcements and supporting elements.

4. A high efficiency motor driven ventilation fan shall provide ventilation and cooling integral to the sound enclosure and shall operate whenever the blower is operating. The Design/Builder shall coordinate with the electrical subcontractor for the required interlock between the 110V cooling fan and the 460 volt starter for the blower. The fan shall be capable of limiting the temperature within the acoustical enclosure to 125°F with an outside temperature of 105°F. Cooling fan shall be sized for sufficient heat removal from the sound enclosure. Alternatively, the ventilation fan may be connected directly to the blower shaft such that the fan operates when the blower runs.

5. All enclosure fasteners and anchor bolts shall be Type 316 stainless steel. Anchor bolts shall be designed by the manufacturer.

6. Access to enclosure shall be through the front and back, with primary access through the front. Access through the sides of the enclosure shall not be required for regular maintenance of the equipment.

2.07 SPARE PARTS

A. Furnish all special tools and appliances necessary to disassemble, service, repair and adjust the equipment and appurtenances.

B. Spare parts which are identical and interchangeable with the original parts shall be furnished in clearly identifiable and labeled containers. The Design/Builder shall provide the following spare parts:

- Two (2) filter elements per blower
- One (1) year supply of manufacturers recommended oil, per blower
- One set of V-belts per blower
- One shaft seal and shaft sleeve per blower

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The manufacturer shall provide the services of qualified service persons with at least five (5) years of experience who are regularly involved in the inspection, installation, start-up, troubleshooting, testing, maintenance, and operation of positive displacement blower systems. The service persons shall:

1. Check installation.

2. Conduct field tests and prepare a written report as specified below.

3. Witness and check start-up of the system.

4. Make adjustments and modifications as necessary to optimize operation of system components.

5. Troubleshoot and correct any mechanical problems that are noted during tests and start-up.

6. Submit written certification that the systems have been properly installed, tested, and adjusted; and that all protective devices operate properly, including date of final acceptance test, as well as a listing of all persons present during the tests.

7. Investigate and supervise correction of any operating problems that may arise up to the end of the guarantee period of the equipment.

8. Instruct Owner personnel in the operation and maintenance of the equipment.

B. Assist Design/Builder during installation to include observation, guidance, and instruction of the manufacturer's recommended procedures for assembly, erection, installation and application.

C. Inspect, check, and adjust equipment as required for equipment to function as guaranteed.

D. The services of a manufacturer's technical representative, qualified to install, test, service, operate, and provide training on the flocculation and sedimentation systems, mixers, and sludge collection system, shall include the following site visits:

Service	**Number of Trips**	**Number of Days/Trip**
Installation and Testing	2	1
Startup and Training	1	2

E. A written report covering the manufacturer's representative's findings at each visit and at installation approval shall be submitted to the Design/Builder. The report shall cover all inspections and shall outline in detail any deficiencies noted and all corrective measures taken or recommended.

3.02 SHOP TESTING

A. Shop testing shall be in accordance with Section 11000, Equipment General Provisions and with the following additional requirements:

B. A detailed shop test plan shall be submitted with the Shop Drawings. The shop test plan shall fully describe the manufacturer's test facilities and the test procedure to be used.

C. After assembly, each blower system shall be factory lubricated, aligned and operationally tested. Run time on each blower shall be at least one (1) hour after which each blower shall be rechecked for alignment and tension of V-belts and adjusted if necessary. If adjustments are made, the blower(s) shall be restarted and run an additional 15 minutes, shut down and rechecked again.

D. Each blower system shall be provided with a bench test complying per ISO 1217 to demonstrate compliance with all specified performance requirements.

E. A report on each blower system shall be furnished with the O&M manuals giving as a minimum the following readings taken during shop tests at or near the end of the one hour run time.

1. Motor current, per phase.

2. Applied motor voltage, phase-to-phase

3. Discharge pressure, psi

4. Air Flow, scfm

5. Air Flow, icfm

6. Blower discharge air temperature

7. Vibration levels in inch/second of blower housing in horizontal, vertical and axial direction.

8. Barometer, psia

9. Relative humidity, %

10. Speed

11. Sound pressure level in dBA measured at 3 ft. from the blower system in six locations: one on each short side of the blower, and two on each long side of the blower. A comparison shall be made of tested performance to specified performance including calculations of variance from specified requirements.

F. Performance tests shall be conducted over the specified blower speed range. Tolerances allowable in testing shall be as approved by the Design/Builder.

G. A comparison shall be made of tested performance to specified performance including calculation of variance from specified requirements.

H. In case of failure of any unit to meet the test requirements, the manufacturer, at his own expense, shall make such alterations as are necessary and the tests shall be repeated without additional cost to Owner until the equipment is satisfactory.

I. Complete instrumentation layout and manufacturer's information for all instrumentation used during testing shall be submitted including the arrangement and device for flow measurement, conversion tables/graphs, and accuracies over the specified flow range. All instruments and measuring devices that the manufacturer proposes to use for shop performance testing shall be calibrated by a laboratory not more than twelve months prior to the first performance test.

J. The blower manufacturer shall prepare and submit test results, performance curves at standard conditions, and all calculations with a statement certifying that shop tests were successfully conducted in accordance with the test requirements and that all specified performance conditions were demonstrated for each blower system.

3.03 INSTALLATION AND FIELD TESTING

A. Prior to field testing of blower equipment, the Design/Builder shall take all necessary precautions to insure that the air piping is completely clean and free of any debris, dirt, or other foreign materials which could clog the aeration equipment or interfere with acceptable operation.

B. After each blower unit and its accessories have been completely installed and the electrical connections have been made, it shall be subjected to field tests conducted by the manufacturer to determine if it is free from all objectionable vibration, bearing heating, noise, or other defects. Vibration shall not exceed 0.55 in/sec at any bearing in any plane. Sound pressure level shall be measured along each side of the enclosure to verify conformance to the requirements specified herein. Each blower unit shall be subjected to running tests under actual operating conditions for a period of 8 hours during the Performance Test for the equipment supplied herein. The manufacturer shall make such changes of alterations in the blower units or their auxiliaries necessary for satisfactory operation.

3.04 PAINTING

A. Painting shall be as specified in Section 09900 unless otherwise specified herein. Blowers shall be coated with the manufacturer’s recommended premium paint system suitable for the blowers’ intended use.

B. All inaccessible surfaces of the equipment, which normally require painting, shall be finished painted by the manufacturer. The equipment and motor shall be painted with a high quality epoxy polyamide semi-gloss coating specifically resistant to chemical, solvent, moisture, and acid environmental conditions, unless otherwise specified.

C. Gears, bearing surfaces, and other unpainted surfaces shall be protected prior to shipment by a heavy covering of rust-preventive compound sprayed or hand applied which shall be maintained until the equipment is placed in operation. This coating shall be easily removable by a solvent.

3.05 EQUIPMENT IDENTIFICATION

A. The blowers shall be provided with a means of identification which complies with Section 15030 - Piping and Equipment Identification Systems. As a minimum the identification

information shall include manufacturer's name, year of manufacture, serial number, design air flow in scfm and icfm, discharge pressure and rpm.

-END OF SECTION-

SECTION 11700

OZONATION SYSTEM

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Ozone System Supplier (OSS), shall furnish, install, and test the ozone system which shall include but not be limited to the major subsystems and components below. The OSS shall be solely responsible for all equipment required, including that which may not be specifically addressed within this specification, to provide a complete and operable ozone system. The ozone system shall be furnished and installed complete and operable in accordance with the requirements of the Specifications.

B. This Section includes

1. Two (2) Ozone generators with power supply units (PSUs) including all skid-mounted analytical monitoring equipment, analyzers, gas detectors, process control valves, isolation valves, pressure switches, temperature switches, meters, local control panels, and all other devices required for a fully functional system.

2. One (1) Main Ozone Control Panel (MOCP)

3. A cooling system consisting of a closed-loop water cooled chiller system or heat exchanger.

4. One (1) side stream ozone injection skid and appurtenances including two (2) motive water pumps, valves, instrumentation, skid piping, venturi injectors, and pipeline ozone mixer.

5. One (1) compressed air system for nitrogen supplementation, if necessary.

6. One (1) ozone destruct system

7. Field instrumentation including ambient ozone monitors, off-gas monitor, and vent gas ozone monitor.

C. Excluded from the OSS scope of supply

1. Liquid oxygen storage and handling equipment. Liquid oxygen storage and vaporizers will be leased under a separate contract.

D. The OSS shall design, provide, supervise the installation by the DESIGN/BUILDER, start up, and test the ozone system as necessary to result in a complete functioning system, ready for continuous use by the Owner.

E. The DESIGN/BUILDER shall receive the ozone system equipment, provide all concrete work, buildings, field piping and field electrical construction not provided by the OSS, and install the equipment, piping and wiring in accordance with written instructions from the OSS.

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F. The OSS shall be fully responsible for the final design and satisfactory performance of the Ozone system. If for any reason, the system fails to perform in the manner herein specified, the OSS shall remedy the defect at no additional expense to the DESIGN/BUILDER or Owner.

G. The system described herein represents minimum criteria for the system. The OSS shall provide all additional equipment and services not shown or described, which are required for a fully functional system.

1.02 RELATED WORK

A. Section 01 33 00 – Submittals

B. Section 01 78 23 – Operation and Maintenance Data

C. Section 01 91 14 – Equipment Testing and Facility Startup

D. Section 05035 - Galvanizing

E. Section 05010 – Metal Materials

F. Section 05120 – Structural Steel

G. Section 05500 – Metal Fabrications

H. Division 16100 – Major Equipment Package Electrical Requirements

I. Division 17126 – Operator Interface Unit- Graphics Standards

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Comply with the applicable provisions and recommendations of the following, except where otherwise shown or specified. Where reference is made to one of the below standards, the revision in effect at the time of bid opening shall apply.

1. Compressed Gas Association (CGA):
    a. CGA G-4.1 - Cleaning Equipment for Oxygen Service, latest edition.
    b. CGA G-4.4 - Industrial Practices for Gaseous Oxygen Transmission and Distribution Piping Systems.
2. National Fire Protection Association (NFPA):
    a. NFPA 50 - Standard for Bulk Oxygen Systems at Consumer Sites.
    b. NFPA 70 - Electrical Code.
3. Section VIII, Division 1 - Rules for Construction of Pressure Vessels.
4. National Safety Council (NSC).
5. Institute of Electrical and Electronic Engineers (IEEE).
    a. IEEE 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power System.

6. International Fire Code (IFC).
7. American National Standards Institute (ANSI).
8. American Society for Testing Materials.
    a. ASTM E591 – Safety and Heath Requirements Related to Occupational Exposure to Ozone.
9. American Water Works Association (AWWA).
10. American Welding Society.
11. Hydraulic Institute.
12. American Society of Mechanical Engineers (ASME).
13. Instrument Society of America (ISA).
14. National Electrical Code (NEC).
15. National Electrical Manufacturers Association (NEMA).
16. Underwriters Laboratory (UL).
17. International Society of Automation.
    a. S.20 Data Sheets.
    b. Loop Diagrams.

1.04 SUBMITTALS

A. Shop Drawings

1. Submit Complete shop drawings in accordance with the following additional items:

    a. Submittal I

        1) Technical Clarifications and Comments

        2) Detailed Process and Instrumentation Diagrams (P&ID) for the entire ozone generation system conforming with ISA F5.1 & F5.4.

    b. Submittal II

        1) Updated Detailed Process and Instrumentation Diagrams for the entire ozone generation system

        2) System design data, including description of recommended and required operating parameters

        3) Power distribution single-line diagram including horsepower requirements

        4) Ozone control system architectural diagram

        5) General equipment arrangement drawings for all OSS-supplied skids

        6) Data sheets / catalog cut sheets on all valves, instruments, and piping components

7) Power interconnection diagrams, electrical wiring diagrams, schematics, conduit and grounding diagrams, and overall electrical interconnection drawings for the Ozone System.

8) Control panel layout, wiring and control diagrams, including power requirements for skid mounted vendor provided instrumentation.

9) Electrical and Control panel layout drawings with complete dimensions and detailed bill of materials.

10) Feed Gas and Cooling Water Specifications

11) Suggested spare parts list to maintain the equipment in service for a period of 1 year and 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance

12) List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance

13) Manufacturer's shipping, storage, protection, handling, and installation instructions

c. Submittal III

1) Functional description of the ozone control system

2) Number and type of registers to be transferred to/from Plant Distributed Control System (DCS).

d. Submit detailed performance curves for the specified ozone generators with the following information:

1) Ozone production capacity, in terms of percent of generator's rated output capacity of pounds per day (ppd) of ozone versus cooling water temperature and at the design cooling water flow rate.

B. O&M Manual Requirements

1. Submit complete technical, operations, and maintenance manuals in accordance with the requirements of Section 01 78 23 – O&M Data.

2. Submit complete technical, operations, and maintenance manuals in accordance with the following additional items:

a. Detailed Process and Instrumentation Diagrams for the entire ozone generation system

b. Thorough description of the function and design criteria of each major component, including but not limited to, ozone generators, ozone destruct system blower heater and catalyst, high and low ozone gas concentration monitors, dissolved ozone monitors, oxygen gas flow meters, and associated equipment.

c. Power distribution single-line diagram

d. Ozone system architectural diagram

e. Safety information and applicable MSDS sheets

f. Ozone System Design Data Sheet

g. Feed Gas and Cooling Water Specifications

h. Control Philosophy

i. Register transfer list to plant DCS

j. Ozone functional description

k. General Arrangement Drawings of all OSS-supplied skids

l. Data sheets / catalog cut sheets on all valves, instruments, and piping connections

m. Description of required operating parameters

n. Description of startup and shutdown procedures

o. Description of abnormal or emergency operating conditions and recommended corrective actions.

p. Description of the automated control loops for the ozone generators

q. Description of frequency and type of maintenance procedures, and special maintenance precautions that should be exercised.

r. Location of OSS's recommended spare parts warehouse

PART 2 – PRODUCTS

2.01 GENERAL

A. All ozone systems and related equipment shall be furnished by a single supplier who shall provide all of the equipment and appurtenances required to achieve a complete, fully integrated, and operational system meeting all the design conditions, testing requirements, performance guarantees, and warranties, as specified herein

B. The ozone generator and corresponding Power Supply Unit shall be skid-mounted with all components pre-piped and pre-wired within the limits of the equipment package so as to require minimum field installation. This shall include, but not be limited to, all electrical, instrumentation, valve operators, skid mounted and remote mounted instrumentation, electrical junction boxes and control panels unless otherwise specified.

C. Skids shall be made of painted mild carbon steel or galvanized steel, meeting the requirements of ASTM A36 and capable of safely supporting and handling the specified equipment.

D. Skid piping connections shall be constructed of ANSI 150 flanges.

E. All equipment shall be designed, fabricated, and assembled in accordance with accepted industry standards. Equipment shall not have been in service at any time prior to delivery, except as required by tests.

F. All structural members shall be designed for shock or vibratory loads.

G. All components and materials of construction shall be suitable for the intended service. All parts in contact with either ozone gas or ozone solution shall be 316L or 316Ti stainless steel, PTFE or other ozone resistant material.

H. Laminated copy of the final panel drawings and wiring shall be placed inside the corresponding panel.

I. Install all instruments according to manufacturer's instructions.

J. Two (2) ozone generators shall be provided, and will operate as 1 duty / 1 standby at the rated ozone production capacity. Each generator shall be manufactured for the following design conditions:

1. Ozone Generator Maximum Production: 200 ppd at ≥10 % wt.

2. Ozone Generator Minimum Production: 20 ppd at ≥10 % wt.

3. Water temperature range (Nansemond Treatment Plant Final Effluent) for cooling water: 56 – 88 °F

K. The ozone generator and all ancillary equipment shall be designed to limit sound production to 85 dBA in any direction at a distance of 3 feet while operating at 100 percent of rated capacity.

L. Reference Specification 16100 for electrical requirements for factory assembled pre-wired equipment. The electrical equipment installed on the Ozone Generator skids shall conform to the requirements of a dry process area. All other electrical equipment shall conform to the requirements of a wet process area.

M. The ozone generation system shall be as manufactured by:

1. SUEZ Treatment Solutions, Inc., or Xylem Water Solutions USA, Inc. or approved equal.

2.02 REFERENCES

A. A single OSS qualified and experienced in the production of ozone generation equipment shall provide the system. OSS shall have at least 30 years of experience in manufacturing and delivering ozone generation systems.

B. The OSS shall have a minimum of fifty (50) high concentration (10% to 12% by weight) ozone generation systems of 150 pounds per day capacity or larger, installed and operating in the United States for at least two (2) years prior to the bid opening date of this project. References, including location, contact person, and telephone numbers shall be submitted to DESIGN/BUILDER upon request.

2.03 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Keep all items thoroughly dry at all times

B. Store all blowers, motors, ozone generators, monitors, and electrical equipment indoors at all times in a weather tight facility at a maintained temperature of 50°F minimum and 110°F maximum, at a relative humidity of <70%. Open on-site storage of equipment shall not be permitted.

2.04 UTILITIES

A. Power will be supplied at 480 volt AC, 3-Phase Wye, 60 Hz

2.05 PAINTING

A. Coating of metal surfaces, if used.

1. Prime coating – apply one coat epoxy polyamide primer to a dry film thickness of 4 – 6 mils. Second coating – apply one coat epoxy polyamide to a dry film thickness of 4 – 6 mils. Finish coating – apply one coat aliphatic polyurethane to a dry film thickness of 3 – 5 mils.

2. The total paint system shall be the product of and be applied in accordance with the recommendations of one manufacturer.

3. Repaint or refinish all damaged surfaces prior to acceptance of equipment. OSS shall provide DESIGN/BUILDER with one pint of paint of all types of coating materials used in new sealed containers, for each color used by the OSS for this job.

2.06 WARRANTY

A. All materials furnished shall be guaranteed to be free from defects in design and/or materials for a period of one (1) year following Substantial Completion. The period of such warranties shall start on the date the Performance Testing as indicated in the General Requirements have been completed and Substantial Completion has occurred. Any design and/or material (or part thereof) which is defective or showing undue wear within the correction period or not meeting performance requirements, shall be corrected, repaired or replaced with new material; furnishing all materials, labor, etc., necessary to return to the specified performance level without charge to the Owner. Where defective designs and/or materials have been repaired or replaced, the correction period for such shall be extended in accordance with the General Conditions.

B. The ozone generating system where in contact with ozone shall be tolerant to nitric acid without causing equipment malfunction or shut down.

2.07 OZONE AND OXYGEN SERVICE

A. All equipment, valves, seats, analyzers, and any other associated components to be used in contact with oxygen or gaseous ozone shall be cleaned and certified for oxygen service prior to shipment

B. All equipment, valves, seats, analyzers and any other associated components to be used in contact with oxygen or gaseous ozone shall be constructed of materials resistant to degradation from contact with these gases.

