Copy No. _____

WASHINGTON COUNTY DIVISION OF ENVIRONMENTAL MANAGEMENT DEPARTMENT OF WATER QUALITY

OAK RIDGE PUMP STATION UPGRADES

TECHNICAL SPECIFICATIONS PROJECT MANUAL

SEPTEMBER 14, 2020

Washington County Department of Water Quality
16232 Elliott Parkway
Williamsport, Maryland 21795

PREPARED BY:
RUMMEL, KLEPPER & KAHL, LLP
159 Plaza Drive
KEYSER, WEST VIRGINIA 26726
PHONE: (304) 788-3370
FAX: (304) 788-3577

THIS PAGE LEFT BLANK

ALL DOCUMENTS INCLUDING DRAWINGS AND SPECIFICATIONS FURNISHED BY THE ENGINEER PURSUANT TO THIS AGREEMENT ARE INSTRUMENTS OF HIS SERVICES IN RESPECT OF THE PROJECT. THEY ARE NOT INTENDED OR REPRESENTED TO BE SUITABLE FOR REUSE BY THE OWNER OR OTHERS ON EXTENSIONS OF THE PROJECT OR ON ANY OTHER PROJECT. ANY REUSE WITHOUT SPECIFIC WRITTEN VERIFICATION OR ADAPTATION BY THE ENGINEER WILL BE AT OWNER'S SOLE RISK AND WITHOUT LIABILITY OR LEGAL EXPOSURE TO ENGINEER, AND OWNER SHALL INDEMNIFY AND HOLD HARMLESS ENGINEER FROM ALL CLAIMS, DAMAGES, LOSSES AND EXPENSES INCLUDING ATTORNEYS'S FEES ARISING OUT OF OR RESULTING THEREFROM. ANY SUCH VERIFICATION OR ADAPTATION PERFORMED BY THE ENGINEER AT THE OWNER'S REQUEST WILL ENTITLE ENGINEER TO FURTHER COMPENSATION AT RATES TO BE AGREED UPON BY OWNER AND ENGINEER.

NOTE: REFER TO DRAWINGS PRIOR TO CONSTRUCTION. PLANS AND SPECIFICATIONS MUST BE READ TOGETHER TO UNDERSTAND FULLY WHAT MUST BE BUILT.

THIS PAGE LEFT BLANK

TABLE OF CONTENTS
TECHNICAL SPECIFICATIONS

DIVISION 1 – GENERAL REQUIREMENTS

01010	GENERAL REQUIREMENTS
01027	APPLICATION FOR PAYMENT
01070	ABBREVIATIONS OF TERMS AND ORGANIZATIONS
01151	MEASUREMENT AND PAYMENT
01170	SPECIAL PROVISIONS
01200	PROJECT MEETINGS
01300	SUBMITTALS
01500	TEMPORARY FACILITIES
01600	MATERIAL AND EQUIPMENT
01700	PROJECT CLOSEOUT

DIVISION 2 – SITE WORK

02050	DEMOLITION
02230	CLEARING AND GRUBBING
02240	DEWATERING
02300	EARTHWORK
02311	FINISH GRADING AND SEEDING
02315	TRENCHING, BACKFILLING AND COMPACTING
02370	EROSION CONTROL DURING CONSTRUCTION
02485	FINE GRADING, TOPSOIL AND SEEDING
02535	PIPE AND PIPE FITTINGS
02732	SANITARY SEWER FORCE MAINS
02750	DRIVEWAYS, PARKING AREAS AND WALKS

DIVISION 3 – CONCRETE

03301	CAST-IN-PLACE CONCRETE (Small Applications)
03600	GROUT
03610	CONCRETE CRACK REPAIRS

DIVISION 4 – MASONRY

04200	UNIT MASONRY

DIVISION 5 – METALS

05120	STRUCTURAL STEEL
05500	MISCELLANEOUS METALS

DIVISION 6 – WOOD AND PLASTICS

06100	ROUGH CARPENTRY
06200	FINISH CARPENTRY

06500 FIBERGLASS PRODUCTS
06600 PLASTIC FABRICATIONS

DIVISION 7 – THERMAL AND MOISTURE

07100 WATERPROOFING AND DAMPPROOFING
07200 THERMAL INSULATION
07920 JOINT SEALANT

DIVISION 8 – DOORS AND WINDOWS

08220 FIBERGLASS REINFORCED PLASTIC DOORS AND FRAMES
08710 FINISH HARDWARE

DIVISION 9 – FINISHES

09900 PAINTING

DIVISION 10 – SPECIALTIES

10400 IDENTIFICATION DEVICES
10522 FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

DIVISION 11 – EQUIPMENT

11101 GENERAL PROCESS MECHANICAL REQUIREMENTS
11320 SUBMERSIBLE CENTRIFUGAL PUMP
11375 WET WELL AERATION SYSTEM

DIVISION 12 – FURNISHINGS

NOT USED

DIVISION 13 – SPECIAL CONSTRUCTION

NOT USED

DIVISION 14 – COVEYING SYSTEMS

14300 PORTABLE GANTRY CRANE

DIVISION 15 – MECHANICAL

15010 GENERAL BUILDING MECHANICAL REQUIREMENTS
15060 INTERIOR PROCESS PIPING, FITTINGS, AND SPECIALTIES
15080 VALVE AND PIPING SPECIALTIES
15200 HEATING AND VENTILATION EQUIPMENT
15210 DUCTWORK
15950 TESTING PIPING SYSTEMS
15950A TESTING PIPING SYSTEM SUPPLEMENT
15960 SANITARY SEWER MANHOLE TESTING

DIVISION 16 – ELECTRICAL

16010 GENERAL REQUIREMENTS – ELECTRICAL
16050 BASIC MATERIALS & METHODS

16400 ELECTRIC SERVICE
16500 LIGHTING FIXTURES
16530 BATTERY EMERGENCY LIGHTING UNITS
16612 EMERGENCY GENERATOR SYSTEM

DIVISION 17 – PROCESS CONTROL

17010 PROCESS CONTROL SYSTEM – GENERAL REQUIREMENTS
17100 MOTOR CONTROL CENTER
17110 VARIBLE FREQUENCY DRIVE
17200 CONTROL PANELS
17300 INSTRUMENTATION
17400 PROGRAMMABLE CONTROLLER SYSTEM
17500 DESCRIPTION OF OPERATION

THIS PAGE LEFT BLANK

SECTION 01010

GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 LOCATION

Work shall be performed at the site location indicated on the Plans. The work is situated at Oak Ridge Pump Station.

1.02 CONTRACT DOCUMENTS

A. The work under this contract shall be performed in accordance with and subject to all terms, conditions and provisions of the following:

1. Project Manual

2. Contract Drawings

3. Standard Specifications and Standard Details

4. Any other Contract Documents so defined in the Standard Specifications.

B. In the event there are conflicting requirements in these documents, the contractor shall follow the more stringent requirements. In interpreting these requirements, the interpretation of the Engineer shall be final.

1. Besides RK&K's Standard Specifications, included within this Project Manual, the Washington County, Division of Environmental Management, Department of Water Quality also has a set of Standard Specifications found at their website (http://www2.washco-md.net/water_sewer/standards.shtm). In the event there are conflicts between the two standards, Washington County's Standards and Specifications shall govern.

2. During the Construction, the Owner assumes all duties and responsibilities as the Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

C. Project Manual

1. The Project Manual contains the Advertisement for Bids, Information for Bidders, Bid, Bid Bond, Performance Bond, Payment Bond, Notice of Award, Notice to Proceed, Agreement, General Conditions, Supplemental General Conditions, Equal Employment Opportunity Contract Compliance Notices, Wage Rates, General Requirements, Insurance Requirements for Independent Contractors, as well as the Subcontractors, and Specifications.

D. Contract Drawings

1. Oak Ridge Pump Station Upgrades

Bids are for furnishing all labor, materials, equipment, and performance of work for the project and all other work necessary to complete the project as detailed in the contract documents and specifications as prepared by Rummel, Klepper & Kahl, LLP.

2. The Contract Drawings consists of 22' X 34" sheets which indicate plans, profiles, sections, details, and notes for completing the work under this Contract. Due to the small scale of the Plans, it is not possible to indicate all fittings, accessories, or incidentals required to complete the work. However, this does not relieve the Contractor of his obligation to provide such fittings, accessories, or incidentals in order to complete the Contract in every respect.

3. It is not intended that the Plans be scaled to determine dimensions or elevations. The Contractor shall conduct his work in accordance with the survey data, dimensions, and elevations specifically noted on the Drawings.

4. The ENGINEER will furnish the Contractor 3 sets of plans and specifications at no cost. If additional copies are requested, they will be furnished for the cost of reproduction.