2.08 SAFETY

A. All equipment shall be designed, manufactured, and provided with due regard to safety of operation, accessibility, and durability of parts, and shall comply with all applicable OSHA, state, and local safety requirements.

B. All belt or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard. Safety guards shall be fabricated of 16 USS gauge or heavier galvanized or aluminum-clad sheet steel or ½-inch mesh galvanized expanded metal. Each guard shall be designed for easy installation and removal. All necessary supports and accessories shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized.

C. Components weighing over 100 pounds shall be provided with lifting lugs

D. Anchor systems for all equipment in the ozone system shall be designed by the OSS and supplied by the DESIGN/BUILDER. Manufacturer shall provide details of the size, number, and location of anchor bolts.

2.09 LUBRICATION

A. Equipment shall be adequately lubricated by systems that require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during startup or shutdown and shall not waste lubricants.

B. Lubricants of the type recommended by the equipment manufacturer shall be provided in sufficient quantity to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment by Owner.

2.10 OZONE GENERATORS

A. The ozone generators shall be a horizontal shell and tube type, corona discharge type, water cooled, fixed voltage and variable frequency ozone generator. Systems that do not utilize shell and tube type ozone generators shall not be allowed.

B. Each generator shall have its own Power Supply Unit (PSU), consisting of incoming power filter, fixed bridge input converter, frequency inverter assembly, high voltage transformer, all associated electrical and electronic equipment, and local control panel.

C. The ozone generator vessels shall be manufactured according to ASME Section VIII, Division 1 requirements for unfired pressure vessels and stamped accordingly.

D. The surface finish of the ozone generator vessel shall be glass bead blast finish.

E. Gaskets used in the ozone generator shall be ozone resistant.

F. All wetted and non-wetted vessel components shall be equal to Type 316L stainless steel or better construction, unless otherwise specified.

G. All cooling water piping installed on the ozone generator skid shall be constructed of 316L SS or better construction. Carbon steel or copper cooling water piping on the ozone generator skid shall not be allowed.

H. All gas piping installed on the generator skid shall be of 316L stainless steel or better construction.

I. All materials on the ozone generator skid in contact with gas shall be cleaned for oxygen service.

J. Minimum Vessel Gas Side Design Pressure Rating (@ 125°F): 50 psig

K. Minimum Vessel Water Side Design Pressure Rating (@ 125°F): 50 psig

L. Dielectrics

1. The dielectric tubes shall be constructed of borosilicate glass of precision manufacturing for high tolerance gaps in the corona discharge area, designed to resist thermal shock and to evenly distribute the applied electric charge over the entire dielectric surface without arcing.

2. The dielectric assembly shall be constructed of borosilicate glass, 316L stainless steel.

3. No coatings or linings shall be allowed on the glass or stainless steel.

4. The dielectric assembly, which consists of the dielectric glass and the HV electrode, shall each be removable independently.

5. Cooling of the dielectrics shall be achieved by closed loop cooling water flowing across the outside of the stainless steel tubes (low voltage electrode) contained within the vessel. No cooling water or media shall be allowed to enter or pass through the gas side of the vessel or the dielectric tube.

6. The grounded electrode shall be permanently fabricated as part of the vessel, and be welded to the tube sheet at both ends to prevent cooling water from entering the gas side of the ozone generator vessel.

M. The ozone generator shall be cooled by a chemically treated closed-loop cooling water system. OSS shall be responsible for assisting OWNER in determining appropriate treatment chemicals. Initial cooling water fill and all associated treatment chemicals shall be provided by the OSS.

2.11 POWER SUPPLY UNITS

A. Provide generators capable of operating using a 480-volt AC, 3-phase, 60-hertz power supply. Each generator control cabinet shall be supplied with an appropriately sized 480 volt AC, 3-phase to 120 volt AC, 1-phase step-down transformer to provide all control power required on the generator skid. The OSS shall also be required to provide all 24 VDC power supplies in each control cabinet for any and all DC analog circuits on the skid assembly.

B. Flexible hoses shall be used for cooling water piping internal to the PSU enclosure. Flexible hoses and fittings for inverter cooling shall be rated at 300 PSI and constructed of BUNA N, flame resistant, single-braid woven rayon, and fiber-reinforced material.

C. The Power Supply Unit shall be of a proven reliable technology, including at the minimum a fixed bridge input converter to rectify the power, and an inverter to enable the rectified power to reach the required frequency. The converter shall be an IGBT type of minimum 18 pulse SCR type to minimize harmonics on the power line at all production levels. The PSU shall be able to produce a single-phase, medium frequency high voltage power from the 480 V, three-phase, 60 Hz power supply. Power factor, as presented by the equipment to the electrical service as measured at the input to the Power Supply Units, shall be a minimum of 0.95 leading and 0.95 lagging per IEEE519 standards.

D. Each generator shall be capable of automatically and fully linearly varying the ozone production by varying the frequency, ranging from 10 to 100 percent of the maximum design ozone production.

E. The Power Supply Units shall be equipped at the minimum with the following main components:

1. Main disconnect or circuit breaker
2. Fuses or other internal protection to meet UL 508A short circuit current rating
3. Input filter
4. Fixed bridge AC to DC converter
5. DC filter choke
6. DC link capacitor
7. Full bridge variable frequency inverter
8. High voltage step-up transformer

F. The PSU shall have a minimum UL 508A short circuit current rating of 65 kA.

G. The PSU shall be completely assembled and compartmentalized within cabinets with individual front opening doors for access, be painted, wired, and mounted on a structural steel skid.

H. Each device in the PSU shall be permanently identified by a reference number attached to the panel or sub-panel in which it is located, adjacent to the device

I. The high voltage cables, control conductors, and signal conductors between each PSU and ozone generator high voltage connection shall be provided by the OSS

J. Harmonic mitigation equipment shall be included with the ozone generator to prevent power system harmonics that are caused by the ozone system equipment and to prevent resonant conditions from developing. Harmonic mitigation equipment shall also meet cUL508A.

1. IEEE Standard 519 shall be followed for Total Voltage Harmonic Distortion not to exceed the limitations for General Systems

2. Current Total Harmonic Distortion limits shall not exceed 5% at full load

3. Harmonic mitigation equipment shall be line reactors, active harmonic filters, active front-end technology, multi-pulse inverters, or other as required by the system proposed to meet the specified standard. Harmonic mitigation equipment shall be installed within the maximum PSU dimensions as shown on the contract drawings.

K. Control panels and the low voltage side of the power supply units shall be constructed by a fabricator authorized to UL 508A. All control panels and the control section of the power supply unit shall bear the label of UL 508A Industrial Controls.

L. Door interlock switches shall automatically shut down the ozone generator when the PSU converter is accessed while the system is in operation. This shut down features shall be applicable to both automatic and maintenance modes.

M. The PSU cabinet shall be independently cooled using cabinet-mounted air conditioners or air/water heat exchangers to maintain the cabinet temperature below the maximum rated operating temperature.

1. Maximum internal temperature shall be no more than 95°F

2. The power electronics shall be water cooled reducing the load of the cabinet mounted air conditioner or air/water heat exchanger.

N. The high voltage transformers designed to step up the line voltage for the power to the ozone generator shall be dry-type and rated at not less than 10 percent above the maximum connected kVA. Each transformer shall be equipped with lifting rings.

O. All components shall be conservatively sized with respect to design operating current and frequency to ensure long operating life under the operating conditions specified herein.

P. The PSU shall be provided with all appropriate protection against damage to the PSU and generator under reasonably foreseeable events and shall include, as a minimum:

1. An adjustable built-in automatic current limitation device to limit the current controlled by the PSU under any operating condition, including surge or short circuit condition, to the maximum combined design current of the PSU and generator. The current shall be limited to the value required at 110 percent of the rated capacity of the ozone generator, to prevent damage to the power supply or vessel which could result from an overload condition or a short circuit in the vessel

2. Automatic ramp-up control limiting the speed of rate of change from one power setting to another

3. Over voltage protection at the generator, at the smoothing capacitor and at the low voltage resonant circuit capacitor (if applicable)

4. Inverter over frequency protection

5. Over current protection

6. High-voltage, short circuit protection

7. Line over-voltage / under-voltage protection

8. Automatic shutdown on high temperature in the incoming isolation and high voltage transformers, capacitor bank, rectifier, net filter, and cabinet high temperature

9. Fail-safe control circuits to maintain last control settings upon failure of control logic

10. A safety interlock on the power supply cabinet to prevent ozone generator operation while PSU door is open

Q. The electronic fault sensors shall lock-off operation should a fault occur more than the preset restart counter within the preset time period.

R. CONTROLS

1. Each PSU shall be provided with a local control panel that contains a PLC and Operator Interface Unit (OIU). Connection of each PSU Control Panel to the MOCP shall be utilizing Cat 5/6e cable.

2. Each PSU panel shall include all controls and protective devices and functions as recommended by the OSS for a complete and operational PSU. As a minimum, each panel shall incorporate the following general control concepts to allow interface with external systems and devices. The electrical / PSU interlocks and alarms shall be determined by the OSS. All application programming, in-house testing, and startup services of the PSU PLC shall be performed by the OSS.

3. Two modes of operation shall be provided for starting and stopping the PSU; ON (Local) and REMOTE.

4. All of the settings previously entered shall be stored when the PSU is switched off. When started again, the system shall use the last set value.

5. A hardwired Emergency Stop button shall be provided on the PSU control panel to shut down the PSU regardless of the mode of operation

6. Each PSU shall be equipped with the following:

   a. Control Power RESET / OFF / ON selector switch

   b. Power Supply POWER ON pilot light

   c. The PSU OIU shall display the following faults, at a minimum:

      1) Power supply unit fault

      2) Phase monitoring

      3) Under / over voltage protection

      4) EMERGENCY STOP activated

5) Cabinet temperature high

6) Transducer overload

7. Power supply on / off operation shall be controlled within the body of the power supply enclosure using a main line contactor.

8. Power supply branch circuit feeders shall originate from the 460 volt switchgear. The branch circuit feeder will be suitably protected from faults and overloads and a disconnecting means shall be provided in accordance with NEC.

2.12 SUPPLEMENTAL AIR SYSTEM (IF NECESSARY)

A. The OSS shall be responsible for providing any minor supply of nitrogen gas necessary to ensure continual, normal operation of each ozone generator. The OSS shall be responsible for the supply of a complete compressed air system with all appurtenances including, but not limited to one (1) oil free air compressor with air receiver tank, 0.01 micron coalescing particulate filter, desiccant air dryer, and all other accessories necessary to properly condition the air supply before feed to the generators.

B. The OSS shall supply a properly calibrated flow meter and dewpoint monitor on the conditioned air supply to the ozone generator to ensure that the conditioned, compressed air feed to the generator does not exceed 3 percent of the flow of pure oxygen gas.

C. The OSS will be responsible for providing all plumbing, wiring and conduit installation, and all instrumentation and control features for a completely operable, pre-assembled, skid mounted unit.

D. Provide a junction box mounted on the compressor skid, for connection of signal wiring between compressor skid and the MOCP.

E. The noise level of the air compressors shall not exceed 80 dBA as measured 3 feet away from the equipment.

2.13 OZONE GENERATOR COOLING SYSTEM

A. Provide one (1) closed loop chilled water cooling water system using cooling water from the building cooling loop, if required. If a chiller is not required, the ozone generator system may use a heat exchanger system using cooling water from the building cooling water loop.

B. The water used for the open loop side of the heat exchanger/water cooled chiller cooling shall be from the building chemically-treated closed loop system.

1. Building cooling water loop temperature: 50°F – 90°F

2. Building cooling water loop flow rate: 90 gpm

3. Building cooling water will be a 15% antifreeze, 85% distilled water mix

C. The closed loop chilled water cooling water system shall include the following:

1. Closed loop chiller or plate and frame heat exchanger
2. Recirculation pump
3. Expansion Tank
4. Pressure indicators
5. Temperature indicators
6. Drain, makeup, and isolation ball valves

D. Liquid chiller, if used

1. Liquid cooled 10.5 ton capacity
2. Integral circulation pump and expansion tank
3. Installed in ozone equipment room
4. Manufacturers: Temptek, or equal

E. Heat exchanger, if used

1. Heat exchanger shall be plate and frame type with individual removable plates contained in a common carrier assembly. The heat exchanger shall be designed, manufactured, and tested in accordance with the A SMI Builder and Pressure Vessel Code, Section VIII, Division 1. Heat exchanger shall be provided with a single pass, counter flow, looped flow U-arrangement, having all four process connections on one end.
2. Plates shall be constructed of 316 Stainless Steel and shall utilize non-clog patterns.
3. Plate and connection materials shall be 316 Stainless Steel.
4. Manufacturers: Tranter, Xylem Standard Exchange, or equal

F. Provide a junction box on the chiller skid, for connection of all signal wiring between chiller skid and the MOCP.

2.14 INJECTION SYSTEM

A. Ozone gas shall be transferred to the sedimentation basin effluent piping (upstream of the ozone contactor) by means of a sidestream solution injection system. The OSS shall furnish all materials and services required for a fully functional ozone sidestream injection system. The sidestream injection system shall be capable of achieving overall transfer efficiency of 95 percent.

B. The injection system shall include the following components as a minimum:

1. Skid-mounted ozone injection system, including:

a. Sidestream venturi eductor

b. Sidestream booster pumps

c. Ozone/liquid separator

d. Valves and instruments as required by the OSS

C. The injection system shall be designed to operate with a range of plant flow rates from 0.61 MGD – 1.22 MGD

1. Maximum capacity at a plant flow rate of 1.22 MGD and 20 mg/L dose

2. Minimum capacity at a plant flow rate of 0.61 MGD and 4 mg/L dose

D. The ozone injection system shall consist of one (1) sidestream injection skid, including:

1. One (1) ozone gas train manifold, consisting of the following components:

a. Manual isolation valves

b. Flow transmitter

c. Flow control valve

d. Liquid / Gas Separator with high level switch

e. Check valve

f. Pressure switch and pressure indicator

2. One (1) motive line consisting of the following components:

a. Manual isolation valves

b. Two (2) installed (one duty/one standby) end-suction centrifugal motive water pumps

c. Pressure indicators

d. One (1) installed venturi eductor (and one (1) shelf spare)

e. Check valve

f. Low flow switch

3. One (1) 12-inch diameter Pipeline Ozone mixer to be shipped loose for installation in the field by the DESIGN/BUILDER. Two (2) mixing nozzles shall be mounted to the side of the pipeline flash reactor.

E. Venturi Injector

1. The injectors shall be operated at a constant motive water flowrate to produce the ranges of gas suction capacities as follows:

a. Motive flow per injector: 305 - 345 gpm

b. Motive water inlet pressure: 5 - 35 psi

c. Outlet water backpressure: 5 - 10 psi

d. Ozone generator outlet pressure: 7 - 17 psig

e. Gas suction capacity: 1.0 – 11.24 scfm

2. Injectors shall have 4” 316L SS flanged inlet and outlet connections and a gas suction port. The injector shall be constructed of Type 316L stainless steel. Gasket material shall be premium grade, heavy duty PTFE material.

3. Manufacturer: Statiflo, Mazzei, or equal

F. Booster Pump

1. The injection system shall include a duty and standby constant speed, end suction type centrifugal pumps.

2. Materials: All liquid handling components shall be constructed of 316L stainless steel.

3. Connections: Pump shall utilize flanged connections to mate with ANSI 150 lb raised face flanges.

4. Seals: Seals shall be John Crane Type 21 mechanical seals.

5. Motors: Motors shall be horizontal TEFC squirrel-cage induction type, designed and manufactured, and tested in accordance with the latest revised NEMA MG1 and other applicable IEEE and ANSI standards.

6. Manufacturer: Goulds, or equal

G. Provide a junction box mounted on the injection skid, for the connection of all signal wiring between injection skid and the MOCP.

2.15 OZONE DESTRUCT SYSTEM

A. Provide one (1) skid-mounted thermal/catalytic ozone destruct shall receive moisture and ozone–laden oxygen from the top of the contactor, precondition the gas to eliminate moisture being applied to the catalyst bed, and destroy the residual ozone prior to discharging the off-gas to atmosphere.

B. The ozone destruct skid shall include the following:

1. Pre-heater

2. 316L Stainless Steel catalyst chamber

3. Cast aluminum off-gas blower with integrated silencer

4. Motorized inlet air valve for low off-gas flow operation

5. Valves and instrumentation required for a complete and operable system.

C. The off-gas shall flow through a demister (shipped loose) for moisture removal upstream of the ozone destruct system.

D. Each ozone destruct system shall be sized for the following conditions:

1. Inlet gas temperature range: 50 – 90 °F

2. Design inlet gas flow: 25 scfm

3. Minimum off-gas pressure at the contactor: To be determined

4. Maximum ozone concentration at destruct inlet: 12%

5. Maximum ozone concentration at destruct outlet: 0.1 ppm

E. Provide a local control panel for indoor installation which shall be mounted on the ozone destruct skid. See specifications regarding PLC and OIU manufacturer as well as integration requirements to the Owners existing DCS. Connection of the Ozone Destruct Control Panel to the MOCP shall be utilizing Cat 5/6e cable.

F. Provide ozone destruct unit capable of discharging contactor off-gas at concentrations less than 0.1 ppm of ozone by volume at the discharge stack with a design life expectancy for the catalyst of at least five (5) years.

G. The ozone destruct skid shall come equipped with one (1) exhaust blower, rated for the maximum flows and pressures as specified.

1. The blower shall include a variable frequency drive (VFD) for purposes of adjusting the blower speed at lower gas flow rates.

2. A make-up valve shall be provided at the suction of the blower for proper operation of the ozone destruct unit at lower gas flow rates.

3. The blower shall be cast aluminum construction, side-channel type.

4. The blower shall include an integral silencer, which shall limit the noise level to 85 dBA at 3 ft.

5. Manufacturer: Cincinnati Fan, Gardner Denver, or equal.

H. Each destruct skid shall be supplied with a pre-heater, prior to the off-gas contacting the ozone destruct catalyst.

1. Heater shall be immersion style with SCR-based control.

2. Manufacturer: Watlow, or equal

I. Any surfaces on the ozone destructor which operate with a surface temperature of more than 120 degrees F shall be properly insulated and covered with 0.016-inch thick aluminum jacketing. Insulation shall be UL rated, preformed, sectional, rigid fiberglass.

2.16 MAIN OZONE CONTROL PANEL

A. The OSS shall furnish and install a Main Ozone Control Panel (MOCP) which shall contain all required PLC hardware, software, and all appurtenances as required for the MOCP.

B. The MOCP shall be responsible for monitoring and controlling the ozone generators, the PSUs, supplemental air system, injection system, closed loop chiller system and the ozone destruct system and any other the associated ancillary equipment as provided by the OSS.

C. The MOCP shall communicate to the existing Emerson Ovation plant distributed control system (DCS).

D. REQUIREMENTS FOR MANUFACTURER-SUPPLIED PLCS

1. PLCs that are supplied for equipment local control panels by individual equipment manufacturers or suppliers shall be integrated into the existing Emerson Ovation Plant Distributed Control System (DCS). The manufacturer-supplied PLC shall be furnished and programmed by the manufacturer. The PLC shall continuously monitor and control the associated system and at the same time shall provide all the required alarms, indications of system parameters, equipment status, etc. to the DCS. The following local control panel PLC, OIU, Ethernet switch and uninterruptable power supply (UPS) components shall be provided. No substitutions or exceptions shall be allowed:

2. PLC shall be an Allen Bradley Model 1769 Compact Logix with a minimum L32E processor module or approved equal. The PLC shall utilize Allen Bradley Ethernet driver to communicate with the DCS.

3. Discrete Inputs:

   a. All discrete inputs to equipment and PLCs, from field devices, starters, panels, etc. shall be unpowered (dry) contacts in the field device or equipment, powered from the PLC, unless specified otherwise.

   b. Sensing power (wetting voltage) supplied by manufacturer-supplied PLCs may be either 24 VDC or 48 VDC. Sensing power may NOT be 120 VAC. Equipment manufacturer shall provide a listing of all discrete inputs from the DCS that require interposing relays.

4. Discrete Outputs:

   a. All discrete outputs from local control panels or PLCs to field devices, starters, panels, etc. shall be 24 VDC via relay outputs and powered (sourced) from power supplies within the PLC.

   b. PLC discrete outputs shall energize 24 VDC pilot relay coils in the field devices, starters, panels, etc. which in turn open or close contacts in the associated control circuit. The 24 VDC relay coil, contacts and associated control circuitry shall be furnished integral with the field device, starter, panel, etc. by the supplier

furnishing the field device, starter or panel. The 24 VDC pilot relays MAY NOT be located within the PLC enclosure. Equipment manufacturer shall provide a listing of all discrete outputs to the DCS that require interposing relays.

Where required or specified, discrete outputs from PLC equipment to field device, starters, panels motor operated valves, etc. shall be dry contact or relay outputs.

5. Operator Inteface Unit shall be Allen-Bradley PanelView Plus 7 1500 color touch screen with a 15" LCD display. Maple HMI HMI5150 XL touch screen with 15" LCD display, or approved equal.

6. Din rail mounted Cisco IE3000 managed Ethernet switch. No substitutions or exceptions shall be allowed.

7. Uninterruptable Power Supply:

    a. UPS by Liebert or APC with 30 minute back up with full load.

    b. UPS's shall be linetrue on-line, double conversion type. Each UPS shall be sized to match the maximum power requirements of the associated digital equipment, control panel power supplies and accessories.

    c. A status monitoring and control panel shall be provided and shall include the following:

    d. Status indicating lights for both normal and abnormal conditions.

    e. Individual alarm contacts that shall close upon loss of the AC line, low battery level or UPS failure. Contacts shall be wired to the closest discrete input subsystem. All required interface software and hardware shall be provided.

8. All shared data between the UV PLC and the Ovation DCS system shall be set up in a manner that facilitates read/write access to/from the DCS via the Allen Bradley Protocol. DCS shall be programmed by the Owner to provide layered security access to the manufacturer PLC.

9. The operator interface for control of each individual system shall be performed by a local operator interface unit as specified above or by individual pilot devices on the equipment local control panel, as specified in the associated equipment specification section.

10. The DESIGN/BUILDER and the OSS shall coordinate testing and startup of the equipment provided by the OSS with the plant control system, including but not limited to the following tasks:

    a. Provide assistance with control system testing of inputs, outputs, and control strategies as needed.

b. Provide support or interface work necessary to perform physical checkout and field testing to the final field devices. The schedule may require the Owner and OSS personnel to perform loop checks simultaneously.

c. Coordinate and assist as needed to maintain I/O connectivity throughout the system.

d. Ensure personnel safety while equipment is exercised via the DCS.

e. Ensure that process, instrumentation, and control equipment are not damaged while equipment is exercised via the future control system.

f. Provide temporary modifications to field devices and their terminations, if needed.

g. Providing labor and supervision, which may include, but is not limited to, the following: electricians, instrument technicians, manufacturer's representatives, and individual(s) knowledgeable about process startup and operation.

h. Operation of process equipment for verification of each DCS input and output.

E. The local control panels shall be mounted on supplied skids. Each local control panel shall be equipped with face-mounted controllers/ indicators, selector switches, annunciation, equipment status indication, and pushbuttons for local control or maintenance of associated equipment. The local control panels shall be capable of and shall provide all the necessary functions to operate in a manual or an automatic mode.

F. CONTROL ALGORITHMS

1. The ozone system start/stop operation and ozone gas output shall be controlled remotely by the plant DCS. The plant DCS shall generate an ozone output demand signal to the ozone system based on one of the following algorithms residing in the Plant DCS programming.

   a. Control based on applied ozone dose.

   b. Control based on operator-entered ozone residual setpoint.

   c. Control based on influent nitrite and TOC concentrations.

2. Oxygen Gas Flow / Ozone Gas Concentration Control:

   a. The oxygen/ozone gas flow to each ozone contactor may be controlled manually (by adjusting the control valves located on the ozone gas lines to the respective contactors) or may be controlled automatically. The following describes the automatic control algorithm requirements of the system which shall operator independent of and regardless of which Ozone Generation Control Algorithm, as described above, is selected.

   b. The constant ozone gas concentration control loop is a single loop control process which shall be able to be used at the same time when either the Water Flow-Paced Control Loop or Dissolved Ozone Control Loop algorithms are in use. This control loop will have an operator input of desired ozone gas concentration (range from 5% to 12% by weight). The PLC shall use this

operator's input to compute a setpoint variable of the oxygen gas flow required to the ozone generator (scfm) to achieve the desired ozone concentration. This computed setpoint variable will be compared to the actual process oxygen gas flow as determined by the thermal mass oxygen flow meters. The control loop will then send a 4-20 mA output signal to a modulating valve and slowly adjust this valve until the proper oxygen gas flow is achieved. Achieving proper gas flow will thus directly correlate to achieving the desired ozone gas concentration. A dead-band of no greater than +/- 5% shall be applied to this control loop.

G. Emergency Shutdown

1. One (1) ambient oxygen leak detector shall be provided in the ozone generator room. The ambient oxygen leak detector shall have adjustable alarm setpoints and will energize an alarm for the following alarm setpoints:

    a. High alarm (oxygen concentration alarm setpoint not to exceed 22.5%)

    b. High-high alarm (oxygen concentration alarm setpoint not to exceed 23.5%)

2. Two (2) ambient ozone leak detectors shall be provided, one in the ozone generator room and one in the main process area. The ambient ozone leak detector shall have adjustable alarm setpoints and will energize an alarm for the following alarm setpoints:

    a. High ozone alarm (ozone concentration alarm setpoint not to exceed 0.1 ppmv)

    b. High-high ozone alarm (ozone concentration alarm setpoint not to exceed 0.3 ppmv)

3. If a high ozone alarm occurs, an alarm signal will be sent to the Plant DCS.

4. One (1) ozone monitor installed on the ozone destruct vent piping.

    a. If a high-high oxygen or high-high ozone alarm occurs, or a high ozone concentration in the vent gas piping is detected, an alarm signal will be sent to the Plant DCS, shutdown the ozone generators by a hard wired relay, and shut the oxygen supply valve.

5. If an emergency stop pushbutton is activated by plant personnel, an alarm signal will be sent to the Plant DCS, shutdown the ozone generators by a hard wired relay, shut the oxygen supply valve.

K. Graphic Displays

1. The graphic displays shall incorporate the detail as shown on the vendor supplied P&ID's along with dynamics and variables available from the vendor supplied instrumentation.

2. Custom graphics shall incorporate, but not be limited to, the following features and functions:

    a. The instrument tag numbers and equipment numbers shall be as assigned by the Owner.

b. Process lines and equipment shall be color-coded. The color scheme shall be proposed to the Owner for approval.

c. Process lines shall have directional flow arrows and shall enter and leave the related graphics displays at approximately the same screen location (from display to display).

d. Process lines shall have a description depicting line origin and destination.

e. Process lines shall be "targeted" where they enter and leave the graphics page so that the operator can select the target and call up the related graphics display, giving the effect of flowing between displays.

f. The operator shall have full control and functionality, from the custom graphics display, of any point appearing within the display. This includes, but is not limited to, set point changes, mode changes, controller tuning, alarm set point adjustment and similar point features.

g. The operator shall be able to acknowledge active alarms from the display.

h. Schematic displays shall be logically arranged and connected so that the operator can move from display to display by using targets, or selectable points, on the graphics.

3. Detailed graphic display development shall incorporate, but not be limited to the features and functions as described in Section 17126.

2.17 INSTRUMENTATION

A. Instruments in oxygen and/or ozone gas service shall be cleaned and shall be of suitable material for the appropriate service. Cleaned instruments shall be properly packaged and shipped to ensure that the instruments remain clean until installation. Install all instruments according to the manufacturer's instructions.

B. All meters and gauges mounted on the skid that have a local display shall be easily accessible. The displays shall face outwards, not require the operator to lean or bend excessively while reading measurements, and shall not require any type of ladder or step to view.

C. OSS shall include instrumentation as required to supply a fully functioning ozone generator system. The following requirements outline the basic instrumentation requirements. Each respective instrument shall conform to the following, as a minimum.

D. Ozone in Gas Analyzers

1. High Concentration Ozone Gas Monitor – One (1) per ozone generator in Ozone outlet line

a. Type

1) Ultraviolet absorption (UV) type at 254 nm wavelength

2) Microprocessor controlled

3) Certified suitable for oxygen / ozone service

4) Calibrated to IOA standards

5) Vent (exhaust) gas destruct shall be included

6) Auto zero with adjustable zero interval

b. Functional / Performance

1) Range: 0 – 25% by weight

2) Display Resolution: 0.01%

3) Accuracy: +/- 1% of full scale

4) Repeatability: +/- 0.5% of full scale

5) Response Time: < 30 seconds to 95%

c. Physical:

1) Wetted Parts: Teflon, 316SS, quartz glass

2) Housing: NEMA4X plastic enclosure

d. Electrical:

1) Input Voltage: 100 – 240 VAC, 74W max

2) Alarm contacts: Dual SPST relay with independently adjustable setpoints

3) Analog output: 4-20 mA proportional to concentration – adjustable range

4) Status output: SPST relay

e. Manufacturers:

1) Teledyne-API 465H

2. Medium Concentration Ozone Off-Gas Monitor – One (1) shipped loose for field installation.

a. Type:

1) Ultraviolet absorption (UV) type at 254 nm wavelength

2) Microprocessor controlled

3) Certified suitable for oxygen/ozone service

4) Calibrated to IOA standards

5) Internal sample gas conditioner for wet gas service

6) Vent (exhaust) gas ozone destruct included

7) Internal sample pump

8) Auto zero with adjustable zero interval

b. Functional / Performance

1) Range: 0 – 5% by weight and 0 – 10,000 ppm

2) Display Resolution: 0.001% wt

3) Accuracy: +/- 1% of full scale

4) Repeatability: +/- 0.5% of full scale

5) Response Time: < 45 seconds to 95%

c. Physical

1) Wetted Parts: Teflon, 316SS, quartz glass

2) Housing: NEMA 4X plastic enclosure

d. Electrical:

1) Input Voltage: 100 – 240 VAC, 74W max

2) Alarm contacts: Dual SPST relay with independently adjustable setpoints

3) Analog output: 4-20 mA proportional to concentration – adjustable range

4) Status output: SPST relay

e. Manufacturers:

1) Teledyne-API 465M

3. Low Level Ozone Gas Monitor – Two (2) for ambient ozone monitoring (one installed in ozone room and one installed in the process area), and one (1) installed on the discharge of the ozone destruct system.

a. Type:

1) Ultraviolet absorption (UV) type at 254 nm wavelength

2) Microprocessor controlled

3) Certified suitable for oxygen / ozone service

4) NIST traceable calibration

5) Internal sample pump

6) Auto zero with adjustable zero interval

b. Functional / Performance

1) Range: 0 – 500 ppm

2) Display Resolution: 0.001 ppm

3) Accuracy: +/- 1% of full scale

4) Repeatability: +/- 0.5% of full scale

5) Response Time: < 30 seconds to 95%

c. Physical:

1) Wetted Parts: Teflon, 316SS, quartz glass

2) Housing: NEMA 4X plastic enclosure

d. Electrical:

1) Input Voltage: 100 – 240 VAC, 74W max

2) Alarm contacts: Dual SPST relay with independently adjustable setpoints

3) Analog output: 4-20 mA proportional to concentration – adjustable range

4) Status output: SPST relay

e. Manufacturers:

1) Teledyne-API 465L

E. Dew Point Analyzer, if necessary

1. Air Service – One (1) unit installed on the Supplemental Air System.

a. Analyzer shall have a dew point range from -110°C to 20°C

b. Analyzer shall have a moisture content range from 0 to 3,000 PPM

c. Communication shall be via a linear 4-20mA output signal

d. Temperature compensation shall be included

e. Analyzer shall be housed in a stainless steel NEMA 4 enclosure

f. Manufacturers: Kahn Easidew, or equal

2. Oxygen Service – One (1) unit shipped loose for field installation on the main gaseous oxygen line after nitrogen addition.

a. Analyzer shall have a dew point range from -100°C to -40°C

b. Communication shall be via a linear 4-20mA output signal

c. Temperature compensation shall be included

d. Analyzer shall be housed in a stainless steel NEMA 4 enclosure

e. Manufacturers: Kahn Easidew, or equal

F. Ambient Oxygen Analyzer – One (1) unit shipped loose for field installation.

1. Type

a. Micro-Fuel Cell

b. Microprocessor controlled

c. Certified suitable for oxygen / ozone service

d. NIST traceable calibration

e. Auto zero with adjustable zero interval

2. Functional / Performance

a. Range: 0 – 25% by weight

b. Accuracy: +/- 5% of full scale

c. Repeatability: +/- 1% of full scale

d. Response Time: < 20 seconds to 90%

3. Physical:

a. Housing: NEMA4X plastic enclosure

4. Electrical:

a. Input Voltage: 100 – 240 VAC, 0.3A max

b. Alarm contacts: Dual SPST relay with independently adjustable setpoints

c. Analog output: 4-20 mA proportional to concentration – adjustable range

d. Status output: SPST relay

5. Manufacturers:

a. Teledyne-API, or equal

G. Flow Measurement

1. Water Service

    a. Rotameters

        1) Provide variable area flowmeters (rotameter) on the cooling water outlet lines from the ozone generator and PSUs.

        2) Flowmeters shall be hermetically sealed

        3) Measuring tube shall be constructed of transparent PVC and shall include a limit switch indicating low cooling water flow from the ozone generator.

        4) Float shall be constructed of PVDF, with an encapsulated magnet with only one polarization

        5) Manufacturers: ASV Stuebbe, or approved equal

    b. Flow Indicating Transmitters

        1) Provide a flow indicating transmitter for water service on the ozone sidestream injection piping.

        2) Flow meter shall be of the Magnetically inductive immersion-type

        3) The flow meter shall utilize a stainless steel housing and EPDM seats

        4) The measurement device shall utilize a 24 VDC supply and provide a 4-20 mA signal, one pulse output.

        5) Manufacturers: Gemu, or approved equal

2. Ozone Flow Measurement: Thermal Mass

    a. Provide ozone gas flow measuring devices on the ozone delivery piping on the sidestream injection skid.

    b. Ozone flow sensors (skid-mounted)

        1) Manufacturer: Rosemount, Endress & Hauser, Siemens, or approved equal

        2) Pipe Size: 1”

        3) Connections: Flanged

        4) Flow range: 1.5 to 20 scfm

        5) Measured fluid: ozone gas

        6) Sensor shall be constructed of 316L stainless steel

        7) Housing shall be of aluminum NEMA4X construction

        8) Accuracy: +/- 1.5%

9) Flow meter shall be powered by 24VDC control power

3. Oxygen Flow Measurement: Thermal Mass

a. Provide oxygen gas flow measuring devices on the oxygen inlet piping to the ozone generators.

b. Oxygen flow sensors (skid-mounted)

1) Manufacturer: Rosemount, Endress & Hauser, Siemens, or approved equal

2) Pipe Size: 1”

3) Connections: Flanged

4) Flow range: 1.5 to 20 scfm

5) Measured fluid: oxygen gas

6) Sensor shall be constructed of 316L stainless steel

7) Housing shall be of aluminum NEMA4X construction

8) Accuracy: +/- 1.5%

9) Flow meter shall be powered by 24VDC control power

4. Air Service

a. Mass Flow Controller – Provide One (1) unit installed on the Supplemental Air System Skid.

1) Flowmeters shall utilize a linear scale for flow readings

2) Accuracy shall be +/- 1% of full scale

3) Body – Stainless Steel

4) Manufacturers: Omega, Burkert, Horiba or equal

H. Pressure Measurement

1. Water Service

a. Pressure Indicating Transmitters

1) A pressure indicating transmitters shall be provided on the sidestream eductor discharge piping

2) Wetted components shall be constructed of 316SS

3) Instrument shall be cleaned for oxygen service

4) Manufacturer: Rosemount, Foxboro, or approved equal

b. Pressure Indicators

1) Pressure indicators shall be provided on the cooling water inlet, sidestream pump suction, sidestream pump discharge, and sidestream educator discharge pipes.

2) Provide unfilled gauges with a 2.5” dial size

3) Accuracy shall be within +/- 1.5% of span

4) Gauge end connection and bourdon tube shall be constructed of 316SS. Casing shall be constructed of 304SS.

5) Manufacturer: Swagelock, Ashcroft, WIKA, or equal

2. Oxygen or Ozone Gas Service:

a. Pressure Indicators

1) Pressure indicators shall be provided on the ozone outlet piping from each ozone generator unit and the ozone delivery piping on the sidestream injection skid.

2) Gauges shall be oxygen cleaned

3) Provide unfilled gauges with a 2.5” dial size

4) Accuracy shall be within +/- 1.5% of span

5) Gauge end connection and bourdon tube shall be constructed of 316SS. Casing shall be constructed of 304SS.

6) Manufacturer: Swaglock, Ashcroft, WIKA or equal

b. Pressure Transmitters

1) Pressure transmitters shall be provided on the oxygen inlet line to each ozone generator unit.

2) Pressure transmitters shall be a combination transmitter / safety switch

3) Wetted components shall be constructed of 316SS

4) Instrument shall be cleaned for oxygen service

5) Manufacturer: Rosemount, Foxboro, or approved equal

c. Differential Pressure Indicators

1) A differential pressure indicator shall be provided to measure the pressure drop across the ozone destruct reactor.