1.03 SCOPE

The Contractor shall provide labor, materials, equipment and services, and perform all operations required for completion of Work of this Contract as specified and as indicated on the Contract Drawings.

1.04 REFERENCED STANDARDS AND SPECIFICATIONS

A. SEE SECTION 01070 – ABBREVIATIONS OF TERMS AND ORGANIZATIONS

1.05 PERMITS (AND CERTIFICATES)

A. Such permits, licenses, insurance policies, as may be required to comply with Federal, State and local laws in conducting the work, shall be provided by the Contractor at his own expense, except as herein provided. The Contractor shall include in his bid all costs relating to permits, licenses, insurance premiums, administrative and inspection costs.

B. The Owner has or will obtain a permit for any work within State Roads and the Contractor shall perform all work in accordance with the requirements of this permit.

C. The Owner has or will obtain all the necessary waterway construction permits for construction of the proposed work. The Contractor shall perform all work in accordance with the requirements of this permit.

D. The Owner has or will obtain a permit for the work from the Maryland Department of the Environment. The Contractor shall perform all work in accordance with the requirements of this permit.

1.06 COMPLIANCE WITH LAWS, ORDINANCES CURRENTLY IN EFFECT

A. The Contractor shall at all times observe and comply with all Federal, State and/or local laws, ordinances, rules and regulations in any manner affecting the conduct of the work, and all such orders or decrees as exist at present and those which may be enacted later, by bodies or tribunals that have any jurisdiction or authority over the work, and shall indemnify and save harmless the Owners and their agents, against any claims or liability arising from or based upon violations of any such law, ordinance, regulation, order or decrees, whether by himself or by his employees.

B. Should the Contractor elect to ignore the conditions stipulated in paragraph 1.05 (A) above and proceed with the work or variance with any applicable ordinances or code, the Contractor shall remove such work without cost to the Owner and proceed with the work in a manner as specified by the Engineer.

C. The Contractor's attention is specifically directed to the fact that the paragraph above shall be taken to include all applicable requirements of the Occupational Safety and Health Act and that it shall be the Contractor's complete and entire responsibility to determine, observe and comply with all such requirements without direction of the Engineer.

D. Contractor shall comply with applicable laws and ordinances governing the disposal of surplus excavation, materials, debris and rubbish on or off the project and commit no trespass on any public or private property in any operation due to or connected with the work.

E. The Contractor shall schedule his earthwork, paving and trenching operations, subject to approval by the Engineer, to ensure that the land areas thereby exposed to increased erosion will not be exposed more than the briefest period of time possible. Graded areas shall be seeded and mulched immediately after topsoil is placed to finished elevations. Turf areas shall not be disturbed beyond the limits of excavations and graded areas.

F. Use of Explosives – The use of explosives will not be permitted adjacent to or on any existing structures unless authorized in writing by the Engineer. Such authorization shall not relieve the Contractor of full responsibility for damages which may occur. When the use of explosives is permitted, the Contractor shall exercise utmost care not to endanger life or property, and whenever necessary, the number of charges and sizes of the charge shall be reduced. Only expert powder men, approved in advance by the Engineer, shall handle and use explosives; all explosives shall be securely stored in conformity with the provision of all statutes, laws, ordinances and regulations in force at the time of construction. All storage places shall be clearly marked "DANGER - EXPLOSIVES".

G. Watchmen, Barricades, Danger and Detour Signs

1. The Contractor shall place sufficient red or flashing lights on or near the work and keep them burning from sunset to sunrise; he shall erect suitable railings, barricades, detour signs, danger signals or signs, fences or other protection about open trenches, materials or supplies after delivery, and shall provide watchmen on the work by day or night, all as necessary for the public safety, and for the prevention of accidents during and after the delivery of materials and supplies, and shall at all times take necessary precautions to avoid accident or injury to persons

or property. The Contractor shall, upon verbal notice from the Engineer that he has not satisfactorily complied with the foregoing requirements, immediately take such measures to comply therewith as the Engineer may direct, but the Contractor shall not be relieved of his obligations under the Contract by any such notice or directions given by the Engineer, or by his neglect, failure or refusal to give such notice or directions. Highways closed to traffic shall be protected by effective barricades on which shall be placed acceptable warning signs.

2. The Contractor shall request permission from the entity having control of the street or road, for any street or highway to be closed due to his work. Upon receipt of such permission, the Contractor shall send notice to the Engineer of the times and places where barricades and other protective devices will be placed. Contractor shall notify 911 Center in advance of all road closings.

1.07 PROGRESS SCHEDULE

Within 10 days after receipt of the Notice to Proceed, the Contractor shall prepare and submit to the Engineer for approval, a construction progress schedule in the critical path format. The schedule shall show the Contractor's proposed sequence of work and the time and dates required for completion of each activity of the work, with sub-schedules of related activities which are essential to its progress.

The Contractor shall revise the progress schedule monthly during the course of the Contract and resubmit three (3) copies of the revised progress schedule to the Engineer at the regularly scheduled progress meetings. The Engineer will review the revised schedule and return any comments within 10 days. If required by the Engineer, the Contractor shall resubmit a revised schedule within 7 days after receipt of any comments. The detail of information to be included in the construction progress schedule shall include, but not necessarily be limited to, activities related to procurement of materials, submission of working drawings, approvals, fabrication and delivery of materials and equipment to the site, on site or construction operations, including acceptance and testing for work of the Contractor and his subcontractors. The anticipated size of working crews shall also be furnished.

The construction progress schedule shall depict the following:

1. Component activities.

2 Sequential relationship of performance of the activities.

3. Time required to perform each activity.

4. Cost associated with related activities.

The information depicted shall be transformed into a printed schedule which shall indicate for each activity the following information:

1. Activity description.

2. Duration required to perform each activity.

3. Earliest date on which activity may be started.

4. Latest date on which activity can be completed without delaying project completion.

5. Slack or float time that exists for performance of this activity.

When and if subsequent analyses indicate the necessity of revision in order to meet Contract time limitations, the Contractor shall supply information and indicate the action to be taken to revise the schedule to accomplish the Contract requirements. The Owner will have the right to withhold payments due the Contractor until such schedule revisions are accomplished.

1.08 DAILY LOG

The Contractor shall submit weekly, to the resident project representative, daily logs outlining the number of people working and their classification, major equipment, and summary of work performed.

1.09 INSTALLATION CERTIFICATES

A. Provide as required by individual Technical Specifications prior to testing equipment or placing equipment into service.

B. When required, obtain and provide the Owner with an Installation Certificate signed by the manufacturer's field representative attesting that the equipment has been properly installed and is ready for testing and operation.

C. The Contractor shall confer and verify with other contractors as to locations and extent of their work, to the end that interferences and deletions between trades are prevented and embedded or required items are installed in conjunction with the work under this contract. Interconnections between work of other contracts shall be made by the contractor whose work is erected last unless otherwise specifically stated in the Contract Documents, required by the Engineer, or necessitated by the nature or extent of the work.

D. The Contractor hereby guarantees all of the work performed under this contract for a period of twelve (12) months after the approval of the substantial completion, by the Owner as follows:

1. Against all faulty or imperfect materials and against all imperfect and careless and/or unskilled workmanship.

2. That all pipe lines, tanks and structures shall be water tight and that leakage shall not exceed the limits set forth in the Standard Specifications.

3. The Contractor shall, upon receipt of written notice from the Owner, replace with proper workmanship and materials and to re-execute, correct or repair without cost to the Owner, any work which may be found to be improper or imperfect and to restore and maintain all roads, ditches and slope areas.

4. No use or acceptance by the Owner of the work or any part thereof, nor any failure to use the same, nor any repairs, adjustments, replacements or corrections made by the Owner, due to the Contractor's failure to comply with any of his obligations under the Contract Documents shall impair, in any way, the guarantee obligations, assumed by the Contractor under these Contract Documents.

5. That the entire equipment and each and every part thereof, shall operate (with proper care and attention) in a satisfactory and efficient manner, and in accordance with the requirements of the Contract Documents.

6. The maintenance period obligations assumed by the Contractor under these Contract Documents shall not be held or taken to be in any way impaired because of the Specifications, indication or approval by or on behalf of the Owner of any articles, materials, means, combinations or things used or to be used in the construction, performance and completion of the work, or any part thereof.

7. In case the Contractor neglects to make such repairs required during the maintenance period, the Engineer may cause such damage to be repaired and made good, at the cost and expense of the Contractor.

8. Maintenance work during the guarantee period shall not include routine maintenance work such as lubrication of equipment, changing of light bulbs, fuses, and routine paint repairs. The Contractor shall turn over to the Owner a maintenance log for all equipment furnished under this Contract prior to receiving conditional acceptance of the Contract work.

9. If other sections of these specifications require a more stringent guarantee, then that requirement shall supersede this section.

1.10 DIRECTION OF WORK

A. The work shall be done under the direction of the Engineer. While it is intended that the Contractor be allowed to carry on the work in accordance with such general plan as may appear to him most desirable, the Engineer, at his discretion, may from time to time direct the order in which, and at points which, the work shall be prosecuted; he may exercise such general control over the conduct of the work, at any time or place as in his judgment shall be required to comply with the intent of the Contract Documents or to safeguard the interest of the Owner and the public, and the Contractor shall have no claim for damages or extra compensation on account of such control, or the necessity to carry on the work in different sequence from that which the Contractor may have contemplated. The Contractor shall immediately comply with any and all orders and instructions given by the Engineer, but nothing herein shall be considered as such assumption of control over the work by the Engineer as to relieve the Contractor of any of his obligations or liabilities under the Contract.

B. The Contractor shall supervise and direct the work efficiently, using his best skill and attention. He shall be solely responsible for the techniques and sequences of construction. The work shall be prosecuted by the Contractor in such a manner, and with sufficient materials, equipment and labor to insure completion on or before the time specified.

C. The Contractor shall keep on the work at all times during its progress, a competent superintendent, authorized to receive orders and act for him, together with the necessary supervisory staff, all satisfactory to the Engineer. The superintendent shall not be changed except with the consent of the Engineer.

D. The Engineer will not be responsible for acts or omissions of the Contractor, any subcontractor, or any of his or their superintendents or employees.

1.11 CONTRACTOR'S USE OF PREMISES

A. The Contractor shall confine construction equipment, the storage of materials and equipment, and operations of workmen to within the limits of construction as shown on the Drawings.

B. The Contractor shall assume full responsibility for materials stored on site including materials for which the Owner has made payment. The Contractor shall purchase and maintain such additional amounts of insurance as are necessary to provide coverage against loss or damage to the materials. The Contractor shall take all measures necessary to secure and protect stored materials from vandalism, theft and weather degradation.

C. The Contractor shall transport materials remaining at the completion of the project for which the Owner has made payment to a storage area designated on site by the Owner.

D. The Contractor shall perform his work in a neat manner and, upon completion, shall remove from the site all excess materials, trash and appurtenances not required to be incorporated in the finish work. The Contractor shall be required to effectively protect the portions of the existing facilities to remain; any resultant damage to existing remaining portions of structures, piping systems or equipment thereof shall be restored to conditions existing prior to execution of his work.

1.12 ORDER OF WORK

A. Contractor shall make himself familiar with all alteration and renovation notes on Drawings and actual site conditions. The Contractor shall become familiar with any special conditions or requirements as listed in contract documents or plans or setforth in pre-construction meeting.

B. It shall be the Contractor's responsibility to arrange with the Engineer a schedule of operation, so as not to inconvenience the operation of the Owner's program.

C. The Contractor shall be responsible for the protection of the Owner's building, facilities and improvements within the areas where the work is being performed. Any disturbance or damage to the work being performed by the Contractor, a separate contractor, or to the existing building, improvements or equipment, or any other impairment of the Owner's facilities resulting from the Contractor's performance shall be promptly restored, repaired or replaced by the Contractor at no extra cost to the Owner.

D. Contractor shall be responsible for performing his work in such manner so as to maintain essential ingress and egress for visitors and occupants to the Owner's building and facilities and to continuously maintain all required emergency exits from the circulation between existing facilities. Passageways for emergency exits shall be kept continuously open and free from debris, construction equipment, tools, materials or other hazards. The Contractor shall provide all temporary work which may be required to obtain and maintain all such ingress, egress and circulation requirements; temporary work shall be removed when no longer required.

E. Contractor shall commence the work and so schedule his work, through the Engineer, to avoid interference with the Owner's operations. Unavoidable interference with the Owner's operations shall not be carried out without the

Owner's approval obtained not less than forty-eight (48) hours prior to the anticipated interference.

F. Where existing building utilities such as gas, water, electricity or other facilities are required to be curtailed for making connections, extensions of services or other required work, all such work shall be scheduled with and approved by the Owner. All such work shall be scheduled so that it shall not interfere with the Owner's programs and may be done on weekends, after regular hours or as agreed upon by the Owner. All efforts and construction shall be coordinated so that any curtailment is held to a minimum. In the event any building services are interrupted for a period of time longer than two (2) hours, the Contractor shall, at his expense, provide a suitable temporary bypass to conduct his work and to maintain necessary building services.

G. To insure non-interference with the Owner's operations during the performance of the work, the Contractor shall remove from the building, facilities and improvements where the work is being performed all trash, combustible materials and debris of all kind being created during the performance of the work and upon completion of the work. This obligation shall also include all debris created by any subcontractors or material men engaged by the Contractor in performing the work. Such debris shall be disposed of to facilities furnished by the Contractor.

1.13 WORK BY OTHERS

A. The Owner may perform additional work related to the project by himself, or he may let other direct contracts therefore which shall contain general conditions similar to these. The Contractor will afford the other contractors who are parties to such direct contacts (or the Owner, if he is performing the additional Work himself) reasonable opportunity for the introduction and storage of materials and equipment and the execution of work, and shall properly connect and coordinate his work with theirs.

B. It is hereby agreed that the Contractor will conduct his work in such a manner and on such a schedule that the respective work of the Contractor and separate contractors shall be carried on simultaneously and in such manner as not to retard the work of one another or the progress of the project. Nothing in the Contract Documents shall be construed to create a contract or third-party beneficiary relationship between the Contractor and any separate contractor.

C. If any part of the Contractor's work depends for proper execution or results upon the work of any such other Contractor (or the Owner), the Contractor will inspect and promptly report to the Engineer in writing any defects or deficiencies in such Work that render it unsuitable for such proper execution and results. His failure so to report shall constitute an acceptance of the other work as fit and proper for the relationship of his work except as to defects and deficiencies which may appear in the other work after the execution of his work.

D. If the performance of additional work by other contractors or the Owner is not noted in the Contract Documents prior to the execution of the contract, written notice thereof shall be given to the Contractor prior to starting any such additional work. If the Contractor believes that the performance of such additional work by the Owner or others causes an additional expense or entitles him to an extension of the Contract Time, the Contractor may submit a claim.

1.14 CLEANING UP

A. The Contractor shall continuously keep the work, the site and adjacent properties free from accumulations of waste materials, excess excavation, rubbish and windblown debris resulting from construction operations. Waste materials, excess excavation, debris and rubbish shall be removed from the site periodically and disposed of at legal disposal areas away from the project site.

B. The Contractor shall remove grease, mastics, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from site-exposed interior and exterior surfaces of structures; broom clean exterior paved surfaces; rake clean other surfaces of the grounds; restore areas disturbed by construction; provide continuous dust control during construction; and maintain temporary paving areas during the period prior to permanent paving.

C. At the completion of the work, or each major portion thereof, the Contractor shall remove surplus materials, tools, construction equipment and machinery, and leave the site clean and ready for occupancy by the Owner. Upon completion of construction, the Contractor shall clean and flush existing storm drains in the area of construction.

D. The Contractor shall maintain his area of work. If clean-up is not complied with, 10% of the succeeding progress payments, in addition to the normal contract retainage, will be withheld from the Contractor until such clean-up is performed.

E. The Contractor shall be responsible for providing dumpsters for the collection and disposal of waste and debris, except for hazardous or unsanitary waste materials which shall be handled by Contractor producing such waste. Dumpsters shall be approved by Engineer. Contractor shall comply with NFPA 241 for removal of combustible materials. Hazardous materials shall be containerized for removal from site.

F. Final cleaning shall be as specified in Section 01700 - Project Closeout.

1.15 CUTTING AND PATCHING

A. The Contractor shall be responsible for cutting, fitting or patching required to complete the work or to make its parts fit together properly.

B. The Contractor shall be responsible for cutting and patching required in existing areas during the execution of the Work.

C. The Contractor shall not damage or endanger a portion of the work or fully or partially completed construction of the Owner's own forces or of separate Contractors by cutting, patching, excavating or otherwise altering such construction. The Contractor shall not cut or otherwise alter such construction by separate Contractors or by the Owner's own forces except with written consent of the Engineer, Owner and such separate Contractors; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the separate Contractors or the Owner, the Contractor's consent to cutting or otherwise altering the Work.

D. Final finish of cut and patch areas (i.e., painting, flooring, etc.) shall be performed by the Contractor.

1.16 HISTORICAL/ARCHAEOLOGICAL FINDS

If during the course of construction, evidence of deposits of historical or archaeological interest is found, work affecting the find shall be ceased and the Engineer notified. Do not disturb deposits until written notice from Engineer is given to proceed. Compensation for lost time or changes in construction to avoid the find will be made based upon normal change order procedures.