2) Indicator shall include an aluminum housing

3) Flanges, drain, and vent shall be constructed of stainless steel

4) O-ring shall be constructed of glass-filled PTFE

5) Indicator shall include inert sensor fill fluid

6) Manufacturer: Rosemount, Foxboro, or approved equal

3. Air Service:

a. Pressure Indicators

1) Gauges shall include a minimum 1.5” dial

2) Case and bezel shall be constructed of stainless steel

3) Indicator internals and connection shall be constructed of air

4) Manufacturer: Swaglock, Ashcroft, WIKA or equal

b. Pressure Indicating Transmitter

1) Provide a pressure indicating transmitter on the nitrogen boost piping.

2) Transducer shall be housed in stainless steel body

3) Transducer shall utilize a 4-20 mA output

4) Supply voltage shall be 24V

5) Accuracy shall be 0.4% of full scale

6) Sealing material shall be Neoprene

7) Manufacturer: Rosemount, Foxboro, or approved equal

I. Temperature Measurement

1. Temperature Transmitters

a. Provide RTDs with transmitters on the ozone outlet line from each ozone generator unit.

b. Temperature probes shall be furnished with a thermowell.

c. Operating Temperature Range: -50 to 400°C

d. Measuring insert shall be 2 x Pt100 in 2-wire circuit, with Class B tolerance

e. Process connection shall be ½” threaded connection

f. Manufacturer: Rosemount, Endress and Hauser, or approved equal

2. Temperature Gauges

a. Provide temperature transmitters on the oxygen inlet line and cooling water inlet line on each ozone generator unit, and the cooling water outlet line on each PSU.

b. Gauges shall be supplied with a 3” dial

c. Dial range shall be 0 – 200°F

d. Process connection and stem shall be constructed of 316SS

e. Lens shall be constructed of laminated safety glass

f. Manufacturer: Swagelok, Ashcroft, WIKA or equal

3. Temperature switches

a. Provide temperature switches on the ozone generator and PSU cooling water outlet lines from each unit.

b. Close-coupled, liquid filled type vapor-pressure thermal type

c. Thermowells shall be provided for each temperature switch assembly

d. Switch enclosure shall be NEMA 4X or 7, as required

e. Manufacturer: SOR, Ashcroft, United Electric, or equal.

2.18 VALVES

A. Pressure Relief Valves

1. Water Service

a. Pressure relief valves shall be of the spring-loaded type and ASME certified

b. Valve body shall be constructed of 316L SS

c. Manufacturer: Leser or equal

2. Oxygen or Ozone Gas Service

a. Pressure relief valves shall be of the spring-loaded type and ASME certified

b. Valve body shall be constructed of 316L SS

c. Manufacturer: Leser, Kunkle or equal

3. Air Service

a. Pressure relief valves shall be of the spring-loaded type and ASME certified

b. Valve seat, cap and piston shall be of brass construction

c. Valve spring shall be of stainless steel construction

d. Valve seal shall be silicone or Viton

e. Manufacturer: Conrader or equal

4. Ozone Off-Gas Service (for Contactor)

a. OSS shall supply combination pressure / vacuum relief valves for installation on top of the ozone contactor.

b. Valves shall be of the open vent type

c. Valves shall be flanged and constructed of 316SS and shall be cleaned for oxygen service

d. Valves shall utilize PTFE seals

e. Valves shall be sized based on the following criteria:

1) Pressure cracking setpoint: To be determined

2) Vacuum cracking setpoint: To be determined

3) Ozone contactor fill rate: 120 scfm

f. Manufacturer: Shand & Jurs, Varec or equal

B. Ball Valves

1. Water Service

a. Body material shall be stainless steel

b. Ball material shall be 316 stainless steel

c. Seat material shall be Teflon

d. Manufacturer: GEMÜ or equal

2. Oxygen or Ozone Gas Service

a. Body and ball shall be stainless steel

b. Seat material shall be Teflon

c. Flanged connections

d. Manufacturer: GEMÜ or equal

1) Actuators shall be electrically powered from 24V DC circuits

2) Valve and actuators shall be designed for open / close operation

3) Manufacturer: GEMÜ or equal

3. Air Service

    a. Valve body and ball shall be of brass construction, with threaded ends

    b. Valve seat shall be PTFE

    c. Manufacturer: Smith Cooper or equal

C. Butterfly Valves

1. Water Service

    a. Valves shall be lug type and shall have ASME 150 flanged connections

    b. Disc / shaft material shall be stainless steel

    c. Seal material shall be Teflon / EPDM

    d. Where shown on drawings, valves shall be actuated

    e. Manufacturer: GEMÜ or equal

        1) Actuators shall be electrically powered from 24V DC circuits

        2) Valve and actuators shall be designed for open / close operation

        3) Manufacturer: GEMÜ or equal

D. Flow Control Valves

1. Oxygen or Ozone Gas Service

    a. Valves

        1) Body material shall be 316 stainless steel

        2) Seating material shall be PTFE

        3) Valve shall be spring to close

        4) Valve connections shall be ANSI flanged

        5) Valve Manufacturer: Schubert & Salzer, Sharpe or equal

    b. Actuators

        1) Actuator shall be for flow control operation

        2) Actuator shall be operated from 24V DC control power

        3) Actuator Manufacturer: Schubert & Salzer, Sharpe or equal

2. Ozonated Off-Gas Service

a. Valves

1) Body material shall be 316 stainless steel

2) Seating material shall be PTFE

3) Valve connections shall be threaded

4) Valve Manufacturer: Schubert & Salzer, or equal

b. Actuators

1) Actuator shall be for flow control operation

2) Actuator shall be operated from 24V DC control power

3) Actuator Manufacturer: Schubert & Salzer, or equal

E. Needle Valves

1. Air Service

a. Body and needle shall be of brass construction

b. Seat material shall be fluoroelastomer

c. Manufacturers: Deltrol N30B or equal

F. Check Valves

1. Water Service

a. Valve body material shall be stainless steel

b. Seat material shall be PTFE

c. Manufacturer: Schubert & Salzer or equal

2. Oxygen or Ozone Gas Service

a. Check valve shall be angle seat body type

b. Seal materials shall be PTFE

c. Valve body and inner part materials shall be 316SS

d. Manufacturer: Schubert & Salzer or equal

3. Air Service

a. Check valves shall be of the inline type, with the same size inlet and outlet

b. Valve material shall be brass

c. Manufacturer: Conrader or equal

G. Pressure Regulating Valves

1. Oxygen or Ozone Gas Service

a. Valve shall be of flangeless, wafer-type construction

b. Valve body, head section, stem, and fixed disc shall be constructed of 316SS

c. Diaphragm material shall be EPDM

d. Manufacturer: Schubert & Salzer, Cashco or equal

2. Air Service

a. Regulators shall be of the diaphragm-type

b. Valve housing shall be constructed of polyamide

c. Valve seals shall be constructed of Acrylonitrile Butadiene Rubber

d. Manufacturer: Bosch Rexroth or equal

H. Solenoid Valves

1. Oxygen / Ozone Gas Service

a. Valves shall be piston seat type, with forced lifting

b. Valves shall be provided with ANSI flanges

c. Valve body and cover shall be constructed of 316SS

d. Valve cover seal, seat seal, and grooved ring shall be constructed of PTFE

e. Manufacturer: Norgren Buschjost, or equal

2. Air Service

a. Valve body shall be of brass construction

b. Valve seals and discs shall be constructed of NBR or PTFE

c. Manufacturer: ASCO or equal

2.19 ACCESSORIES

A. Oxygen Gas Particulate Filter

a. Filter housing material shall be aluminum

b. Seating and O-ring materials shall be Viton

c. Filter media shall be borosilicate glass fiber fleece

d. Hydrostatic test pressure shall be >150 psig

e. The filter shall be sized for particle removal down to 0.01 µm

f. The gas pressure loss through the filter shall not be greater than 2 psi when the filter is clean

g. Manufacturer: Donaldson, Graver Technologies or equal

2.20 PIPING

A. The OSS shall adhere to the following piping requirements:

1. LOX and Gaseous Oxygen Piping

a. 316L stainless steel

b. All required flange gaskets shall be full face gaskets of material suitable for use in oxygen gas service, either Teflon or Gore-Tex.

2. Ozone / Oxygen Piping

a. Use 316L stainless steel, schedule 10S or thicker as required for proper welding. All flanges shall be raised face and serrated.

b. All required flange gaskets shall be full face gaskets of minimum 1/8 inch thick hard Teflon suitable for use in high concentration ozone gas service (10% - 12% wt)

3. Cooling Water Piping

a. Use 316L or 316Ti SS, with raised face ANSI 150 flanges

b. All required flange gaskets shall be full-face gaskets of material suitable for use in cooling water service

4. Insulating Flange Sets

a. OSS shall provide an insulating flange set on all copper to stainless steel flange connections

b. Each insulating flange set shall include a Teflon, full-face insulating gasket, acetyl resin or equal insulating sleeves and washers, and stainless steel washers as required.

5. All piping shall be run in vertical and horizontal planes. Piping shall be arranged to ensure that undue stresses from thermal expansion are not transmitted to equipment components.

6. The OSS shall design the layout of all associated ozone piping on each skid. The DESIGN/BUILDER is responsible for the design and supply of all the interconnecting piping, pipe supports, hangers, wiring, conduit, etc.

2.21 FACTORY TESTING

A. Hydrostatic Tests. Each ozone generator fully assembled with all of the associated face piping, valves, and field instruments shall be subjected to a hydrostatic factory test prior to shipment. The shop test pressure shall be 1.3 times the gas and water design pressures and held for at least two hours or as required by the specified standard or code. Any leaks or failures discovered during testing shall be repaired and the unit shall afterwards be retested until no leakage occurs

B. Factory Acceptance Testing

1. Before shipping of any equipment from the OSS factory to the jobsite, each new ozone generator shall undergo a factory test, which the DESIGN/BUILDER, Owner, and Engineer may witness, in which the generator is the run and produce ozone at the specified ozone gas concentration. The OSS shall notify the DESIGN/BUILDER of the factory test date at least two weeks before the test is to occur. Should the DESIGN/BUILDER, Owner, or Engineer wish to witness the factory test, all related expenses (i.e. airfare, travel and living costs) shall be borne by the respective parties. Other costs directly associated with the factory test, including setup and operation of an appropriate destruct system for the test and utilities (cooling water, power) shall be the responsibility of the OSS.

2. The failure of the ozone generator to produce at minimum / maximum rate will constitute a failed factory test. If a failed factory test occurs, the DESIGN/BUILDER may reschedule another identical factory test within four (4) weeks after the first failed factory test date.

3. At a minimum, the following test parameters shall be measured for each generator, at the maximum ozone production:

    a. Feed gas inlet pressure

    b. Dew Point

    c. Feed gas flow

    d. Ozone concentration

    e. Ozone production

    f. Converter active power

    g. Cooling water outlet temperature

    h. Cooling water flow rate

    i. PSU cooling water inlet temperature (if applicable)

    j. PSU cooling water outlet temperature (if applicable)

    k. PSU cooling water flow rate (if applicable)

PART 3 – EXECUTION

3.01 INSTALLATION

A. All equipment shall be installed in accordance with the printed recommendations of the OSS.

B. Installation of the dielectrics shall be performed by the OSS. Dielectrics shall be installed prior to shipment.

3.02 FIELD INSPECTION AND TESTING

A. Cleaning of Piping

1. Piping, valves, and all other equipment in oxygen and ozone gas service shall be cleaned according to conditions specified by the Compressed Gas Association and shall be of suitable materials for the appropriate service.

B. Testing of Piping

1. All associated ozone piping and fittings shall be tested as specified in this Section.

a. Ozone and oxygen feed gas piping systems shall be tested according to the following requirements

1) Testing media shall be pure, dry nitrogen or dry oxygen gas

2) Test pressure shall be 65 psig for a duration of not less than 24 hours. Maximum allowable pressure drop from start of test to completion of test shall not exceed 0.5%. The OSS shall supply pressure gauges for witnessing the test with a maximum of 1 ft or 0.5 psig tic increments.

3.03 PERFORMANCE TESTING

A. The OSS shall coordinate and conduct a performance test of the ozone generating system with DESIGN/BUILDER.

B. The ozone generator and power supply units shall be tested onsite under actual operating conditions to determine that the operation is satisfactory and the equipment meets the capacities specified. Testing shall be conducted in accordance with this specification and the following conditions:

1. Ozone generator power settings of 10, 25, 50, 75, and 100 percent of rated production with oxygen gas flows manually adjusted to maintain ozone gas concentrations as needed for instrumentation ranges and the gas mixing system.

2. Maximum cooling water flow rate and temperature as stated in the design conditions as available. If maximum CW temperature is not available, certified curves shall be used for adjustment of performance figures actually measured during the testing.

3. The generator test shall be conducted for 1 hour at each ozone production setting

a. The generator shall be operated for at least 30 minutes to obtain steady-state conditions

b. The test shall be conducted for the remaining 30 minutes

c. Data collection shall be performed at 15-minute intervals until the one-hour test is complete

d. Data collected from the last 30 minutes of the test will be used to evaluate generator specific power efficiency (kwh/lb of ozone gas) and ozone production.

4. The following data shall be collected:

a. Generator power with certified, calibrated meter. The meter used shall be a certified portable kW meter provided by the OSS

b. Gas flow to the generator

c. Ozone concentration using the generator's high concentration ozone monitor.

1) The ozone concentration measured by the ozone concentration monitor shall be the reading of record

2) All ozone gas concentration monitors shall be factory calibrated

d. Generator outlet water coolant temperature

e. Cooling water flow rate

f. Generator gas pressure

3.04 STARTUP AND FIELD TESTING

A. A field service technician or start-up engineer of the OSS shall commission the ozone generation equipment.

B. The field service technician shall certify that all equipment is properly installed and that the plant operators have been trained on proper operation and maintenance procedures.

C. The services of the Manufacturer's technical representative shall include the following site visits at a minimum:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	**10**
Startup and Performance Testing	1	**10**
Training	1	**3**

D. The costs of all inspection, startup, testing, adjustment, calibration, and instruction work performed by said factory-trained representatives shall be borne by OSS. All costs of power, water, liquid oxygen (LOX) and other required utilities shall be borne by the Owner.

E. The factory representative shall also train the OWNER's personnel in the operation of the entire ozone generation system. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by the DESIGN/BUILDER.

- END OF SECTION -

SECTION 12346

STEEL LABORATORY CABINETS AND ACCESSORIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish and install laboratory furniture, including base and wall cabinets with end panels; service shelves, ledges and decks; tops of solid surface, stainless steel at sample sink, and epoxy resin at fume hood, sink basins, service fixtures as specified and/or shown or scheduled on Drawings together with all miscellaneous items required for a complete and operational laboratory.

B. Furnish and install fume hoods including all accessories required for a fully functional fume hood. Coordinate exhaust fan requirements and flow with HVAC installer.

C. Coordinate and provide all necessary cutouts and openings for plumbing and electrical services as well as all filler panels and scribe strips as required where equipment abuts wall and corner conditions in order to obtain a completely enclosed assembly. Furnish brackets and supports as required to fully support countertops.

D. Coordinate final mechanical, electrical, and plumbing connections with other trades.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 06200 – Finish Carpentry (Solid Surface Countertop)

B. Section 09740 – Epoxy Floor Topping.

C Division 15 – Plumbing and Mechanical

D. Division 16 – Electrical

1.03 REFERENCES SPECIFICATIONS, CODES AND STANDARDS

A. Without limiting the generality of these specifications Work shall conform to the applicable requirements of the following documents:

1. SEFA 8 – Scientific Equipment and Furniture Association

1.04 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00-Submittal Procedures, submit the following:

1. Shop Drawings

a. Product Data: Provide dimensions and construction, equipment capacities, physical dimensions, utility and service requirements and locations, and point loads.

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b. Manufacturer's Installation Instructions: Indicate installation requirements.

c. Location Plan: Indicate casework and equipment locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, and clearances required. Show all finished ends, fillers, supports and other accessories.

d. Wiring Diagrams: Comprehensive schematic diagrams showing wiring for each individual item of electrical equipment and all interconnecting wiring. Shop drawing(s) with indicated electrical devices and wiring identification shall be provided by the hood manufacturer to ensure proper hood electrical connections and operation.

2. Samples: Submit two samples of each type of exposed surfaces, illustrating color and finish.

3. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

4. Operation Data: Include description of equipment operation, adjusting and testing required.

5. Maintenance Data: Identify system maintenance requirements, servicing cycles, lubrication types required and local spare part sources.

1.05 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. Furnish qualified field representative of the manufacturers to supervise the installation of laboratory furniture.

1.06 QUALITY ASSURANCE

A. Provide casework, accessories, work tops, fume hoods, and other built in work to assure proper staging, shipment from a single steel laboratory contractor.

B. Provide certification that furniture meets the performance requirements described in SEFA 8.

C. Installers shall have at least 5 years of experience and certified by the manufacturer.

D. All materials used and work performed must conform to the laws and ordinances of the state, municipality, or other political subdivision within which work under this contract is performed.

1.07 PROJECT CONDITIONS

A. Do not deliver or install equipment until the following conditions have been met:

1. Windows and doors are installed and the building is secure and weather tight.

2. Ceiling, overhead ductwork and lighting are installed.

3. Painting is completed and flooring is installed.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver laboratory furniture to the job site and protect same by adequate means against damage during handling, storage and installation.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:

1. Kewaunee Scientific(Basis of Design)

2. BMC Industries

3. Mott Manufacturing

2.02 CASEWORK DESIGN REQUIREMENTS

A. Flush construction: Surfaces of doors, drawers and panel faces shall align with cabinet fronts without overlap of case ends, top or bottom rails. Horizontal and vertical case shell members (panels, top rails and bottoms) shall meet in the same plane without overlap, cracks or crevices.

B. Slimline styling: Front width of end panels 3/4" and front height of top and bottom members 1".

C. Self-supporting units: Completely welded shell assembly without applied panels at ends, backs or bottoms, so that cases can be used interchangeably or as a single, stand-alone unit.

D. Interior of case units: Easily cleanable, flush interior. Base cabinets, 30" and wider, with double swinging doors shall provide full access to complete interior without center vertical post.

E. Drawers: Sized on a modular basis for interchange to meet varying storage needs, and designed to be easily removable in field without the use of special tools.

F. Case openings: Rabbeted-like joints all four sides of case opening for hinged doors and two sides for sliding doors in order to provide dust resistant case.

G. Framed glazed doors: Identical in construction, hardware and installation to solid panel doors. Design frame glazed doors to be removable for glass replacement.

H. Structural performance requirements: Casework components shall withstand the following minimum loads without damage to the component or to the casework operation:

1. Steel base unit load capacity: 500 lbs. per lineal foot.

2. Suspended units: 300 lbs.

3. Drawers in a cabinet: 150 lbs.

4. Utility tables (4 legged): 300 lbs.

5. Hanging wall cases: 300 lbs.

6. Load capacity for shelves of base units, wall cases and tall cases: 100 lbs.

2.03 CASEWORK MATERIALS

A. Sheet steel: Mild, cold rolled and leveled unfinished steel.

B. Minimum Gauges

1. 20 gauge: Solid door interior panels, drawer fronts, scribing strips, filler panels, enclosures, drawer bodies, shelves, security panels and sloping tops.

2. 18 gauge: Case tops, ends, bottoms, bases, backs, vertical posts, uprights, glazed door members, door exterior panels and access panels.

3. 16 gauge: Top front rails, top rear gussets, intermediate horizontal rails, table legs and frames, leg rails and stretchers.

4. 14 gauge: Drawer suspensions, door and case hinge reinforcements and front corner reinforcements.

5. 11 gauge: Table leg corner brackets and gussets for leveling screws.

C. Glass for glazed swinging and sliding doors and/or unframed doors: 6mm Clear Float Glass (unframed).

2.04 CASEWORK FABRICATION

A. Base Units and Cases

1. Base units and wall cases: End panels and back reinforced with internal reinforcing front and rear posts.

2. 49" and 84" high cases: Formed end panels with front and rear reinforcing post channels; back shall be formed steel panel, recessed 3/4" for mounting purposes.

3. Posts: Front post fully closed with full height reinforcing upright. Shelf adjustment holes in front and rear posts shall be perfectly aligned for level setting, adjustable to 1/2" o.c.

4. Secure intersection of case members with spot and arc welds. Provide gusset reinforcement at front corners.

5. Base unit backs: Provide drawer units without backs and cupboard units with removable backs for access to services behind units.

6. Bottoms: Base units and 25", 31", 37" and 49" high wall cases shall have one piece bottom with front edge formed into front rail, rabbeted as required for swinging doors and drawers and flush design for sliding doors.

7. Top rail for base units: Interlock with end panels, flush with front of unit.

8. Horizontal intermediate rails: Recessed behind doors and drawer fronts.

9. Base for base units: 4" high x 3" deep with formed steel base and 11 ga. die formed steel gussets at corners. Provide 3/8" diameter leveling screw with integral bottom flange of minimum 0.56 sq. in. area at each corner, accessible through openings in toe space.

10. Tops of wall cases: One piece, with front edge formed into front rail.

B. Drawers

1. Drawer fronts: 3/4" thick, double wall construction, prepainted prior to assembly and sound deadened.

2. Drawer Bodies: Bottom and sides formed into one-piece center section with bottom and sides coved and formed top edges. Front and back panels spot welded to center section.

3. Drawer suspension: Heavy duty coved raceways for both case and drawer with nylon tired, ball bearing rollers; self-centering and self-closing when open to within 3" of the closed position.

4. Provide drawer with rubber bumpers. Friction centering devices are not acceptable.

C. Doors

1. Solid panel doors: 3/4" thick, double wall, telescoping box steel construction with interior prepainted and sound deadened, top corners welded and ground smooth. Reinforce interior of front panel with welded steel hat channels. Hinges with screws to internal 14 gauge reinforcing in case and door. Hinges shall be removable; welding of hinges not acceptable. Doors shall close against rubber bumpers.

2. Frame glazed doors: Outer head to be one piece construction. Inner head to consist of top, bottom and side framing members which are removable for installation or replacement of glass. Provide continuous vinyl glazing retainer to receive glass. In all other respects, framed glazed door construction and quality shall match solid panel doors.

3. Sliding doors - solid or framed glazed: Design for tilt-out removal after removal of bottom guide. Doors shall be hung with nylon tired sleeve bearing rollers in formed steel top hung track and shall close against rubber bumpers.

4. Unframed sliding glass doors: Glass with edges ground set in extruded aluminum shoe with integral pulls, wheel assemblies and top and bottom extruded aluminum track. Provide rubber bumpers at fully opened and closed door position.

D. Shelves

1. Form front and back edges down and back 3/4". Form ends down 3/4".

2. Reinforce shelves over 36" long with welded hat channel reinforcement the full width of shelf.

3. Pull out shelves: Same suspension as specified for drawers.

E. Base molding: 4" high rubber.

F. Corner base guards: 4" high #304 stainless steel corner guards.

G. Hardware

1. Drawer and hinged door pulls: Clear anodized extruded aluminum, screw attached on 4" centers.

2. Pull Location: Horizontal at drawers, vertical at doors.

3. Sliding door pulls: Recessed stainless steel, styled and sized to harmonize with drawer pulls.

4. Hinges: Institutional type, five knuckle projecting barrel hinges, minimum 2-1/2" long, type 302 or 304 stainless steel. Provide two hinges for doors up to 36" high; three hinges for doors over 36" high. Drill each leaf for three screw attachment to door and frame.

5. Door catches: Adjustable type, spring actuated nylon roller catches.

6. Elbow catches: Spring type of cadmium plated steel, with strike of suitable design.

7. Shelf clips: Die formed steel, zinc plated, designed to engage in shelf adjustment holes.

2.05 SPECIAL PURPOSE STORAGE CABINETS

A. Acid and Base Storage Cabinets: Specifically designed for the storage of acids and bases. Provide cabinets below fume hood and vented through fume hood. The cabinet shall be labeled: "ACID" – "BASE".

2.06 METAL FINISHES

A. Preparation: Spray clean metal with a heated cleaner/phosphate solution, pretreat with iron phosphate spray, water rinse, and neutral final seal. Immediately dry in heated ovens, gradually cooled, prior to application of finish.

B. Application: Electrostatically apply urethane powder coat of selected color and bake in controlled high temperature oven to assure a smooth, hard satin finish. Surfaces shall have a chemical resistant, high grade laboratory furniture quality finish of the following thickness: Liquid dripped, solvent based finishes are not and will not be acceptable.

1. Exterior and interior exposed surfaces: 1.5 mil average and 1.2 mil min.

2. Backs of cabinets and other surfaces not exposed to view: 1.2 mil average.

C. Cabinet Surface Finish Tests: Full compliance with SEFA 8 – 1998 standards.

1. Independent, third part performance testing must be submitted validating compliance to the finish specifications.

D. Metal Finish Performance Requirements

1. Abrasion resistance: Maximum weight loss of 5.5 mg per 100 cycle when tested on a Taber Abrasion Tester #E40101 with 1,000 gm wheel pressure and Calibrase #CS10 wheel.

2. Hardness: Surface hardness equivalent to 4H or 5H pencil.

3. Humidity resistance: Withstand 1,000 hour exposure in saturated humidity at 100 degrees F.

4. Moisture Resistance

a. No visible effect to surface finish after boiling water trickled over test panel inclined at 45 degrees for five minutes.

b. No visible effect to surface finish following 100 hour continuous application of a water soaked cellulose sponge, maintained in a wet condition throughout the test period.

5. Adhesion: Score finish surface of test panel with razor blade into 100 squares, 1/16" x 1/16", cutting completely through the finish but with minimum penetration of the substrate, and brush away particles with soft brush. Minimum 95 squares shall maintain their finish.

6. Salt spray: Withstand minimum 200 hour salt spray test.

E. Chemical Resistance Finish Performance Requirements

1. Test procedure: A finished test panel shall be laid flat and level on a horizontal surface. Chemical spot tests shall be made by applying 10 drops (approximately 0.5 cm^3) of each reagent identified to the surface to be tested. Each reagent spot

shall be open to the atmosphere. Ambient temperature shall be 68°-72°F (20-22.2°C). After a test period of one hour, chemicals shall be flushed away with cold water and the surface washed with detergent, warm water at 150°F (65.5°C) and alcohol to remove surface stains. Surface shall be examined under 100 foot candles of illumination.

2. Evaluation ratings: Change in surface finish and function shall be described by the following ratings:

   a. No effect: No detectable change of finish film.

   b. Excellent: Indicates excellent to superior integrity of finish film. Includes no effect or slight change in gloss and slight discoloration.

   c. Good: Allows change of gloss or discoloration or surface discoloration while retaining integrity of finish film.

   d. Fair: Objectionable changes in appearance due to slight swelling or change in gloss while retaining integrity of finish film.

   e. Poor: Obvious and significant deterioration, including pitting or erosion of finish material.

3. Test results: Chameleon Powder Coat CH
   (Concentration by weight)

Reagent	**Rating**
Acetic Acid-Glacial, 98%	Excellent-sl shadow
Formic Acid, 88%	Excellent-sl shadow
Hydrochloric Acid, 37%	No Effect
Nitric Acid, 25%	No Effect
Nitric Acid, 60%	Excellent-sl yellowing
Phosphoric Acid, 75%	No Effect
Sulfuric Acid, 25%	No Effect
Sulfuric Acid, 85%	Excellent-sl shadow
Ammonium Hydroxide, 28%	No Effect
Sodium Hydroxide, 10%	No Effect
Sodium Hydroxide, 25%	No Effect
Acetone	Excellent-sl shadow
Sodium Hypochlorite, 5.25%	No Effect
Ethyl Acetate	Excellent-sl shadow
Ethyl Alcohol	No Effect
Ethyl Ether	Excellent-sl shadow
Formaldehyde, 37%	No Effect
Hydrogen Peroxide, 30%	No Effect
Methylethyl Ketone	Excellent-sl shadow
Phenol, 85%	Excellent-sl shadow
Xylene	Excellent-sl shadow

2.09 WORK SURFACE AND ACCESSORIES

A. Material: Chemical and abrasion resistant, durable top of one inch thick cast material of epoxy resins and inert products, cast flat, with a uniform non-glare matte finish at fume hoods. Provide solid surface countertop typical in accordance with Specification 06200. Color samples of epoxy and solid surface materials shall be provided for color selection.

B. Backsplash curb: Same material as top, 4" high, butt jointed and cemented to top. Provide where tops abut wall surfaces. Include end curb where top abuts end wall.

C. Sinks: Undercounter mounted epoxy sinks shall be sealed to solid surface countertop. See drawings for dimensions. Sample sink shall be custom made stainless steel unit with sound deadening material applied and two drains. Provide perforated stainless steel splash guard at bottom of sink. Sink shall be integral with stainless steel top.

D. Bond epoxy sinks installed in countertops to produce an integral unit with invisible joint line. Bonding agent shall be compatible with solid surface and epoxy without staining.

E. Cup Sinks: Epoxy, 3”x6” nominal size provide one in fume hood.

F. Color: shall be selected by Owner.

G. Pegboards: Stainless steel with replaceable solid white polypropylene pegs with glassware protector base. 4½” stainless steel drip-stop trough with drain located on right side.

2.10 PERFORMANCE REQUIREMENTS FOR EPOXY RESIN MATERIALS

A. Test procedure: Apply five drops of each reagent to surface and cover with 25mm watch glass, convex side down; test volatiles using one ounce bottle stuffed with saturated cotton. After 24 hour exposure flush surface, clean, rinse and wipe dry.

B. Evaluation ratings: Change in surface finish and function shall be described by the following ratings:

1. No Effect: No detectable change in surface material.

2. Excellent: Slight detectable change in color or gloss, but no change to the function or life of the work surface material.

3. Good: Clearly discernible change in color or gloss, but no significant impairment of work surface function or life.

4. Fair: Objectionable change in appearance due to surface discoloration or etch, possibly resulting in deterioration of function over an extended period.

5. Poor: Pitting, cratering or permanently etching of work surface material; obvious and significant deterioration.

C. Test Results - Epoxy Resin Work Surface (Black):

	CHEMICAL		RATING
1.	Hydrochloric Acid	20%	No Effect
2.	Hydrochloric Acid	37%	No Effect

	CHEMICAL		RATING
3.	Nitric Acid	20%	Excellent
4.	Nitric Acid	70%	Good
5.	Sulfuric Acid	30%	No Effect
6.	Sulfuric Acid	77%	No Effect
7.	Sulfuric Acid	96%	Poor
8.	Phosphoric Acid	85%	No Effect
9.	Perchloric Acid	60%	No Effect
10.	Aqua Regia	--	No Effect
11.	Chromic Acid	60%	Good
12.	Acetic Acid	98%	No Effect
13.	Formic Acid	90%	No Effect
14.	Boric Acid	Sat.	No Effect
15.	Citric Acid	Sat.	No Effect
16.	Oxalic Acid	Sat.	No Effect
17.	Hydrobromic Acid	48%	No Effect
18.	Hydroflouric Acid	48%	Good
19.	Vinegar	--	No Effect
20.	Ammonium Hydroxide	28%	No Effect
21.	Sodium Hydroxide	10%	No Effect
22.	Sodium Hydroxide	40%	No Effect
23.	Sodium Hydroxide	Flake	No Effect
24.	Potassium Hydroxide	10%	No Effect
25.	Zinc Chloride	Sat.	No Effect
26.	Calcium Hypochlorite	Sat.	No Effect
27.	Clorox Bleach	--	No Effect
28.	Silver Nitrate	10%	No Effect
29.	Sodium Sulfide	Sat.	No Effect
30.	Sodium Chloride	Sat.	No Effect
31.	Iodine, Tincture	--	No Effect
32.	Hydrogen Peroxide	--	No Effect
33.	Phenol	80%	No Effect
34.	Cresol	--	No Effect
35.	Formaldehyde	40%	No Effect
36.	Mineral Oil	100%	No Effect
37.	Glycerin	100%	No Effect
38.	Methyl Alcohol	100%	No Effect
39.	Ethyl Alcohol	100%	No Effect
40.	Buty Alcohol	100%	No Effect
41.	Naphtha	100%	No Effect
42.	Turpentine	100%	No Effect
43.	Kerosine	100%	No Effect
44.	Heptane	100%	No Effect
45.	Gasoline	100%	No Effect
46.	Benzene	100%	No Effect
47.	Toluene	100%	No Effect
48.	Xylene	100%	No Effect
49.	Acetone	100%	No Effect
50.	Methyl Ethyl Ketone	100%	No Effect
51.	Methyl Isobutyl Ketone	100%	No Effect
52.	Ethyl Acetate	100%	No Effect
53.	Ethyl Ether	100%	No Effect

	CHEMICAL		RATING
54.	Chloroform	100%	No Effect
55.	Methyl Chloride	100%	No Effect
56.	Trichlorethylene	100%	No Effect
57.	Carbon Tetrachloride	100%	Excellent
58.	Monochloro Benzene	100%	No Effect
59.	Dioxane	100%	No Effect
60.	Furfural	--	No Effect
61.	Congo Red	1%	No Effect
62.	Eosin Y	0.5%	No Effect
63.	Gentian Violet	1%	No Effect
64.	Indigo Carmen	0.5%	No Effect
65.	Methyl Green	0.5%	No Effect
66.	Wrights Blood Stain	0.35%	No Effect

2.11 SERVICE FITTINGS.

A. Manufacturer: Broen Lab USA, Waukesha, WI 53187 (877) 276-3652. Alternate manufacturers will be considered provided that they are certified by ISO 9001 to meet the requirements of the “Boss Line” by Broen Lab.

B. All service fixtures to match Broen Boss laboratory fixtures in all respects.

C. Materials

1. Material shall be carefully selected to accommodate the media used. The valve house shall be o high quality forged brass for maximum material density.

2. All fixtures for sample sinks must be in stainless steel have a coated brass column with internal PP or PE liner.

D. Valves: All valves must be fully assembled with mounting shanks and test before leaving the factory. All valves for gases and water to have an integrated shutoff valve for presetting of flow as shut off the maintenance (no deviation accepted).

E. Handles to be made of metal and powder coated according to US recommendations for media indication.

F. Nozzles: Nozzles for water, non-burning gases and oxygen shall be fixed but yet detachable with a hexagon key which is used inside of the nozzle to avoid damaging of the chemical resistant coating. The nozzle shall be tapered and shall be serrated. The valve house shall be prepared for female 3/8” connection once the nozzle has been removed.

G. Coating: The coating on all fixtures and handles must be color coded according to US recommendations to identify media used.

H. Pressure Testing: All fixtures must be pressure tested before leaving the factory. Maximum working pressure for water, air, vacuum, and non-burning gas fixtures must be 147 PSI (no deviation). Fixtures for burning gases must have a minimum working pressure of 100PSI.

I. Headworks: Head works for all laboratory service fixtures must be renewable units containing all working components subject to wear.

1. Water: Hot and cold water as well as CHWF and CHWR. Ceramic headwork cartridge (no deviation). Opening/closing function: 180 degree turn.

2. Gas: All fixtures for burning gases must be provided with a Press/Turn safety headwork with handle including pop-up indication safety buttons (no deviation). Internal O-rings and lubricant must be approved for burning gases.

J. Gooseneck

1. Water fixtures must be supplied with a field adjustable gooseneck for either partly swivel turn, 360 degrees, swivel turn or fixed in any desired location. Only double O-ring seal will be accepted.

2. All goosenecks shall provide a ½" male outlet thread for attachment of aerators, serrated nozzles, aspirators, etc.

3. Vacuum breaker must be integrated in gooseneck at all H/CW and CW faucets.

4. Goosenecks shall have 9" spread.

K. Electrical fixtures and fittings: Flush, pedestal or line type, provided in strict accordance with the current edition of the National Electric Code of the National Fire Protection Association, and with requirements of all local regulatory authorities. See Division 16.

2.12 FUME HOODS

A. Manufacturers

1. Subject to compliance with the Specifications, provide a low flow, 60 fpm, fume hood from one of the following manufacturers:

a. Labconco. (Basis of Design)

b. Kewaunee Scientific

B. Low Flow Fume Hood General Design Requirements

1. Fume hoods shall function as Low-Flow (60-80 fpm) ventilated, enclosed workspaces, designed to capture, confine and exhaust fumes, vapors and particulate matter produced or generated within the enclosure.

2. Design fume hoods for consistent and safe air flow through the hood face. Negative variations of face velocity shall not exceed 20% of the average face velocity at any designated measuring point as defined in this section.

3. Average illumination of work area: Minimum 80 foot-candles. Work area shall be defined as the area inside the superstructure from side to side and from face of baffle to the inside face of the sash, and from the working surface to a height of 28 inches.

4. Design fume hoods to minimize static pressure loss with adequate slot area and bell shaped exhaust collar configuration.

5. Fume hood shall maintain essentially constant exhaust volume at any sash position for safety. Maximum variation in exhaust CFM, static pressure and average face velocity as a result of sash adjustment shall not exceed 5% for any sash position at the specified exhaust volume.

6. Noise Criteria: Test data of octave band analysis verifying hood is capable of a 50 NC value when connected to a 50 NC HVAC source. Reading taken 3' in front of open sash at 60 fpm face velocity.

7. UL 1805 Specification: (Mandatory) Fume Hood must be Underwriters Laboratories subject 1805 classified. The 1805 standard covers electrical and mechanical hazards, investigates the flammability of materials and measures the effectiveness of airflow characteristics. Proper labeling must be affixed to the face of each fume hood indicating classification to the UL 1805 standard for Laboratory Fume Hoods. UL listing covering electrical components only or other listings that do not encompass all issues covered in UL 1805 is insufficient. All factory testing shall be performed in a U.L. certified test facility.