1.17 CONSTRUCTION STAGING AREA

Area location for Contractor's field office, equipment storage, fabrication, vehicle parking, and Engineer's field office and parking will be responsibility of Contractor.

1.18 SOIL EROSION AND SEDIMENT CONTROL PLAN

A. This work shall consist of the application of temporary and permanent measures throughout the life of the project in order to control erosion and to minimize the siltation of rivers, streams, lakes and reservoirs. Such measures shall include, but are not limited to, the use of berms, dikes, dams, sediment basins, fiber mats, netting, gravel or crushed stone, mulch, grasses, silt fence, slope drains and other methods whether shown on plans or not.

Erosion and sediment control measures shall comply with all applicable Federal, State and Local laws and regulations concerning environmental pollution control and abatement.

Any conventional sediment and erosion procedures which would normally be expected to be required shall be implemented by Contractor whether shown on plans or not with all associated cost to incidental to other bid prices.

B. The erosion and sediment control features installed by the Contractor shall be acceptably maintained by the Contractor for the duration of the Contract.

C. The Contractor shall source of all borrow material, and the disposal site for excess material. The off-site locations for disposal and borrow shall be approved by the Federal, State or Local agencies having jurisdiction. Contractor shall acquire all required permits.

D. The Contractor shall not pollute streams with fuels, oils, bitumens, calcium chloride, acids or harmful materials. It is the responsibility of the Contractor to investigate and comply with all applicable Federal, State and Municipal laws concerning pollution of rivers and streams. All work under this Contract shall be performed in such a manner that objectionable conditions will not be created in rivers, streams, reservoirs, or ponds in or through or adjacent to the project areas.

E. Surface drainage from cuts and fills within the construction limits, whether or not completed, and from borrow and waste disposal areas, shall be held in suitable sedimentation ponds or shall be graded to control erosion within acceptable limits. Temporary erosion and sediment control measures, such as berms, dikes, silt fences, drains or sedimentation basins, if required to meet the above standards, shall be provided and maintained until permanent drainage and erosion control facilities are completed and operative. The area of bare soil exposed at any one time by construction operations shall be held to a minimum. Fills and waste areas shall be constructed by selective placement of materials to eliminate silts or clays on the surface that will erode and contaminate adjacent

rivers, streams, lakes or ponds. Further protection of any excavation, storage area, waste area, or fill area shall be provided by the Contractor by the installation and maintenance of a silt fence around the down slope perimeter of such areas.

F. The cost for any excavation and/or fill involved in connection with the construction of erosion, sediment and pollution control devices required for this project shall be included in the other prices bid.

1.19 WATERTIGHTNESS OF STRUCTURES

Refer to Section 03301

1.20 GENERAL WORKING HOURS

Unless otherwise specified or directed by the Engineer, the regular working day shall begin no earlier than 7:00 A.M. Unless in an emergency situation, or approved by the Engineer, shall be limited to the hours between 7:00 A.M. and 5:00 P.M., Monday through Friday. Work on the Weekends (Saturday and Sunday) is prohibited unless approved by the Engineer or during an emergency situation.

1.21 INSPECTORS OVERTIME REIMBURSEMENT

Any work necessary to be performed after regular hours, on Saturday(s), Sunday(s) or Legal Holiday(s), shall be performed without additional expense to the Owner. Should the Contractor elect at any time, or from time to time, to conduct his operations on any regular shift of more than forty (40) hours in any week, or on any Saturday(s), Sunday(s) or Legal Holiday(s) and in the opinion of the Engineer, it is necessary for a Resident Project Representative(s), as a consequence thereof, to work more than forty (40) hours in any week, the Contractor shall be responsible for, bear and pay the costs of any overtime earned by the Resident Project Representative(s). The minimum charge for overtime for a Resident Project Representative(s) on Saturday(s), Sunday(s) or Legal Holiday(s) shall be eight (8) hours. Observations of work on Saturday(s), Sunday(s) or Legal Holiday(s), requested by or made necessary by the actions of the Contractor, shall be scheduled and/or approved by the Owner or his representative forty-eight (48) hours in advance. The Contractor shall bear all costs of inspections after the expiration of Contract Time and if an extension of Contract Time is granted by the Owner at the Contractor's request. However, if the Owner approves an extension of Contract Time related to an increase in the Scope of Work, the Owner shall bear any related cost of Inspection. For purposes of this section, the following Holidays are observed by the Owner:

New Years Day – January 1st
Dr. Martin Luther King, Jr. Birthday – ThIrd Monday in January
President's Day – Third Monday in February
Good Friday – Friday before Easter
Memorial Day – Last Monday in May
Independence Day – July 4th
Labor Day – First Monday in September
Veterans' Day – November 11th
Thanksgiving Day – Last Thursday in November
Friday after Thanksgiving
Christmas Eve – December 24th
Christmas Day – December 25th
New Year's Eve – December 31st

Note: No work will be permitted on SHA rights-of-way the day before and after a State recognized Holiday.

1.22 PROJECT SIGN

NOT USED

END OF SECTION

SECTION 01027

APPLICATION FOR PAYMENT

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.

1. Coordinate the Schedule of Values and Application for Payment with the Construction Schedule, List of Subcontracts, and Submittal Schedule.

1.02 SCHEDULE OF VALUES

A. Coordinate preparation of the Schedule of Values with preparation of the Construction Schedule.

1. Correlate line items in the Schedule of Values with other required administrative schedules and forms, including.

a. Construction Schedule

b. Application for Payment form

c. List of subcontractors

d. List of products

e. List of principal suppliers and fabricators

f. Schedule of submittals.

B. Submit the Schedule of Values to the Engineer at the earliest feasible date, but in no case, later than ten (10) days before the date scheduled for submittal of the Contractor's initial Application for Payment. The Engineer and Owner shall review and approve the proposed Schedule of Values.

C. Format and Content: Use the Project Manual Table of Contents as a guide to establish the format for the Schedule of Values.

1. Identification: Include the following Project identification on the Schedule of Values:

a. Project Name:

b. Engineer Name:

c. Project Number:

d. Owner's Name:

e. Contract Number _____; Contract Name: _____

f. Contractor's Name and Address:

g. Date of Submittal:

D. Arrange the Schedule of Values in a tabular form with separate columns to indicate the following for each item listed:

1. Generic name

2. Related Specification Section

3. Name of subcontractor

4. Name of manufacturer or fabricator

5. Name of supplier

6. Change Orders (numbers) that have affected value

7. Dollar value

8. Percentage of Contract Sum to the nearest one-hundredth percent, adjusted to total 100 percent.

E. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Break principal subcontract amounts down into several line items.

F. Round amounts off to the nearest whole dollar; the total shall equal the Contract Sum.

G. For each part of the work where an Application for Payment may include materials or equipment, purchased or fabricated and stored, but not yet installed, provide separate line items on the Schedule of Values for initial cost of the materials, for each subsequent state of completion, and for total installed value of that part of the work.

H. Schedule Updating: Update and resubmit the Schedule of Values when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.03 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by the Engineer and paid by the Owner.

1. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the final Application of Payment involve additional requirements.

B. Payment Application Times: Each progress payment date is as indicated in the Agreement or as specified at pre-construction meeting. The period of

construction work covered by each Application for Payment is the period indicated in the Agreement or as specified at pre-construction meeting.

C. Application Preparation: Complete every entry on the form, including notarization and execution by person authorized to sign legal documents on behalf of the Owner. Incomplete applications will be returned without action.

1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions have been made.

2. Include amounts of Change Orders and Construction Change Directives issued prior to the last day of the construction period covered by the application.

D. Transmittal: Submit six (6) executed copies of each Application for Payment to the Engineer by means ensuring receipt within 24 hours; one copy shall be complete.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information related to the application in a manner acceptable to the Engineer.

E. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of the first Application for Payment include the following:

1. Schedule of Values

2. Submittal Schedule (preliminary if not final)

3. List of Contractor's staff assignments.

4. List of Contractor's principal consultants

5. Initial progress report.

F. Progress Payments: Monthly applications submitted by the date of the month agreed upon at the preconstruction meeting for the completed value of the work and the value of the work to be completed by that date of the month will be paid by the Owner within forty-five (45) days in the amount recommended by the Engineer.

G. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment; this application shall reflect any Certificates of Partial Substantial Completion issued previously for Owner occupancy or designated portions of the work. The following administrative actions and submittals shall precede or coincide with this application.