C. Fume Hood Liner Surface Finish Performance Requirements

1. Test liner for the following chemicals to achieve the following ratings:

2. Ratings are described as follows:

a. No Effect: No detectable change in surface material.

b. Excellent: Slight detectable change in color or gloss, but no change to the function or life of the work surface material.

c. Good: Clearly discernible change in color or gloss, but no significant impairment of work surface function or life.

d. Fair: Objectionable change in appearance due to surface discoloration or etch, possibly resulting in deterioration of function over an extended period.

e. Failure: Pitting, cratering or erosion of work surface material; obvious and significant deterioration.

3. Test Results: “P” Fume Hood Liner:

	Reagent List Concentrations by Weight	Test No. 1 Spills	Test No. 2 Fumes and Gases
1.	Sodium Hydroxide Flake	---	No Effect
2.	Sodium Hydroxide, 40%	Excellent	No Effect
3.	Sodium Hydroxide, 20%	Excellent	No Effect

	Reagent List Concentrations by Weight	Test No. 1 Spills	Test No. 2 Fumes and Gases
4.	Sodium Hydroxide, 10%	Excellent	No Effect
5.	Ammonium Hydroxide, 28%	No Effect	No Effect
6.	Eldorado - Plus (Solution)	No Effect	No Effect
7.	Chloroform	Excellent	No Effect
8.	LpH SE (Solution)	No Effect	No Effect
9.	Trichloroethylene	Excellent	No Effect
10.	Monochlorobenzene	Excellent	No Effect
11.	Tincture of Iodine	Excellent	Excellent
12.	Methyl Alcohol	No Effect	No Effect
13.	Ethyl Alcohol	No Effect	No Effect
14.	Butyl Alcohol	No Effect	No Effect
15.	Phenol, 85%	Excellent	No Effect
16.	Cresol	Excellent	No Effect
17.	Sodium Sulfide, Saturated	Good	No Effect
18.	Furfural	Fair	No Effect
19.	Dioxane	No Effect	No Effect
20.	Zinc Chloride, Saturated	No Effect	No Effect
21.	Benzene	Excellent	No Effect
22.	Toluene	Excellent	No Effect
23.	Xylene	Excellent	No Effect
24.	Gasoline	Excellent	No Effect
25.	Naphthalene	Excellent	No Effect
26.	Methyl Ethyl Ketone	Excellent	No Effect
27.	Acetone	Excellent	No Effect
28.	Ethyl Acetate	Excellent	No Effect
29.	Amyl Acetate	Excellent	No Effect
30.	Ethyl Ether	Excellent	No Effect
31.	Silver Nitrate, 10%	Good	No Effect
32.	Di Methyl Formamide	No Effect	Excellent
33.	Formaldehyde, 37%	No Effect	No Effect
34.	Formic Acid, 88%	No Effect	No Effect
35.	Acetic Acid, Glacial	No Effect	No Effect
36.	Dichloro Acetic Acid, 93%	Excellent	Excellent
37.	Chromic Acid, Saturated	Good	No Effect
38.	Phosphoric Acid, 85%	No Effect	No Effect
39.	Sulfuric Acid, 33%	No Effect	No Effect
40.	Sulfuric Acid, 77%	Excellent	No Effect
41.	Sulfuric Acid, 93%	Good	No Effect
42.	Hydrogen Peroxide, 30%	No Effect	No Effect
43.	Acid Dichromate	Excellent	No Effect
44.	Nitric Acid, 20%	Excellent	No Effect
45.	Nitric Acid, 30%	Excellent	No Effect
46.	40 & 47 Equal Parts	Excellent	Good
47.	Nitric Acid, 70%	Excellent	Good
48.	Hydrochloric Acid, 37%	No Effect	Excellent
49.	Hydrofluoric Acid, 48%	No Effect	Failure

D. Fume Hood Materials

1. Steel: High quality, cold rolled, mild steel meeting requirements of ASTM A366; gauges U.S. Standard and galvanized.

2. Stainless steel: Type 304; gauges U.S. Standard.

3. Ceiling closure panels: Minimum 18 gauge; finish to match hood exterior. Removable access panel to allow for service and maintenance access.

4. Downdraft bypass: Low resistant type, 18 gauge steel chamber, directional louvers – not acceptable. All bypass air shall enter top of bypass chamber and enter hood in a downflow direction. Chamber shall protect user from expelled particulate in the event of an adverse internal reaction.

5. Safety glass: 3/16" thick laminated safety glass or 3/8" thick laminated safety glass viewing panel.

6. Sash chain: ANSI #35 steel, single strand. Average tensile strength of 2,400 pounds, maximum working load of 480 pounds.

7. Sash guides: Extruded PVC.

8. Pulley assembly for sash chain: Finish bored steel drive sprockets and keyed drive, 1/2" dia. front connector shaft. Rear idler sprockets; double sealed ball bearings type, lubricated. All sprockets steel with zinc dichromate finish.

9. Sash pull: Full width corrosion resistant steel with chemical resistant powder coating. Maximum 1.5" thick.

10. Gaskets: White 70 durometer PVC for interior access panels. Gasket interior access panels to eliminate air leakage and to retain liquids inside hood.

11. Fastenings:

    a. Exterior structural members attachments: Sheet metal screws, zinc plated.

    b. Interior fastening devices concealed. Exposed screws not acceptable. (Screw head "caps" not acceptable.)

    c. Exterior side access panel member fastening devices to be exposed corrosion resistant, non-metallic material, creating a positive mechanical latch. Latch must be flush type. Exposed screws or velcro type fasteners – not acceptable.

12. Instruction plate: Corrosion resistant or plastic plate attached to the fume hood exterior with condensed information covering recommended locations for apparatus and accessories, baffle settings and use of sash.

E. Fume Hood Construction

1. Superstructure: Rigid, self supporting assembly of double wall construction, maximum 4-7/8" thick.

   a. Wall consists of a sheet steel outer shell and a corrosion resistant inner liner, and houses and conceals steel framing members, attaching brackets and remote operating service fixture mechanisms and services. Panels must be attached to a full frame construction, minimum 14 gauge galvanized members. Panels and brackets attached to eliminate screw heads and metallic bracketry from hood interior.

   b. Access to fixture valves concealed in wall provided by exterior removable access panels, gasketed access panels on the inside liner walls, or through removable front posts.

2. Exhaust outlet: Rectangular with ends radiused, shaped and flanged, 18 gauge steel finished with Chameleon powder coating.

3. Access opening perimeter: Air foil or streamlined shape with all right angle corners radiused or angled. Bottom horizontal foil shall provide nominal one inch bypass when sash is in the closed position. Bottom foil shall be removable without use of special tools. Bottom foil shall provide access areas for electrical cords. Bottom foil: Steel with black powder coating or stainless steel to increase acid and abrasion resistance.

4. Fume hood sash: Full view type with clear, unobstructed, side to side view of fume hood interior and service fixture connections.

   a. Bottom sash rail: 2" maximum, 18 gauge steel with powder coating finish. Provide integral flush pull the full width of bottom rail.

   b. Set safety glass into rails in deep form, extruded polyvinyl chloride glazing channels.

   c. Counter balance system: Single weight, pulley, cable, counter balance system which prevents sash tilting and permits one finger operation at any point along full width pull. Balance weight to be located off center on rear exterior of hood to prevent any conflict when fume hoods are placed back to back. Design system to hold sash at any position without creep and to prevent sash drop in the event of cable failure.

   d. Open and close sash against rubber bumper stops.

5. Airfoils: The perforated air foil shall be provided directly across the bottom of the sash opening to allow the air to bypass underneath and through the foil and sweep across the work surface to prevent any back flow of fumes escaping from the front of the hood. The foil shall be at least 4" wide and extend back under the sash to prevent closure of the lower by-pass opening when the sash is in the fully closed position. The air foil shall have a large aerodynamic radius to sweep the air into the hood with minimal turbulence and perforated to pull inflow air from beneath so that clean air continually flows over the foil creating a constant protective barrier from contaminants. This airflow shall continue even if blocked by the presence of the operator.

6. Liner and baffle: The interior liner and baffle(s) shall be cut to fit in terms of size and securely held in place. The baffle(s) shall provide uniform draw throughout the fume cavity. The hood shall include a two-baffle system. The first or primary baffle shall have multiple horizontal slots and shall direct the air to be exhausted in a non-turbulent/laminar flow stream from the hood face into the baffle in a single pass. The secondary baffle, located between the primary baffle and the back wall of the hood, shall neutralize any upward air streams and reduce air stream roll. Baffles shall be removable for cleaning. No moving parts shall be required for high performance airflow.

7. Remote adjuster: Toggle style control handle and an acid resistant label indicating proper control handle location for baffle function.

    a. Rigidly correlate control handles to baffle positioner; cable-type adjustments are not acceptable.

    b. Design baffle adjuster to engage and disengage from the adjustable baffle without the use of tools.

    c. Must comply with OSHA Lab Standard Guidelines.

    d. Baffles providing no adjustment or requiring internal manipulations are not acceptable.

    e. Non-metallic support and fasteners required inside of hood for completely metal free interior. This is critical for end user testing and lab procedures.

8. Fume hood liner: Poly-resin (product number denoted by the suffix "P"): Reinforced polyester panel; smooth finish and white color in final appearance. Flexural strength: 14,000 psi. Flame spread: 15 or less per U.L. 723 and ASTM E84-80. Baffle must be same material as liner. Metallic baffles, brackets or supports on hood interior – not acceptable. Liner and baffle material must meet 1.03 performance test. Independent test validation is mandatory.

9. Service fixtures and fittings: Color coded washers at hose nozzle outlets and valves mounted inside the fume hood and controlled from the exterior with color coded index handles.

    a. Valves: Needle point type with self-centering cone tip and seat of hardened stainless steel. Tip and seat shall be removable and replaceable.

b. Provide piping for all service fixtures from valve to outlet: Galvanized iron or copper for water, air and vacuum and black iron for gas services.

c. Fixtures exposed to hood interior: Brass with chemically resistant color coded powder coating.

d. Remote control handles: Black nylon four-arm handle with nylon color-coded index buttons.

e. Services: As shown or specified.

10. Service Fixtures and Fittings

a. Service treatment: Fittings are to be coated with a chemically resistant polyester powder lacquer electrostatically applied and backed on for a uniform finish. Epoxy coatings are not acceptable.

b. Handle and outlet nozzle will be color coded to the media, with the same polyester powder lacquer finish. Outlet nozzles shall be made of the same high quality brass as the valve bodies. Other materials may be in contact with media where appropriate.

c. Provide piping for all service fixtures from valve to outlet: Galvanized iron or copper for water, air and vacuum and black iron for gas services.

d. Fixture fittings shall incorporate quick-connect compression fittings on the valve body (for the media inlet and media outlet) as well as the fume hood outlet nozzle. With this system, no soldering or brazing should be required to complete mechanical connections.

e. Fixtures exposed to fume hood interior. Brass with chemically resistant polyester powder lacquer color coded to the media.

f. Fixtures are to be provided with easy-to-mount attachment device for secure mounting in deck or wall mounted applications. System to be installed with simple hand tools.

g. Fittings are to be constructed to operate with the following maximum working pressure without leak or failure.

- Water Fittings: 145 PSI
- Non-Burning Gas: 145 PSI
- Burning Gases: 100 PSI
- Special Water Fittings: 145 PSI
- Oxygen Fittings: 145 PSI

h. All outlets shall have detachable serrated nozzles.

i. All valves shall be front-loaded for ease of access and maintenance at point of use.

11. Hood light fixture: Two lamp, rapid start, UL listed fluorescent light fixture with sound rated ballast installed on exterior of roof. Provide safety glass panel cemented and sealed to the hood roof.

    a. Interior of fixture: White, high reflecting plastic enamel.

    b. Size of fixture: Largest possible up to 48" for hoods with superstructures up to six feet. Provide two 36" fixtures for hoods with eight foot superstructures.

    c. Include lamps with fixtures. Hoods without lamps – not acceptable.

    d. Illumination: Per performance values, Part 1 of this Section.

    e. Access to light thru lintel panel – no tools required.

    f. Electrical services: Three wire grounding type receptacles rated at 120 VAC at 20 amperes. Flush plates: Black acid resistant thermoplastic.

12. Work Surfaces: 1-1/4" thick surface, dished a nominal 3/8” to contain spills.

    a. Molded resin work surfaces for hoods with Poly-resin liners.

13. Safety Monitor/Alarm System: provide Safety Monitor/Alarm System which monitors face velocity and provides audible and visual alarm if face velocity drops below 50 FPM or rises above 170 FPM.

    a. Safety monitor: UL listed, with all alarm circuit electric components, external tubing, restrictors, and manifolds furnished complete and factory installed. Monitor shall have light emitting diode display which provides clear indication of airflow conditions. Safety monitor shall be tamper proof.

    b. Factory calibrate monitor based upon user-specified face velocity.

    c. Airflow sensor: Thermally compensated glass-beaded thermistor, factory connected to a manifold assembly at the fume hood collar to facilitate multipoint air flow sensing.

    d. Alarm signal: Audible pulsating signal and a visual, flashing red large light emitting diode.

        i. Silence pushbutton, which disables the audible alarm for a period of five minutes shall be accessible on the front of the Safety Monitor.

        ii. Provide alternate mode in which visible alarm is silenced indefinitely but visual alarm remains activated until the alarm condition is corrected.

        iii. It shall not be possible to routinely disable the alarm signal.

        iv. When alarm condition is corrected and face velocity and volume return to specified levels, the Safety Monitor will automatically reset and begin routine monitoring.

v. Test circuit will be provided to verify proper Safety Monitor operation.

vi. System that permits users to routinely or easily reset alarm signal points or turn off power to the unit is unacceptable.

vii. Electrical rating: Maximum 15 VDC, and maximum current rating of 200MA.

14. Receptacles

a. Provide 110v duplex receptacle and 220v duplex receptacle for fumehoods used for cynide testing.

b. Provide (2) 110v duplex receptacles for all other fumehoods.

15. Blowers

a. Coordinate fume hood blowers with HVAC design.

F. Testing of Fume Hood

1. Evaluation of manufacturer's standard product shall take place in manufacturer's own test facility, with testing personnel, samples, apparatus, instruments, and test materials supplied by the manufacturer at no cost to the Owner.

2. Submit test report consisting of the following test parameters and equipment for each hood width and configuration specified.

3. Hood shall achieve a rating of 4.0 AM 0.05 PPM or better. Tested to ASHRAE-110-1995 readings at all points.

G. Electrical Requirements

1. Fume hood shall be furnished with a factory installed lights and lighting switch.

2. Two 120V receptacles, mounted to the front of the hood, shall be provided. Additionally, one 240V receptacle mounted to the front of the fume hood shall be furnished where indicated on the drawings.

3. The hood shall be provided with a factory installed control switch for manually turning the hood blower on and off, mounted to the front of the hood. Coordinate controls with HVAC design

4. All internal wiring shall be factory installed, clearly marked and terminated at a common junction box within the hood.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Install plumb, level, true and straight with no distortions. Shim as required, using concealed shims. Where metal laboratory furniture abuts other finished work, scribe and apply filler strips for accurate fit with all fasteners concealed where practicable.

B. Set base cabinets straight, plumb and level. Adjust within 1/16" of a single plane. Where required, assemble units into one (1) integral unit with joints flush, tight and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16". Provide holes for mechanical, plumbing and electrical work as shown or as directed by trades involved.

C. Securely fasten wall cabinets to solid supporting materials; not plaster, lath or wallboard. Anchor, adjust and align wall cabinets as specified for base cabinets. Reinforcement of stud walls to support wall-mounted cabinets shall be performed during wall erection by the trade involved, working from laboratory furniture shop drawings.

D. Adjust laboratory equipment and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

E. Securely attach access panels but provide for easy removal and accurate realignment.

3.02 CLEANING AND TOUCH UP

A. Clean all surfaces, including both sides of all glazing. All cabinets shall be left with an unblemished finish, shop coats of paint shall be "touched up" as needed. Touch up paint shall be furnished to the Owner.

- END OF SECTION -

SECTION 12500

WINDOW TREATMENT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Furnish all labor, materials, equipment and appliances required for the complete execution of the Work show on the Drawings and Specified herein.

1.02 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:

1. Manufacturer's product data and installation instructions.

2. Color samples.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The following manufacturers are approved for use.

1. Hunter Douglas, Flexalum Decor 1 inch Aluminum Blind.

2. Levolor Corporation, Monaco 1 inch Blind.

2.02 MATERIALS

A. Headrail: 1 inch by 1 inch deep "U"-shaped channel fabricated from 0.024 inch phosphate treated steel with rolled edges and with baked on polyester enamel finish to match color of slats. Enclose hardware in headrail.

B. Bottomrail: Manufacturer's standard steel bottom rail with baked on polyester finish to match color of slats. Provide end caps, of color coordinated thermoplastic.

C. Slats: Aluminum alloy, 1 inch wide and .0075 inch thick, unperforated. Painted solid colors.

D. Tilter: Steel housing. Worm and gear construction, with worm gear, shaft and gear of die-cast metal or other suitable material.

E. Tilt Wand: Extruded clear acrylic with tubular construction, and detachable without tools.

F. Tilt Rod: Solid steel with corrosion resistant finish.

G. Cord Lock: Steel with corrosion resistant finish. Locking device shall be crash proof.

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H. End Locks: Steel lock with an adjustable tab for centering blinds.

I. Braided Ladder: Polyester yarn of color compatible with slats.

J. Lift Cords: Two ply polyester cord filler, and braided polyester jacket, .070 inch diameter.

K. Ladder Tape Roll: Manufacturer's standard.

L. Tilt Rod Support: Manufacturer's standard.

M. Tape Locks: Manufacturer's standard.

N. Installation Brackets: .042 inch steel with baked on polyester finish to match headrail. Blinds over 60 inches wide shall have intermediate support brackets.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Install window treatments in strict accordance with manufacturer's instructions.

B. Install window treatments level and plumb. Provide adequate clearance for proper operation.

- END OF SECTION -

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SECTION 13207

POLYETHYLENE STORAGE TANKS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. The Design/Builder shall furnish, deliver, install, test and place in satisfactory operation cross-linked high-density polyethylene storage tanks, complete with all necessary accessories, at the locations shown on the Drawings and as specified herein.

B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions.