1. Occupancy permits and similar approvals.

2. Warranties (guarantees) and maintenance agreements

3. Test/adjust/balance records

4. Maintenance instructions

5. Meter readings

6. Start-up performance reports

7. Change-over information related to Owner's occupancy, use, operation and maintenance

8. Final cleaning

9. Application for reduction of retainage and consent of surety

10. Advice on shifting insurance coverages

11. List of incomplete work; recognized as exceptions to Engineer's Certificate of Substantial Completion.

H. Final Payment Application: Administrative actions and submittals which must precede or coincide with submittal of the Final Application for Payment include the following.

1. Completion of Project closeout requirements

2. Completion of items specified for completion after Substantial Completion

3. Assurance that unsettled claims will be settled

4. Transmittal of required Project construction records to Owner

5. Proof that taxes, fees and similar obligations have been paid

6. Removal of temporary facilities and services

7. Removal of surplus materials, rubbish and similar elements

1.04 PAYMENT FOR EQUIPMENT AND MATERIALS STORED ON SITE

A. Payment for the following major equipment and materials stored on site shall be made subject to the terms and conditions as defined below.

1. Payment will be made for equipment and materials stored on the site, if approved by the Engineer, and under the following conditions:

a. Payment will be made for the value of equipment or material only, not installed.

b. For equipment items stored on site, the Contractor may request payment by submitting an invoice which identifies the cost of the equipment with the monthly Application for Payment. If approved for payment, the Engineer will recommend payment to

the Owner. The Contractor must then submit to the Engineer proof of payment to the equipment supplier in the form of a certified paid invoice within 30 days of the receipt of payment to the Contractor from the Owner. In addition, the Contractor will certify at that time, that the item stored on site has been paid for, is free and clear of all liens and encumbrances, and that title for such item shall pass to the Owner. If proof of payment to the supplier and the above certification are not received within 30 days, the value of the equipment will be deducted from the subsequent Application for Payment. By requesting payment for these items, the Contractor agrees to incorporate these items into the construction of the project within 120 days of the payment request. If approved for payment, the Engineer will recommend payment to the Owner. No payments will be made for materials stored off site.

c. Equipment storage requirements will remain unchanged as follows:

The Contractor shall follow equipment storage requirements outlined hereinbefore. The Contractor will be responsible to establish a system and provide for identification of items for which payment is made while stored on site subject to the approval of the Engineer. The Contractor shall provide documentation described above prior to requesting payment.

d. Insurance requirements will remain unchanged as follows:

The Contractor shall retain responsibility for material stored on or off site and shall purchase and maintain insurance in the full value of the material stored on or off site in the name of the Owner. Such insurance will insure against loss and/or damage on an all-risk basis. Proof of insurance must be submitted prior to requesting payment.

e. Method of calculating percentage of completion of work will remain unchanged as follows:

Payment made to Contractor for materials and equipment stored at the site, but not yet incorporated into the work, shall not be included in any computation to determine the percentage of completion of the work for the purpose of retained percentage.

F. Payments will not be made for materials stored off site.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 01070

ABBREVIATIONS OF TERMS AND ORGANIZATIONS

PART 1 - GENERAL

1.01 LIST OF ABBREVIATIONS

A. Applicable Codes, Specifications and Standards: All references to codes, specifications and standards in the Contract Documents shall mean, and are intended to be, the latest edition, amendment and/or revision of reference standards in effect as of the date of bid opening for this Contract

B. The Contractor shall maintain on the site copies of permits, local codes governing and applicable to the Contract work, including Department of Highways Standard Specifications for Roads and Bridges.

C. Where the publications, standards, codes or other material referenced in the specification are not required to be on site as specified in 1.03 (B) of Section 01010, the Contractor shall, when requested by the Owner or Engineer, produce a copy of the standard, code, or specification within four (4) hours from the time of request.

D. The Specification format as bound herein for the technical requirements of the work, in general, follows the arrangement of work suggested by the Construction Specifications Institute. The arrangement and grouping of items within the various Division and Section of the Specifications are for the purpose of associating work items of similar nature for the convenience of the bidders and shall not constitutes the imposition of a sub-contract upon the prime bidding Contractors who, alone, shall be responsible for the general direction and administration of the Contract.

E. Where the following or any other standards, codes, or specifications are referred to in these Contract Specifications, the reference is to the particular standard code, or specifications, together with all amendments and errata applicable at the time the Bids are taken and shall apply except to the extent that said standards, and/or requirements may be in conflict with applicable laws ordinances.

AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ABMA	American Boiler Manufacturers Association
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies
AFBMA	Antifriction Bearing Manufacturers Association
AFPA	American Forest & Paper Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	American Hardboard Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute

APA	American Plywood Association
API	American Petroleum Institute
AREMA	American Railway Engineers and Maintenance-of-Way Association
ARI	American Refrigeration Institute
ASAHC	American Society of Architectural Hardware Consultants
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AVATI	See RTI
AWG	American Wire Gage
AWI	Architectural Woodwork Institute
AWPA	American Wood-Preservers' Association
AWPB	American Wood Preservers Bureau
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Institute of America (formerly SCPI)
CBA	The Certified Ballast Manufacturers Association
CDA	Copper Development Association
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers Association of America
CRA	California Redwood Association
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard (U.S. Department of Commerce)
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association
EEI	Edison Electric Institute
EJCDC	Engineers' Joint Contract Documents Committee
EPA	Environmental Protection Agency
ETL	Electrical Testing Laboratories, Inc
FCC	Federal Communications Commission
FCI	Fluid Controls Institute
Fed Spec	Federal Specification
FGMA	Flat Glass Marketing Association
FHWA	Federal Highway Administration
FIA	Factory Insurance Association
FM	Factory Mutual
FSA	Fluid Sealing Association
FTI	Facing Tile Institute
HEI	Heat Exchange Institute
HMI	Hoist Manufacturers Institute
HPMA	Hardwood Plywood Manufacturers Association
HTI	Hand Tools Institute
I-B-R	Institute of Boiler and Radiator Manufacturers
IEEE	Institute of Electrical and Electronics Engineers

IBC	International Building Code
IES	Illuminating Engineering Society
IFI	Industrial Fasteners Institute
IPCEA	Insulated Power Cable Engineers Association
IRI	Industrial Risk Insurers
ISA	Instrumentation, Systems, and Automation Society
JIC	Joint Industry Conference
MDSHA	Maryland State Highways Administration
MHI	Materials Handling Institute
MIL	Military Specification
MMA	Monorail Manufacturers Association
MSS	Manufacturers Standardization Society of Valve and Fitting Industry
NAAMM	National Association of Architectural Metals Manufacturers
NACE	NACE International
NBBPVI	National Board of Boiler and Pressure Vessel Inspectors
NBFU	National Board of Fire Underwriters
NBHA	National Builders Hardware Association
NBS	National Bureau of Standards
NCSPA	National Corrugated Steel Pipe Association
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NEMI	National Elevator Manufacturing Industry
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology (formerly NBS)
NLA	National Lime Association
NPC	National Plumbing Code
NPT	National Pipe Thread
NRMCA	National Ready Mix Concrete Association
NSC	National Safety Council
NSF	NSF International (formerly Nation Sanitation Foundation)
NTMA	National Woodwork Manufacturers Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PS	Product Standard
RIS	Redwood Inspection Service
RLM	Reflector and Lamp Manufactures Institute, Inc
RTI	Resilient Tile Institute (formerly AVATI)
SAE	Society of Automotive Engineers
SCPRF	Structural Clay Products Research Foundation
SDI	Steel Door Institute
SFPA	Southern Forest Projects Association
SI	Systeme International des Unites (International System of Units)
SIGMA	Sealed Insulating Glass Manufacturers Association
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association

SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SPFA	Steel Plate Fabricators Association
SPI	Society of the Plastics Industry
SPTA	Southern Pressure Treaters Association
SSI	Scaffolding and Shoring Institute
SSPC	SSPC: The Society for Protective Coatings
TEMA	Tubular Exchanger Manufacturers Association
UL	Underwriters' Laboratories
USBR	U.S. Bureau of Reclamation
WEF	Water Environment Federation

END OF SECTION

SECTION 01151

MEASUREMENT AND PAYMENT

PART 1 - SCHEDULE OF VALUES

A. LUMP SUM ITEMS

When a Lump Sum Bid, or bid items exists, the Contractor shall submit a Schedule of Values for the lump sum work, including quantities and unit prices aggregating the Lump Sum Price, for approval in accordance with the General Conditions. The Schedule of Values shall show component work and associated price of lump sum items in sufficient detail to allow evaluation of partial payment applications and must be approved by Engineer.