1.02 CONDITIONS OF SERVICE/STORAGE TANK SCHEDULE

	Aluminum Chlorohydrate Bulk Tank	**Sodium Hydroxide Bulk Tank**	**Sodium Hypochlorite Day Tank**
Max Solution Concentration	50%	50%	15% Trade
Specific Gravity	1.34	1.525	1.2
Viscosity	< 50 cps	70 cps	2.6 cps
Freezing Point	25°F	54°F	-10°F
pH	2.5-4.6	14	12-13
Quantity	One (1)	One (1)	One (1)
Type	Vertical, Cylindrical	Vertical, Cylindrical	Vertical, Cylindrical
Bottom Configuration	Flat Bottom	Flat Bottom	Flat Bottom
Top Configuration	Dome Top	Dome Top	Dome Top
Useable Capacity	6,000 gallons	1,000 gallons	440 gallons
Maximum Diameter	10'-2"	5'-4"	4'-0"
Maximum Straight Shell Height	10'-5"	7'-2"	5'-2"
Maximum Overall Height	12'-5"	8'-6"	6'-4"
Connection Openings:			
1) Fill Line	2"	2"	2"
2) Metering Pump Suction	4"	3"	3"
3) Overflow Line	3"	3"	3"
4) Vent	6"	6"	3"
5) Manway Diameter	24"	17"	17"
6) Level Instrument	*	*	*
Heating Panels and Insulation	No	No	No
Materials of Construction of Metal Fasteners in Containment Area	Titanium, C-276 or Coated 316 SS	316 SS	Titanium or Coated 316 SS
Materials of Construction of Metal Fasteners above Containment Area	316 SS	316 SS	316 SS
Materials of Construction of Elastomers	EPDM or Viton	EPDM	Viton
Containment Wall Height**	**	**	**

* Coordinate with instrumentation supplied by Design/Builder

** Refer to Drawings

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1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. American National Standards Institute (ANSI)

1. ANSI B16.5 – Pipe Flanges and Flanged Fittings.

B. American Society of Testing Materials (ASTM)

1. ASTM D638 – Standard Test Methods for Tensile Properties of Plastics.

2. ASTM D746 – Brittleness Temperature of Plastics and Elastomers by Impact.

3. ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

4. ASTM D883 – Standard Definitions of Terms Relating to Plastics.

5. ASTM D1505 – Density of Plastics by the Density-Gradient Technique.

6. ASTM D1525 – Vicat Softening Temperature of Plastics.

7. ASTM D1693 – ESCR Spec. Thickness .125” F50-10% Igepal.

8. ASTM D1998 – Standard Specification for Polyethylene Upright Storage Tanks.

1.04 SUBMITTALS

A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01 33 00, Submittal Procedures; and Section 11000, Equipment General Provisions:

1. List of at least three similar installations of the tank type, size, chemical service, and location conditions being proposed, including date installed, contact name, address and phone number

2. Warranty

3. Dimensions of tank and dimensions and location of fittings and attachments

4. Weight of tanks

5. Drawing details for ladder as recommended by Manufacturer and conforming with OSHA standards

6. Wall thickness calculations per ASTM D 1998-06 using 600 psi design hoop stress @ 100°F

7. A complete manufacturer’s specification of the resin used

8. Statement that materials and resin used are suitable for intended service

9. Statement that fabrication is in accordance with these Specifications

10. Instructions for handling, storage and installation of tanks

11. Supporting information of UL tank manufacturing capabilities

12. Supporting information of ISO 9001 certification

13. Supporting information of NSF 61 certification

1.05 QUALITY ASSURANCE

A. Tanks shall be constructed by a firm that has at least ten (10) years prior experience in construction of similar polyethylene tanks in similar applications.

B. Tanks shall be manufactured by a firm with a nationally accepted quality standard (i.e., ISO 9001 or equal).

1.06 WARRANTY AND GUARANTEE

A. Warranty and Guarantee shall be as specified in Section 11000.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The polyethylene storage tank(s) shall be as manufactured by Poly Processing Company, Snyder Industries, or equal.

2.02 MATERIALS AND CONSTRUCTION

A. Each tank shall be one-piece construction, rotationally molded, high-density cross-linked polyethylene. Tank shall have a specific gravity rating of 1.9 and shall be completely resistant to corrosion by the specified chemicals. The tank manufacturer shall be fully responsible for the structural design and integrity and watertightness of the tank, including all anchorages and connections. Each tank shall be capable of storing the specified chemical at temperatures up to 130°F.

B. All materials in contact with the stored chemical shall be NSF 61 certified for use in the treatment of drinking water. Tank manufacturer shall provide a low-density polyethylene liner if required for oxidation resistance for the specified chemicals.

C. The plastic shall not contain any fillers. All plastic shall contain a minimum of 0.25 percent UV stabilizer and maximum of 0.60 percent. Pigments may be added as designated by the manufacturer, not to exceed 0.5 percent of dry blended or 2 percent if melt compound of the total weight of the tank.

D. The nominal properties of the material are as follows based on molded parts:

Property	ASTM Specification	Value
Density	D1505	.940 to .945 g/cc
ESCR Specification Thickness .125" F50 10% Igepal	D1693A	>1,000 hours
Tensile Strength Ultimate 2 in/min	D638 Type IV Specification	2,830 psi
Elongation at Break 2 in/min.	D638	700 percent
Vicat Softening Temperature	D1525	240 degrees F
Flextural Modulus	D790B	86,700 psi

E. Design Requirements

1. The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the following equation, but shall not be less than 0.187 in thick.

   T = P x O.D./2 SD = 0.433 x S.G. x H x O.D./2 SD
   T = wall thickness
   SD = Hydrostatic design stress, PSI
   P = pressure (.433 x S.G. x H), PSI
   H = fluid head, ft.
   S.G. = specific gravity, g/cm^3
   O.D. = outside diameter, in.

2. The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM D2837 using rotationally molded samples, with a service factor selected for the application. The hydrostatic design stress is 600 PSI at 73 degrees Fahrenheit.

3. The hydrostatic design stress shall be derated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.

4. The standard design specific gravity shall be 1.9.

5. The minimum required wall thickness for the cylinder shell must be sufficient to support its own weight in an upright position without any external support.

6. For dome top tanks, the top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall. The cover shall be provided with a manway and connections as described herein and as shown on the Drawings.

F. All tank capacities (volumes) specified shall include only that volume in the straight shell below the overflow pipe invert elevation and above the top of the outlet pipe. At least four inches of freeboard shall be provided between the invert elevation of the overflow pipe and the top of the straight shell.

G. Tanks shall be anchored to the concrete base in accordance with the Drawings.

H. The tanks shall be cylindrical and vertical in orientation with tank penetrations as indicated on the Contract Drawings.

2.03 CONNECTIONS AND ACCESSORIES

A. All connections/openings shall be flanged in accordance with ANSI B 16.5 150 pounds. Flanged connections, nozzles and openings shall be reinforced and shall be perpendicular to the straight shell of the tank. All pipe supports, gaskets, hardware, accessories, etc., shall be provided. All piping connected to the tanks shall be perpendicular or parallel to the straight shell of the tanks. All piping into the tanks shall be supported such that no weight is placed on the tank and its connections. Piping supports requiring holes through the side wall of the tanks shall not be allowed.

B. Each tank connection located on the lower third of the tank shall be provided with a flexible connector resistant to the specified chemical to allow for lateral and vertical expansion and contraction of the tank and to isolate the tank from pump and piping vibration. Flexible connectors shall be provided by the tank manufacturer.

C. Sidewall fittings above the chemical fill level shall be Schedule 80 PVC or CPVC bulkhead fittings. Sidewall fittings below chemical fill level shall be bolted one-piece polyethylene with backing ring designed to reduce stress on the fitting. Opening for pump suction line shall be Integrally Molded Flanged Outlet. Bolts and gaskets shall be constructed of materials as shown in the Storage Tank Schedule.

D. Vent lines shall be top-mounted. Each vent shall be extended to the atmosphere and shall have a PVC vent insect screen.

E. Each bulk storage tank fill line shall be provided with a camlock type quick connect coupling with downstream ball valve as shown on the Drawings for connection with delivery vehicle. The dry quick connections shall be resistant to corrosion by the specified chemicals and shall be provided with fittings, quick lock coupling and dust cap and chain. The signage at each chemical fill station shall be as specified in Section 10400.

F. Each tank shall be provided with an overflow pipe as specified and indicated on the Drawings. The tank manufacturer shall provide a Flange Insert Check Valves (FIV) for the overflow pipe of interior storage tanks as shown on the Drawings. The FIVs shall be complete with unions, liquid traps, and flanges as indicated in the Drawings. The valves shall be flanged check valve type inserted between two mating flanges. The valves shall be the same size as the tank overflow line. Each valve shall have a cracking pressure of 0.5 psig. The valve bodies shall be constructed of PVC, and valve seats and metal springs shall be as specified in the Tank Schedule. The flange insert valves shall be as manufactured by Check-All Valves Manufacturing Company, or equal.

G. Each tank shall be provided with level instruments in accordance with Division 17, Control and Information Systems. The mounting and connecting requirements, including mounting flange diameter, required clearance between mounting flange and tank wall, and height above liquid level, shall be coordinated with the Design/Builder.

H. Each tank shall be provided with a top-mounted chemically-resistant manway with a bolt-on type cover for 24” manways and threaded cover for 17” or smaller manways. Gaskets and

bolts shall be resistant to specified chemicals. Manway cover shall provide emergency pressure relief venting.

I. Access Ladder - All tanks over six feet in height shall be equipped with an exterior access ladder for access to the manway. The ladders shall be constructed of FRP. Ladder shall meet OSHA requirements. Ladder shall provide 18 inches between side rails and 12 inches between rungs. Angle clips shall be furnished for mounting the bottom of the ladder to the concrete pad. Design/Builder shall coordinate bottom of ladder with tank pad. Ladders shall be furnished with gooseneck handrails at the top. The tank top shall be equipped with ladder clips to bolt ladder handrails thereto. Ladder clips shall be resistant to corrosion by the specified chemicals. Ladders must be mounted to the tank to allow for tank expansion and contraction due to temperature and loading changes. All top ladder mounts shall be connected to integrally molded in attachment lugs that allow for tank movement. Each tank ladder shall be equipped with a fall prevention system equal to the North Consumer Products "Saf-T-Climb" system. All construction materials shall be identical to the materials of construction of the ladder. The fall prevention system shall be equipped with rung clamp assemblies at 6 ft. maximum spacing and a dismount section extending 4'-6" above the landing level or 2 ft. above a railing. The fall prevention system shall meet or exceed federal specification RR-S-001301 and all OSHA regulations. Equipment shall be tested according to ANSI 14.3.

K. The tank shall be provided with a minimum of three lifting lugs integrally molded into the top head. Lifting lugs shall be capable of withstanding weight of an empty tank with a safety factor of 3 to 1.

L. Each tank shall be provided with a restraint system with necessary cable assemblies, anchor clips and anchor bolts. Materials in the containment area shall be completely resistant to corrosion by the specified chemicals. Restraint system shall be capable of withstanding buoyancy of empty tank in a containment area flooded to the top of the containment wall and seismic activity. Seismic restraint systems shall be designed to meet current UBC code. Refer to Drawings for containment wall height. The tank manufacturer shall submit calculations, sealed by a Professional Engineer, to verify that restraint system can withstand buoyancy and seismic activity. Anchor clips requiring holes through the side wall of the tanks shall not be allowed.

M. The tank shall be provided with a permanently attached label providing the following information:

- Type of material stored
- Concentration of material stored
- Specific gravity
- Maximum temperature
- Tank capacity
- Manufacturer
- Date of manufacture

2.04 PIPING SUPPORT

A. All horizontal sections of piping inside the containment area and trench shall be supported by thermoplastic pads at maximum 5 foot intervals as shown in the Drawings to prevent the piping from resting directly on concrete.

B. For vertical piping exterior to the tank, all pipe supports, hardware, accessories, etc., shall be provided for connections as shown in the Tank Schedule. Vertical piping into the tanks shall be supported every five feet and shall be parallel to the tank wall. External vertical piping shall be not less than 6 inches from the tank wall.

C. All piping into the tanks shall be supported such that no weight is placed on the tank or its connections. Piping supports shall not be bolted through the straight shell of the tanks.

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following site visits for each series of tanks:

Service	**Number of Trips**	**Number of Days/Trip**
Installation and Testing	1	1
Startup and Training	1	1

3.02 INSTALLATION

A. The polyethylene storage tanks and related items shall be installed in accordance with the manufacturers' recommendations and in accordance with Section 11000, Equipment General Provisions.

B. A manufacturer's field representative shall be on site when each tank is installed to observe installation and verify that each tank has been installed per manufacturer's recommendations. The manufacturer shall provide a report certifying that each tank has been installed properly.

C. All piping, valves, fittings, conduit, wiring, etc., required to interconnect system components shall be furnished and installed as required. Piping materials shall be as specified in Section 15390 – Schedule.

C. All metallic fasteners, brackets, mounting hardware, and accessories located in chemical storage and feed areas shall be constructed of corrosion-resistant metals as specified in the Tank Schedule.

D. A rubber pad shall be installed between each concrete pad and storage tank. The tanks shall be installed on level pads.

3.03 FIELD TESTING

A. Field testing shall be performed in accordance with Section 11000, Equipment General Provisions.

B. Upon completion of installation of tank and prior to connecting piping, blind flanges or other suitable plugs shall be provided for all openings in the tanks, tanks shall be filled with potable water provided by the Owner, and leakage tests shall be conducted as specified herein. Tanks shall be filled up to the top of the straight shell of the tank and left to sit over a 5-day test period. There shall be no leakage over the test period. Leakage around openings in the tanks shall be stopped by tightening nuts and bolts or replacing gaskets as required. Upon satisfactory completion of leakage test, the tanks shall be drained, and water shall be disposed of in a suitable manner.

- END OF SECTION -

SECTION 13450

DISINFECTION OF WATER TREATMENT FACILITIES

PART 1 -- GENERAL

1.01 GENERAL

A. Design/Builder shall clean and disinfect all water treatment facilities including, but not limited to flocculation and sedimentation system, ozone contact piping, biofilters, filter media, GAC vessels, UV disinfection system, GAC feed pump station, and all piping pumps etc. that convey water that is or will become potable, prior to placing the facilities into service in accordance with the regulations of the Virginia Department of Health and as specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 15 20 – Maintenance of Facility Operations

B. Division 11 – Equipment

C. Division 15 – Mechanical

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work hereunder shall conform to the applicable requirements of the following documents to the extent that the requirements therein are not in conflict with the provisions of this Section.

1. AWWA C652 – Disinfection of Water Storage Facilities

2. AWWA C653 – Disinfection of Water Treatment Plants

3. AWWA B300– Hypochlorites

1.04 SUBMITTALS

A. Design/Builder shall submit procedures for completing the disinfection of the plant facilities described herein, including the proposed methods of storing, handling and dispensing the disinfectant.

B. Submit a "Record of Compliance" stating that bacteriological testing has been accomplished and certifying that the water is free of coliform bacteria contamination. Results of this testing shall meet all Commonwealth of Virginia Department of Health requirements and regulations.

C. Testing and disinfection shall be accomplished in the presence of the Engineer.

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PART 2 -- PRODUCTS

2.01 WATER SUPPLY

A. Reasonable quantities of water necessary for initial and subsequent flushing, testing, and disinfection of all facilities associated with this Project shall be provided by the Owner.

B. No permanent connections shall be made to the potable water system for the purpose of flushing and disinfecting new water lines. A temporary connection with an Owner approved backflow prevention device shall be utilized to deliver potable water to the new waterline. Utilizing a portable pump with check vales is one method of preventing backflow and achieving the high flows that are needed to adequately flush large diameter waterlines.

C. All chemical equipment (pumps, testing kits, etc.) associated with leakage testing, cleaning, or rinsing of the facilities, disinfection and de-chlorination - shall be furnished by the Design/Builder. The Owner has limited facilities for potable water use and reserves the right to limit the volume of water used per day and the times of the day when the use of water is permitted for the project. Disposal of water for leak testing, cleaning and rinsing, disinfection and de-chlorination shall be performed by the Design/Builder in accordance with all federal, state and local requirements in such a manner as to cause no adverse environmental effects such as fish kills or erosion.

D. All basins, pipes, vessels, and appurtenances shall be filled slowly either through an existing valve or through taps. Special care shall be exercised in loading lines and filling basins, vessels and pipes to prevent damage. The Design/Builder shall coordinate with the Owner the operation of all existing valves. All valve operations shall be performed by the Owner's personnel only.

2.02 CHEMICAL

A. All chemicals required for disinfection shall be furnished by the Owner.

B. All chemicals used for disinfection and de-chlorination shall be NSF approved for use in potable water.

2.03 BACTERIOLOGICAL TESTING

A. The Owner shall furnish bacteriological testing for verification of disinfection procedures.

PART 3 -- EXECUTION

3.01 GENERAL

A. Materials

1. Chlorine for disinfection shall be in the form of sodium hypochlorite solution, or calcium hypochlorite granules or tablets.

B. Scheduling

1. The Owner shall be provided with a detailed plan for flushing, bacteriological sampling and testing, maintaining disinfected conditions in working area, treatment and/or disposal of super-chlorinated water, and disinfection plan for approval.

2. The Design/Builder shall coordinate all work with the Owner, and shall give the Owner at least 1 week advance notice of the intent to begin flushing, testing and disinfecting any portion of the water treatment and potable water distribution system.

3. All flushing, testing and disinfection shall be witnessed by a representative of the Owner and shall give the Owner at least 24 hours advance notice prior to performing any work.

C. Flushing

1. Excessive water shall be prevented from flowing onto private property.

D. Disinfection

1. The Owner shall be advised when the tank, vessel or pipe is ready for bacteriological sampling. The tank or pipe shall be sampled in accordance with AWWA C652.

2. The chlorine disinfection solution shall be thoroughly flushed out prior to placing the tank, vessel or pipeline into service. Spent chlorine solution must be disposed of in such a way as not to be detrimental to animal, plant or fish life. A NSF approved reducing agent may be added to the highly chlorinated water to reduce the chlorine residual to an acceptable level. A water disposal plan shall be submitted by the Design/Builder to the Owner prior to tank, vessel and pipe cleaning, filling or disinfection. Chlorine residual tests will be made by the Owner after flushing to assure that the chlorine residual is not in excess of 1 ppm.

3. No monetary compensation from the Owner shall be awarded for the inability of the Owner to provide adequate water at the proposed time of disinfection. Compensation is limited to an extension of time to perform filling activities only.

3.02 DISINFECTION OF BIOLOGICALLY ACTIVATED FILTERS

A. After placement and washing of the filter sand and gravel and before the placement of GAC media and before the filter is placed in service, the entire depth of the filter, media, underdrain system, and associated piping in each gravity filter cell shall be disinfected according to the following procedure unless an alternate procedure is required by VDH.

1. With all other filter valves closed, the filter shall be filled with finished water directed to the filter. Sufficient disinfectant (calcium hypochlorite or sodium hypochlorite) shall be added to the incoming water to achieve a level of 50 mg/l of free chlorine in the disinfecting water. This level of chlorine shall be maintained during the disinfection process.

2. The water level shall be maintained approximately 6 inches below the top of the filter box for not less than twenty-four (24) hours.

4. Upon completion of disinfection by the Design/Builder and satisfactorily passing bacteriological testing by the Owner, the filter contents shall be discharged to the plant drain system and properly dechlorinated by the Design/Builder in a manner acceptable to the Owner.

5. The Owner shall perform bacteriological testing for verification of disinfection of the biologically active filter cell and filter pertinent media.

3.03 DISINFECTION OF PUMP STATION WETWELLS AND CAN PUMPS

A. Wet Well Filling

1. All pipelines and wet wells shall be filled slowly either through pumping or connections to potable sources.

2. Special care shall be exercised in loading lines and filling wet wells to prevent damage to the new facilities.

3. The Design/Builder shall coordinate with the Owner the operation of all existing valves and pumps for wet well filling operations.

B. Wet Well Testing

1. The Design/Builder shall perform wet well inspection, water-tightness testing and evaluation in accordance with Section 01470.

C. Wet Well and Can Pump Disinfection

1. The wet wells and pump cans shall be disinfected in accordance with the procedures described in AWWA C652, Disinfection of Water Storage Facilities and specified herein. Disinfection shall be in accordance with all requirements and regulations of Virginia Department of Health.

2. The Design/Builder shall wash down the wet wells' interior to remove all dirt and loose materials prior to disinfection. Potable water shall be used to clean the wet well. All equipment, including brooms, brushes, spray equipment and workmen's boots shall be disinfected before they are used to clean the wet well. Prior to both testing and disinfecting, wet well shall be cleaned by thoroughly hosing down all surfaces with a high-pressure hose and nozzle of sufficient size to deliver a minimum flow of 50 gpm. All water, dirt and foreign material accumulated during this cleaning operation shall be properly de-chlorinated and discharged from the structure.

3. Disinfection shall be accomplished after the wet wells have been flushed. Disinfection shall be repeated as often as necessary, until the minimum residual chlorine content has been reached.

4. The Design/Builder shall be responsible for the discharge of water from the wet well after completion of the hydrostatic testing and disinfection is complete. Disposal of the water shall be in accordance with Federal, Commonwealth of Virginia, and local requirements.

5. The wet wells shall be disinfected by the method of chlorination outlined herein and in accordance with AWWA C652. The wet wells shall be filled to the overflow level with potable water to which enough chlorine has been added to produce an initial chlorine concentration of 50 mg/L in the full tank. The full wet well should stand for 24 hours while maintaining 50 mg/L chlorine residual level. At the end of the holding period, the chlorinated water shall be disinfected and properly discharged, the wet well refilled with potable water and tested for satisfactory bacteriological quality before placing the wet well in service.

6. The chlorine disinfection solution shall be thoroughly flushed out prior to placing the wet well in service. An NSF approved reducing agent shall be added to the highly chlorinated water to reduce the chlorine residual to an acceptable level. A water disposal plan shall be submitted to the Owner prior to wet well cleaning, filling and disinfection. Chlorine residual tests will be made after flushing to assure that chlorine residual is not in excess of 1 ppm.

3.05 DISINFECTION OF GAC VESSELS AND PIPING TO AND FROM THE GAC VESSELS

A. Disinfection of GAC Vessels shall be performed by the Design/Builder as specified in Section 11415. Disinfection of influent and effluent piping and valves both to and from the GAC vessels and all other piping and valves both to and from the GAC Vessels shall be performed by the Design/Builder as specified in Section 15000.

B. Prior to installing GAC media, the Design/Builder shall wash down each GAC Vessel interior to remove all dirt and loose materials prior to disinfection. Potable water shall be used to clean each GAC Vessel. Prior to both testing and disinfecting procedures, vessels shall be cleaned thoroughly hosing down all surfaces with a high-pressure hose and nozzle. All water, dirt and foreign matter accumulated during this cleaning operation shall be properly de-chlorinated and discharged from the structure.

C. Disinfection shall be accomplished after the GAC Vessels have been pressure washed and flushed and before media has been installed.

D. With all GAC Vessel filter valves closed, the vessel shall be completely filled with potable water. Sufficient disinfectant (calcium hypochlorite or sodium hypochlorite) shall be added to the incoming water to achieve a level of 50 mg/L of free chlorine residual in the disinfecting water. The GAC Vessel shall be maintained at full water level in the GAC Pressure Vessel for not less than twenty-four (24) hours.

E. Upon completion of disinfection of the GAC Vessel and satisfactorily passing bacteriological testing by the Owner, the GAC Vessel contents shall be discharged and properly de-chlorinated by the Design/Builder in a manner acceptable to the Owner and in accordance with Federal, Virginia Department of Health, and local requirements.

F. Disinfection of each GAC Pressure Vessel shall be performed as described herein directly before GAC media is installed in the vessel.

G. During the work described herein, including GAC Vessel pressure washing, flushing, disinfection, and media installation, the Design/Builder shall use appropriate personal protective equipment, including all work performed in confined spaces, and proper safety procedures while performing all work on the GAC Vessels. Safety of all workers in the GAC Pressure Vessel work area shall be ensured by the Design/Builder at all times. Design/Builder's safety plan shall be submitted to the Owner for approval.

3.06 DISINFECTION OF PIPING

A. Disinfection of piping and valves shall be performed by the Design/Builder as specified in Section 15000.

- END OF SECTION -

SECTION 14241

HOLELESS HYDRAULIC ELEVATORS

PART 1 -- GENERAL

1.01 SUMMARY

A. Section includes: Holeless hydraulic passenger elevators as shown and specified. Elevator work includes all work required for a code compliant, ADA compliant, seismic resistant, and fully functional elevator with the following items:

1. Standard pre-engineered holeless 2-stage hydraulic passenger elevator.

2. Elevator car enclosures, hoistway entrances and signal equipment.

3. Guide, cylinder, hydraulic unit and accessories.

4. Operation and control systems.

5. Accessibility provisions for physically disabled persons.

6. Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.

7. Materials and accessories as required to complete the elevator installation.

8. Coordination with security system with hall control button first floor lobby.

9. Coordination of hoistway and pit requirements.

B. Related Sections:

1. Division 3 Concrete: Installing inserts, sleeves and anchors in concrete. Hoistway and pit dimensions and configurations.

2. Division 5 Metals: Providing hoist beams, pit ladders, steel framing, auxiliary support steel and divider beams for supporting guide-rail brackets. Providing steel angle sill supports and grouting hoistway entrance sills and frames.

3. Division 9 Finishes: Providing elevator car finish flooring and field painting unfinished and shop primed ferrous materials.

4. Division 15 Plumbing: Sump pit and pump. Include oil minder control and pump system

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5. Division 16 Sections:

   a. Providing electrical service to elevators, including fused disconnect switches.

   b. Emergency power supply, transfer switch and auxiliary contacts.

   c. Heat and smoke sensing devices.

   d. Convenience outlets and illumination in machine room, hoistway and pit.

   e. Conduits for control wiring and coordination with security system.

1.02 SUBMITTALS

A. Shop drawings:

   1. Show equipment arrangement in pit and hoistway. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.

   2. Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.

   3. Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.

   4. Indicate electrical power requirements and branch circuit protection device recommendations.

   5. Layouts for cab and controls showing compliance with Virginia Statewide Building Code Accessibility requirements and the American with Disabilities Act (ADA).

   6. Control schematics showing security and call button interface and normal operation schematics.

B. Submit manufacturer's standard selection charts for exposed finishes and materials.

C. Operation and maintenance data. Include the following:

   1. Owners Manual and Wiring Diagrams.

   2. Parts list, with recommended parts inventory.

1.03 QUALITY ASSURANCE

A. Qualifications: Approved manufacturer with minimum fifteen years experience in manufacturing, installing, and servicing elevators of the type required for the project.

   1. Must be the manufacturer of the power unit, controller, signal fixtures, door operators cab, entrances, and all other major parts of the elevator operating equipment.

a. The major parts of the elevator equipment shall be manufactured in the United States, and not be an assembled system.

2. The manufacturer shall have a documented, on-going quality assurance program.

3. ISO-9001:2000 Manufacturer Certified

B. Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than fifteen years of satisfactory experience installing elevators equal in character and performance to the project elevators.

C. Regulatory Requirements:

1. ASME/ANSI A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code.

2. Virginia Statewide Building Code.

3. NFPA 70 National Electrical Code.

4. NFPA 80 Fire Doors and Windows.

5. Americans with Disabilities Act Accessibility Guidelines (ADAAG).

D. Fire-rated Entrance Assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, UL10(B), and NFPA 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory.

E. Inspection and testing: Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.

1. Arrange for inspections and make required tests.

2. Deliver to the Owner upon completion and acceptance of elevator work.

1.04 DELIVERY, STORAGE AND HANDLING

A. Manufacturing will deliver elevator materials, components and equipment and the Design/Builder is responsible to provide secure and safe storage on job site.

1.05 PROJECT CONDITIONS

A. Prohibited Use: Elevators shall not be used for temporary service or for any other purpose during the construction period before Substantial Completion and acceptance by the purchaser unless agreed upon by Elevator Design/Builder and General Design/Builder with signed temporary agreement.

1.06 WARRANTY

A. Warranty: Submit elevator manufacturer's standard written warranty agreeing to repair, restore or replace defects in elevator work materials and workmanship not due to ordinary wear and tear or improper use or care for 12 months from date of Substantial Completion.

1.07 MAINTENANCE

A. Furnish maintenance and call back service for a period of 12 months from date of Substantial Completion during normal working hours, excluding callbacks. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation.

1. Manufacturer shall have a service office and full time service personnel within a 100 mile radius of the project site.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer: Otis HydroFit (Basis of Design), ThyssenKrupp Elevator, Kone, or approved equal.

2.02 MATERIALS, GENERAL

A. Colors, patterns, and finishes: As selected by the Architect from manufacturer's standard colors, patterns, and finish charts.

B. Steel:

1. Shapes and bars: Carbon.

2. Sheet: Cold-rolled steel sheet, commercial quality, Class 1, matte finish.

3. Finish: Factory-applied baked enamel.

C. Plastic laminate: Decorative high-pressure type, complying with NEMA LD3, Type GP-50 General Purpose Grade, nominal 0.050" thickness.

D. Floor: Epoxy Terrazzo to match lobby. Provide floor pan as required to accommodate Epoxy Terrazzo.

E. Stainless Steel: No. 4 Brushed.

2.03 HOISTWAY EQUIPMENT

A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood subfloor. Underside of the platform shall be fireproofed. The car platform shall be designed and fabricated to support one-piece loads weighing up to 25% of the rated capacity.

B. Sling: Steel stiles affixed to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.

C. Guide Rails: Steel, T shaped, fastened to the building structure with steel brackets.

D. Guide Shoes: Slide guides shall be mounted on top and bottom of the car.

E. Buffers: Provide substantial buffers in the elevator pit. Installed as required by manufacturer.

F. Plunger and cylinder: Provide manufacturer's standard units designed for weights and speeds inidcated. Provide system designed to resist the operating pressures without failure. Units shall be designed to prevent seepage of oils. Each plunger shall be designed and installed to operate freely with minimum friction.

G. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the landings and correct for overtravel or undertravel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level (+/- ¼") with the landing irrespective of its load.

H. Wiring, Piping, and Oil: Provide all necessary hoistway wiring in accordance with the National Electrical Code. All necessary code compliant pipe and fittings shall be provided to connect the power unit to the jack unit. Provide proper grade oil as specified by the manufacturer of the power unit.

2.04 POWER UNIT

A. Power Unit (Oil Pumping and Control Mechanism): A self-contained unit consisting of the following items and located in the hoistway:

1. Oil reservoir with tank cover.

2. An oil hydraulic pump.

3. An electric motor.

4. Oil control valve with the following components built into single housing; high pressure relief valve, check valve, automatic unloading up start valve, lowering and leveling valve, and electro-magnetic controlling solenoids.

B. Pump: Pump specifically manufactured for oil-hydraulic elevator service. Pump shall be designed for steady discharge with minimum pulsation to give smooth and quiet operation.

C. Motor: Motor specifically designed for oil-hydraulic elevator service. Duty rating shall be selected for specified speed and load.

D. Control System: Shall be microprocessor based and protected from environmental extremes and excessive vibrations in a NEMA 1 enclosure. Controller shall be capable of communicating with security system.

E. Oil Control Unit: The following components shall be built into a single housing. Welded manifolds with separate valves to accomplish each function are not acceptable. Adjustments shall be accessible and be made without removing the assembly from the oil line.

1. Relief valve shall be externally adjustable and be capable of bypassing the total oil flow without increasing back pressure more than 10 percent above that required to barely open the valve.

2. Up start and stop valve shall be adjustable and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, ensuring smooth up starts and up stops.

3. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.

4. Lowering valve and leveling valve shall be adjustable for down start speed, lowering speed, leveling speed and stopping speed to ensure smooth "down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling after slowdown is initiated.

F. Solid State Starting: Provide an electronic starter featuring adjustable starting currents.

G. A manual lowering feature shall be provided to allow for lowering if there is a power failure or for adjustments.

2.05 HOISTWAY ENTRANCES

A. Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening bolted\knock down construction.

1. Manufacturer's standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates, sight guards, and necessary hardware.

2. Main landing door & frame finish: Stainless steel panels, no. 4 brushed finish.

3. Typical door & frame finish: Stainless steel panels, no. 4 brushed finish.

B. Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Provide door restriction devices as required by code.

C. Door Hanger and Tracks: Provide sheave type two point suspension hangers and tracks for each hoistway horizontal sliding door.

1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.

2. Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.

3. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.

D. Hoistway Sills: Extruded metal, with groove(s) in top surface. Provide mill finish on aluminum.

2.06 CAR ENCLOSURE

A. Car Enclosure:

1. Walls: Reinforced cold-rolled steel with two coats factory applied baked enamel finish, with applied vertical wood core panels covered on both sides with high pressure plastic laminate.

a. Base, Reveals and frieze: Stainless steel, no. 4 brushed finish

2. Canopy: Cold-rolled steel with hinged exit.

3. Floor: Provide manufacturer's steel pan as required to accommodate field applied Epoxy Terrazzo to match lobby.

4. Ceiling: LED Downlight type, suspended stainless steel metal pans with 4 LED downlights.

5. Cab Fronts, Return, Transom, Soffit and Strike: Provide panels faced with brushed stainless steel.

6. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides.

a. Door Finish: Stainless steel panels: No. 4 brushed finish.

b. Cab Sills: Extruded aluminum, mill finish.

7. Handrail: Provide 4" flat metal bar on side and rear walls on front opening cars and side walls only on front and rear opening cars. Handrails shall have a stainless steel, no. 4 brushed finish.

8. Ventilation: Manufacturer's standard exhaust fan, mounted on the car top.

B. Car Top Inspection: Provide a car top inspection station with an "Auto-Inspection" switch, an "emergency stop" switch, and constant pressure "up and down" direction and safety buttons to make the normal operating devices inoperative. The station will give the inspector complete control of the elevator. The car top inspection station shall be mounted in the door operator assembly.

2.07 DOOR OPERATION

A. Door Operation: Provide heavy duty operator designed to operate the car and hoistway doors simultaneously. Door movements shall be electrically cushioned at both limits of travel and the door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. Closed-loop, microprocessor controlled motor-driven linear door operator, with adjustable torque limits, also acceptable. AC controlled units with oil checks or other deviations are not acceptable.

1. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car. Door shall not open when call button is pressed on Lobby side, unless an authorized card or is presented at the car or at the reception desk.

2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.

3. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer will sound. When the obstruction is removed, the door will begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors will stop and resume closing only after the obstruction has been removed.

4. Limited Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors will reverse and reopen partially. After the obstruction is cleared, the doors will begin to close.

5. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors will recycle closed then attempt to open six times to try and correct the fault.

6. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors will recycle open then attempt to close six times to try and correct the fault.

7. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.

B. Door Protection Devices: Provide a door protection system using microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

2.08 CAR OPERATING STATION

A. Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in an integral swing return panel requiring no applied faceplate. Swing return shall have a brushed stainless steel finish. The main car operating panel shall be mounted in the return and comply with handicap requirements. Pushbuttons that illuminate using long lasting LED's shall be included for each floor served, and emergency buttons and switches shall be provided per code. Switches for car light and accessories shall be provided.

B. Emergency Communications System: Integral phone system shall be provided.

2.09 CONTROL SYSTEMS

A. Controller: The elevator control system shall be microprocessor based and software oriented. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings. Door shall not open when call button is pressed on Lobby side, unless an authorized card or is presented at the car or at the reception desk.

B. Automatic Light and Fan shut down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.

2.10 HALL STATIONS

A. Hall Stations, General:

Provide one pushbutton riser with faceplates having a brushed stainless steel finish.

1. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.

2. Hall Station at Lobby shall not be operational unless an authorized card is presented. Coordinate with Security System provider.

B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.

C. Hall lanterns: A hall lantern with adjustable chime shall be provided at each landing and located adjacent to the entrance. The lanterns, when illuminated, shall indicate the elevator car that shall stop at the landing and in what direction the car is set to travel. When the car reaches a predetermined distance from the floor where it is going to stop, the corresponding hall lantern shall illuminate and the chime shall sound. The hall lantern shall remain illuminated until the car doors close in preparation for leaving the floor. Illumination of the arrow shall be with LED's. Faceplates shall match the hall station finish. Provide at all typical landings.

2.11 MISCELLANEOUS ELEVATOR COMPONENTS

A. Oil Hydraulic Silencer: Install an oil hydraulic silencer (muffler device) at the power unit location. The silencer shall contain pulsation absorbing material inserted in a blowout proof housing arranged for inspecting interior parts without removing unit from oil line.

PART 3 -- EXECUTION

3.01 EXAMINATION

A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and machine rooms/control space, as constructed and verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 INSTALLATION

A. Install elevator systems components and coordinate installation of hoistway wall construction.

1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.

2. Comply with the National Electrical Code for electrical work required during installation.

B. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Design/Builder, to ensure dimensional coordination of the work.

C. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.

D. Lubricate operating parts of system where recommended by manufacturer.

3.03 FIELD QUALITY CONTROL

A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required by A17.1 Code and local authorities having jurisdiction. Perform other tests, if any, as required by governing regulations or agencies.

B. Notify the Owner, Design/Builder, Engineer, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.04 ADJUSTING

A. Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

3.05 CLEANING

A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless stall shall be cleaned with soap and water and dried with a non-abrasive surface; shall not be cleaned with bleached-based cleansers.

B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean hoistway. Remove trash and debris.

3.06 PROTECTION

A. At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.07 DEMONSTRATION

A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.

B. Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

3.08 ELEVATOR SCHEDULE

A. Elevator Qty. 1

1. Elevator Model: Hydrofit, 2-Stage

2. Rated Capacity: 2500 lbs.

3. Rated Speed: 100 ft./min.

4. Operation System: Manufacturer’s recommended.

5. Travel: 14’-0”

6. Landings: 2 total

7. Openings:

    a. Front 1

    b. Rear: 1

8. Minimum Clear Car Inside: 4’-4” x 6’-5”.

9. Cab Height: 7’-9” nominal

10. Hoistway Entrance Size: 3' - 6" wide x 7'-0 high

11. Door Type: Single Speed

12. Power Characteristics: 460 volts, 3 Phase, 60 Hz.

13. Seismic Requirements: See Structural Drawings

14. Fixture & Button Style: Standard Stainless Steel

- END OF SECTION -