If any unit price in the approved Schedule of Values requires that the said unit price cover and be considered compensation for certain work or material essential to the item, this same work or material will not also be measured or paid for under any other pay item which may appear elsewhere in the Specifications.

B. UNIT PRICE ITEMS

When bid is per unit price, a Schedule of Values shall not be required since the scope of work and materials to be provided are adequately setforth in this measurement and payment section under respective bid item to allow evaluation of partial payment applications.

PART 2 - MEASUREMENT OF QUANTITIES

A. GENERAL

1. Payment for the work completed under this Contract will be made at the lump sum and unit prices bid, which lump sum and unit prices shall include the furnishing of all labor, tools, equipment, materials, overhead, profit, insurance, and the performance of all work required to complete the project as indicated and specified in accordance with all requirements of the Contract Documents and to the entire satisfaction of the Engineer.

2. All incidental minor and miscellaneous items, work, and materials for which no specific lump sum or unit price bid item is shown and which are necessary to complete the work and to maintain and/or repair the work, shall be done and furnished by the Contractor without extra charge.

3. It is intended that all work shown and stipulated in the Contract Documents is to be measured and paid for under the items listed in the Bid Form. The absence of specifically described or shown items from the Bid shall be interpreted as meaning that the quantity and cost of any such work contemplated by the Contract Documents shall be included in related items which are listed in the Bid Form. The Contractor shall not be entitled to receive additional compensation for anything furnished or done except as provided for in the General Conditions and Supplemental General Conditions.

4. Lump Sum items will not be measured.

B. MEASUREMENT

1. Square Yard: In figuring quantities for payment under the applicable items, the payment widths will be taken as not more than a width equal to the "specified pavement removal limits where additional pavement cut back is specified. Shoulder restoration will be measured to the limits specified and established by the Engineer.

2. Ton: In figuring quantities for payment of material placed in trenches, the payment widths will be taken as actual trench width not to exceed the "specified maximum trench width" where no cut back is specified or the specified pavement removal limits where additional pavement cut back is specified, the thickness of the material installed and a length measured horizontally along the centerline of the trench. The tonnage will be the product of the volume and the weight per cubic foot. The tonnage will be determined by duplicate certified weight slips furnished to the Engineer or his representative at the time of each truck delivery to the area of work. Engineer may compute tonnage in lieu of weight tickets, if so, tickets cannot be used to verify tonnage, using the following densities:

   a. Bituminous Concrete Base and Surface Material: 148 pounds per cubic foot (13.5 cubic feet per ton).

   b. Gravel for driveway trench or aggregate for streets: 125 pounds per cubic foot in place (16 cubic feet per ton).

3. Cubic Yard: In figuring quantities for payment under the applicable items, the payment widths will be taken as not more than a width equal to the specified maximum trench width as specified on the drawings. The depth will be the thickness installed and a length measured horizontally along the centerline of the trench.

4. Linear Foot: In figuring quantities for payment under the applicable items, measurement shall be along the centerline of the item as installed and measured in place by the Engineer.

C. PAYMENT

1. No separate or additional payment will be made for removing existing pavement, whether asphalt or concrete. The Contractor shall, prior to bidding, perform tests and inspections as necessary to determine depth and type of existing pavement to be removed and include cost of same in unit bid price of other items.

2. Where the actual width of the existing pavement removed is less than the maximum payment width specified, payment will only be made for the actual quantity of pavement replaced.

3. No separate or additional payment will be made for removing and maintaining temporary paving required on paved roadways and pavement shoulders of roads and streets or for performing any additional excavation or any other work required to prepare the subgrade to receive the specified permanent pavement.

4. No separate or additional payment will be made for dust control.

5. The prices herein bid for the performance of the work shown and as specified shall be inclusive; that is, the said prices shall include not only the doing the work, but also all costs in connection with the work and payment therefore; including the furnishing of all materials, equipment, supplies, and appurtenances; all construction, plant, tools, and other equipment; services; and the performance of all necessary labor, superintendence, and administration required to fully complete the work. No item of work that is required for the proper and successful completion of the work, whether shown or not, shall be paid for outside of or in addition to the prices submitted in the Proposal except as specifically provided for in the Contract Documents.

D. EXPLANATION OF BID ITEMS

1. ITEM 1 – PUMP STATION IMPROVEMENTS

a. Measurement

The improvements to the Oak Ridge Pump Station item will not be measured for payment but will be paid for at the lump sum price.

b. Payment

The lump sum price shall be full compensation for all work necessary to provide the Owner with a complete operational sewage pump station as designed in the accompanying construction plans and specifications. Work shall include but not limited to mobilization, demolition, excavation, backfill, installation, site work, yard piping, temporary bypass, piping, valves, pumps, lining system, building modifications, flow metering, HVAC equipment, miscellaneous equipment and fixtures and all associated civil, structural, mechanical, electrical, testing, start-up and training as contained in the plans and specifications for the project.

Partial payments will be made for work completed in accordance with Schedule of Values as identified in Part 1 of this Section. The Schedule of Values shall list component parts of scope of work in sufficient detail as to allow preparation of progress payments during performance of the work. Schedule of Values shall list component parts of scope of work in sufficient details as to allow preparation of progress payments during performance of the work. Schedule of Values shall be submitted to the Engineer for approval prior to commencement of construction. Dollar amounts submitted for work items must be realistic and total the amount of the Bid. Reference is made to the Standard General Conditions for additional requirements in preparing a Schedule of Values.

PART 3 – SCOPE OF PAYMENT

A. The Contractor will receive and accept compensation provided for in the Contract Documents as full payment for furnishing materials, labor, tools, and equipment and for performing work under the Contract in a complete and acceptable manner and for all risk, loss, damage, or expense of whatever character arising out of the nature of the work or the prosecution thereof, subject to the provisions of the General Conditions.

B. Mobilization

1. When included in the Contractor's Schedule of Values, mobilization shall consist of the assembling and setting up for the project, the Contractor's necessary general plan, including Contractor's offices, Engineer's field office, shops, storage areas, sanitary and any other facilities, as required by the Specifications and special requirements of the Contract, as well as by local or State law and regulation. The determination of the adequacy of the Contractor's facilities, except as noted above, shall be made by the Contractor. The cost of required insurance and bonds and/or any other initial expense required for the start of work will be included in this item. The Contractor shall furnish all materials and furnishings required, and these materials and furnishing will not be considered as part of the other various items of the completed Contract.

Only fifty (50%) percent of the mobilization cost will be paid on the first payment applications.

No additional payment will be made for demobilization. Costs for demobilization shall be included in this item.

END OF SECTION

SECTION 01170

SPECIAL PROVISIONS

PART 1 - GENERAL

1.01 GENERAL OBLIGATIONS OF THE CONTRACTOR

General obligations of the Contractor shall be as set forth in the Bid Documents. All incidental work and expense in connection with the completion of work under the Contract will be considered a subsidiary obligation of the Contractor and all such costs shall be included in the appropriate items in the Fee Schedule in connection with which the costs are incurred.

1.02 SITE INVESTIGATION

The Contractor shall satisfy himself as to the conditions existing within the project area; the type of equipment required to perform the work; the character, quality and quantity of the subsurface materials, solids and grit to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, as well as from information presented by the Drawings and related Sections. Any failure of the Contractor to acquaint himself with the available information will not relieve him from the responsibility for estimating properly the difficulty or cost of successfully performing the work. The Owner assumes no responsibility for any conclusions or interpretation made by the Contractor on the basis of the information made available by the Owner.

1.03 COORDINATION WITH LOCAL AGENCIES

A. Supply the Local Law Enforcement, Fire Department(s), School Board and the Owner with the following information.

1. A list of streets and intersections where work will be in progress to be supplied at intervals as required by the Engineer.

2. Areas where approved detours and street closings are in effect.

3. Immediate notification of any sewer or appurtenant breaks.

1.04 PUBLIC UTILITIES AND STRUCTURES

A. Notify utility companies of any damage to their utilities resulting from inspection and cleaning operations.

B. If, during the course of the work, the Contractor for whatever reason causes the existing utilities in the area to fail, the Contractor shall restore service in the shortest possible time, working around the clock if necessary. The Contractor will complete repairs to the satisfaction of the utility owner and will cooperate with the owner in supplying emergency service to local residents.

C. Assume full responsibility for the protection of all buildings, structures, and utilities, public or private, including poles, signs, services to buildings, utilities in the street, gas pipes, water pipes, hydrants, sewers, drains and electric and telephone cables, whether or not they are shown on the Drawings. Carefully support and protect all such structures and utilities from injury of any kind.

Immediately repair, at no additional expense to the Owner, property owner or utility, any damage resulting from the operations.

D. Assistance will be given the Contractor in determining the location of existing services. The Contractor, however, shall bear full responsibility for obtaining all locations of underground sewers and appurtenances. Maintain services to buildings and pay costs or charges resulting from damage thereto.

1.05 PROGRESS SCHEDULE

A. Submit a progress schedule before starting any work, as specified herein.

B. Review the progress schedule with the Engineer on a monthly basis or more frequently as required by the Engineer. The progress schedule shall be adjusted as required.

1.06 ENVIRONMENTAL PROTECTION, CLEANUP AND DISPOSAL

A. Provide for the flow of sewers interrupted during the progress of the work, and immediately cart away and remove all offensive matter. Discuss the entire procedure of maintaining existing flow with the Engineer well in advance of the interruption of any flow. Take sufficient precautions during operations to minimize the run-off of polluting substances such as spoils, grit, debris, wastewater, fuels and oils into the supplies and surface waters of the State.

B. During the course of the work, keep the site of operations as clean and neat as possible. Dispose of all residues resulting from the inspection work and, at the conclusion of the work, remove and haul away any temporary structures and any other refuse remaining from the operations and leave the entire site of the work in a neat and orderly condition.

C. In order to prevent environmental pollution arising from the activities related to the performance of this Contract, comply with all applicable Federal, State and local laws and regulations concerning waste material disposal, as well as the specific requirements stated in this Section and in other related Sections. The Contractor shall also be required to comply with the requirements and regulations of the debris disposal facility.

D. Disposal of waste material and other debris removed during cleaning operations in wetlands, stream corridors and plains is strictly prohibited even if the permission of the property owner is obtained. Any violation of this restriction by the Contractor, his subcontractors or any person employed by these companies, will be brought to the immediate attention of the responsible regulatory agencies, with a request that appropriate action be taken against the offending parties. The Contractor will be required to remove the fill and restore the area impacted at no increase in the Contract Price.

E. The Contractor shall immediately remove from the site and legally dispose all debris removed from existing sewers and appurtenances cleaned and inspected under this Contract. At no time, shall these materials be stacked around the access port or surrounding area. Such material should be considered non-hazardous and the costs for disposing of it shall be included in the unit pricing for sewer cleaning, testing and disposal bid by the Contractor.

F. The Engineer will notify the Contractor in writing of any non-compliance with the foregoing provisions or of any environmentally objectionable acts and corrective action to be taken. State or local agencies responsible for verification of certain aspects of the environmental protection requirements shall notify the Contractor in writing, through the Engineer, of any non-compliance with State or local requirements. After receipt of such notice from the Engineer or from the regulatory agency through the Engineer, immediately take corrective action. Such notice, when delivered to the Contractor or his authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails or refuses to comply promptly, the Engineer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs or damages by the Contractor unless it is later determined that the Contractor was in compliance.

1.07 PERMITS AND NOTIFICATIONS

A. Obtain all necessary permits required for proper execution of the project. Fill out all forms and furnish all drawings required to obtain the permits. A copy of each permit shall be submitted to the Engineer. All fees associated with these permits shall be paid by the Contractor as part of the work. Work shall not commence on any phase of the work requiring a permit until the permit is obtained.

B. The Contractor shall be responsible for notifying local agencies of their intent to conduct inspection operations. The Contractor should coordinate work with these entities to ensure the owner is aware that work will be taking place near these facilities and to identify any facilities of concern that may not have been identified above.

C. The Contractor will also be responsible for contacting local businesses and individuals when encroaching onto private property.

1.08 NOTICE TO PROPERTY OWNERS

Do not enter or occupy private land outside of rights-of-way, except by permission of the landowner or supervising authority.

1.09 CARE AND PROTECTION OF PROPERTY AND WORK

A. Be responsible for the preservation of all public and private property and use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part of the Contractor, restore such property to a condition similar or equal to that existing before the damage was done, or make good the damage in other manner acceptable to the Engineer at no additional cost to the Owner.

B. From the commencement of the work until its completion and acceptance by the Owner, the Contractor shall be solely responsible for the care of the work, and all injury or damage to the same, from whatever cause, shall be repaired by him at his own expense, before the final estimate is made. The Contractor shall provide suitable means of protection for all materials intended to be used in the work in progress, as well as for completed work.

1.10 OPEN SEWERS

A. Adequately safeguard all open openings and other access points by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons and damage to property. The size of the opening will be according to the particular feature. If the opening becomes a hazard, or if it excessively restricts traffic at any point, the Engineer may require special inspection procedures such as limiting the hours of operation or installing alternate traffic control measures.

B. Take precautions to prevent injury to the public due to open access ports and manholes. Provide adequate light at all openings, equipment, or other obstacles that could be dangerous to the public at all times. No access opening to the sewer system will be left unsupervised by the Contractor.

1.11 COOPERATION WITHIN THIS CONTRACT

All firms or persons authorized to perform any work under this Contract shall cooperate with the Contractor and Subcontractors or trades and assist in incorporating the work of other trades where necessary or required.

1.12 WATER FOR OPERATIONS

A. In locations where public water supply is available, the Contractor may be allowed to use water without charge for cleaning purposes with approval of Owner.

B. The express approval of the Owner shall be obtained before water is used. Waste of water shall be sufficient cause for withdrawing the privilege of unrestricted use. Hydrants shall only be operated under the supervision of the Owner's personnel.

C. If water restrictions are in force, the Contractor shall supply his own source of water that shall be acceptable to the Engineer.

D. When drawing water for cleaning purposes, the Contractor shall use caution at all times so as to prevent potential contamination of the Owner's water supply and distribution system. The Owner may require that a backflow preventer be utilized.

E. The Contractor shall supply a working reduced pressure backflow preventer and flow meter for each hydrant utilized during work. At the end of the work, the Contractor shall furnish a tabulation of the total gallons of water utilized each month during the course of the Contract.

F. The Contractor must exercise extreme care when opening and closing Owner hydrants. All hydrants must be opened and closed SLOWLY to prevent damage.

G. Prior to the start of work on any sewer segment, the Contractor shall submit a water use plan for approval by the Engineer. The plan shall detail the location of hydrants to be utilized, the routing of hoses across sidewalks and roadways, and the means to be used to protect hoses from traffic and pedestrians from tripping hazards as well as to minimize the occurrence of water hammer.

1.13 TEMPORARY FACILITIES

A. Furnish temporary light and power, complete with wiring, lamps and similar equipment as required to adequately light all work areas and with sufficient power capacity to meet the reasonable needs to complete work during evening hours.

B. Provide self-contained, single occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed in a fiberglass or other approved non-absorbent shell.

C. Completely remove all temporary materials and facilities when their use is no longer required. Clean and repair damage caused by temporary installations or use of temporary facilities.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 PROTECTION OF STREAMS AND SURFACE WATERS

A. Take all precautions to prevent, or reduce to a minimum, any damage to any stream or surface water from pollution by debris, sediment or other material, or from the manipulation of equipment and/or materials in or near such streams. Water that has been used for washing or cleaning, or that contains oils or sediments that will reduce the quality of the water in the stream, shall not be returned to the stream.

B. Do not discharge waters from cleaning operations directly into any live or intermittent stream, channel, wetlands, surface water or any storm sewer.

C. Take all preventative measures to avoid spillage of solid and liquid materials removed from the sewer system. In the event of any spillage, prompt remedial action shall be taken in accordance with the Maryland Department of Environment. The Contractor shall be liable for any penalties or fines for discharges or occurrences related to contract work.

3.02 PROTECTION OF LAND RESOURCES

A. Restore land resources within the project boundaries and outside the limits of permanent work to a condition, after completion of work that will appear to be natural or matches the conditions existing prior to the start of work. Confine all activities to the general areas shown on the Drawings.

B. Do not deface, injure, or destroy trees or shrubs, nor remove or cut them without prior approval. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorage unless specifically authorized by the Engineer. Where such special emergency use is permitted, first wrap the trunk with a sufficient thickness of burlap or rags over which softwood cleats shall be tied before any rope, cable, or wire is placed. The Contractor shall in any event be responsible for any damage resulting from such use.

C. Before beginning operations near them, protect trees that may possibly be defaced, bruised, injured, or otherwise damaged by equipment, by placing boards, planks, or poles around them. Monuments and markers shall be protected similarly.

D. Any trees or other landscape features scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to their original condition. The Engineer will decide the method of restoration to be used and whether damaged trees shall be treated and healed or removed, disposed of and replaced in kind.

1. All scars made on trees by equipment or during operations shall be coated as soon as possible with an approved tree wound dressing.

E. Unless specifically shown on plans, no arrangements will be made for any means of access to the right-of-ways or construction strips by the Owner. The Contractor shall therefore be required to make his own arrangements for access to the work within these points and copy of these arrangements shall be furnished to the Owner.

3.03 PROTECTION OF AIR QUALITY

Burning - The use of burning at the project site for the disposal of refuse and debris will not be permitted.

3.04 NOISE CONTROL

Make every effort to minimize noises caused by the operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise in compliance with Federal and State regulations.

3.05 MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION

Maintain all facilities constructed for pollution control as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created.

3.06 LINES GRADES AND ELEVATIONS

A. The Contractor shall furnish the field stakeout of all necessary lines, grades, and elevations to complete the work as shown on the plans and specifications. Horizontal and vertical control data will be furnished by the Engineer. Such stakeouts must be approved by the Engineer, and corrected if and as necessary, before the Contractor proceeds with construction. The Contractor shall have no claims for damages or extra compensation due to delays originating from unapproved stakeouts and/or necessary corrections thereto.

B. The Contractor shall preserve and maintain in proper condition all stakes, grade-boards and lines until authorized to remove same.

C. Cut sheets for all utility lines shall be provided by the Contractor for the Engineer's approval before the start of any excavation for utility lines. The cut sheets shall include profile information along the existing ground, along the centerline of the utility at intervals not exceeding 50 feet and at the location of all proposed structures. The cut sheets shall also include elevations of the finished

utility invert and the cut from proposed invert grade of the utility to the existing ground line.

3.07 INSPECTION

A. The Engineer will appoint such persons, contingent upon approval of Owner, as he may deem necessary to inspect the materials furnished or to be furnished, and the work done under the Contract, and to see that the same is proceeding in accordance with the Contract Documents. Work and material will be inspected promptly, but, if for any reason, delay should occur, the Contractor shall have thereby no claim for damages or extra compensation.

B. The Inspector is authorized to direct the attention of the Contractor to any failure of work or materials to conform to the requirements of the Contract Documents. The Inspector is authorized to reject materials, or suspend the work until any questions at issue can be referred to and decided by the Engineer.

C. The Inspector is not authorized to revoke, alter or waive any requirements of the Contract, nor to direct the Contractor to undertake extra work which is beyond the scope of the Contract or for which the Contractor may subsequently claim extra compensation or extensions of time, nor to approve or accept any portion of the completed work.

D. The Inspector shall in no case act as foreman or perform other duties for the Contractor, nor interfere with the management of the work. Advice which the Inspector may offer the Contractor shall not bind the Engineer in any way, nor release the Contractor from fulfilling all of the terms of the Contract.

E. Any disagreement between the Contractor and Inspector will be immediately directed by the Inspector to the Engineer for decision. The Engineer will render his decision promptly, and should the Contractor refuse to comply, the Engineer will suspend the work, and direct the Inspector to leave the site. Any work performed by the Contractor during the Inspector's absence will be neither accepted nor paid for.

F. The Contractor shall furnish the Engineer with every reasonable facility for ascertaining whether or not the work performed and materials used are in accordance with the requirements and intent of the Contract Documents. If the Engineer so requests, the Contractor shall, at any time before acceptance of the work, remove or uncover such portions of the finished work as may be directed. After examination, the Contractor shall restore said portions of the work to the standard required by the Specifications. Should the work thus exposed or examined prove acceptable, the cost of uncovering, or removing, and the replacing of the covering or making good of the parts removed will be paid as extra work, but should the work so exposed or examined prove unacceptable, the cost of uncovering or removing, and the replacing of the covering or making good of the parts removed, shall be the Contractor's sole expense.

G. The Contractor shall pay for all necessary inspection costs incurred by any other agency than the Owner, such as public service utility company, governmental agency, or other agency whose jurisdiction affects the work in any manner, unless otherwise specified herein.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 01200

PROJECT MEETINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Preconstruction Conference
2. Progress Meetings
3. Pre-Installation Meeting
4. Coordination Meetings

B. Related Requirements

1. Section 01700 - Project Closeout

1.02 PRECONSTRUCTION CONFERENCE

A. Engineer will schedule and administer preconstruction conference.

B. Engineer will administer site mobilization conference at Project site for clarification of Owner and Contractor responsibilities in use of site and for review of administrative procedures.

C. Agenda: Discuss items of significance that could affect progress including such topics as:

1. Tentative construction schedule
2. Critical work sequencing
3. Designation of responsible personnel
4. Procedures for processing field decisions and Change Orders
5. Procedures for processing Applications for Payment
6. Distribution of Contract Documents
7. Submittal of Shop Drawings, Product Data and Samples
8. Preparation of record documents
9. Use of the premises
10. Office, work and storage areas
11. Equipment deliveries and priorities
12. Safety procedures
13. First aid

14. Security

15. Housekeeping

16. Working hours

17. Procedures for testing

18. Requirements for start-up of equipment

1.03 SUPERINTENDENT'S MEETINGS

A superintendent's meeting will be held at beginning of every week by Contractor which shall cover planned work for upcoming week stressing any unusual aspects of planned work as well as safety. The Engineer and representatives of any utilities to be affected shall be invited to the meeting.

1.04 PROGRESS MEETINGS

A. Engineer will schedule and administer Progress meetings throughout progress of the work at least once a month or as deemed necessary by Engineer. Times and dates shall be agreed upon by the Engineer, Owner and Contractor.

B. Project meetings shall be held at the Owner's Office.

C. Attendance: Contractors' Project Manager and Job Superintendent, Owner and Engineer as appropriate to agenda topics for each meeting. Major subcontractors and suppliers shall attend when requested by the Engineer.

D. The first progress meeting shall be held soon after start of work. The Contractor, having previously carefully examined Drawings and Specifications, shall present to Engineer any questions that have arisen.

E. Agenda

1. Review and correct or approve minutes of the previous progress meeting.

2. Review other items of significance that could affect progress.

3. Include topics for discussion as appropriate to the current status of the Project.

4. Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities shall be completed within the Contract Time.

5. Review the present and future needs of each entity present, including such items as:

a. Interface requirements

b. Time

c. Sequences

d. Deliveries

e. Off-site fabrication problems

f. Access

g. Site utilization

h. Temporary facilities and services

i. Hours of work

j. Hazards and risks

k. Housekeeping

l. Quality and work standards

m. Change orders

n. Documentation of information for payment requests

1.05 PRE-INSTALLATION CONFERENCE

A. When required in individual Specification Sections, convene a pre-installation conference prior to commencing work of the Section.

B. Require attendance of entities directly affecting, or affected by, work of the Section.

C. Review conditions of installation, preparation and installation procedures, and coordination with related work.

D. Review the progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for:

1. Contract Documents

2. Options

3. Related Change Orders

4. Purchases

5. Deliveries

6. Shop Drawings, Product Data and quality control samples

7. Possible conflicts

8. Compatibility problems

9. Time schedules

10. Weather limitations

11. Manufacturer's recommendations
12. Compatibility of materials
13. Acceptability of substrates
14. Temporary facilities
15. Space and access limitations
16. Governing regulations
17. Safety
18. Inspection and testing requirements
19. Required performance results
20. Recording requirements
21. Protection

1.06 ADMINISTERING MEETINGS

The Engineer will schedule, administer, record and report all meetings. Minutes will be distributed within five business days after each meeting.

1.07 COORDINATION MEETINGS

It is strongly suggested that the General Contractor hold weekly meetings, every Monday morning, with the sub-contractors to coordinate up-coming work and to review progress.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. Administrative Submittals
2. Shop Drawings (electronic submissions)
3. Product data
4. Samples
5. Manufacturer's equipment certification
6. Construction photographs **(minimum of six 8"x10"'s monthly)**
7. Submittal procedures

B. Related Requirements

1. Section 01010 - General Requirements
2. Section 01027 - Applications for Payment
3. Section 01600 - Material and Equipment
4. Section 01700 - Project Closeout

1.02 PREPARATION OF SUBMITTAL

A. Use the form at the back of this section as the cover for each submittal

B. Submittals that fail to conform to these requirements may be cause for being returned without any action for correction by the Contractor. No extension of Contract Time will be authorized because of submittals being returned without action because of failure to comply with these regulations.

C. Package each submittal appropriately for transmitting and handling.

1.03 COORDINATION AND SCHEDULING

A. Schedule: Within twenty-one (21) working days of Execution of the Contract, submit a schedule for all submittals; indicate the date of submittals and date of return. The first application for payment will not be approved until an acceptable schedule is received by the Engineer.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

C. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.

D. Coordinate transmittal of different types of submittals for related elements of the work so processing will not be delayed by the need to review submittal concurrently for coordination.

E. Schedule a minimum of three (3) weeks for handling and review for each submittal. Schedule additional time for review if submittal must be coordinated with subsequent submittals.

F. Schedule a minimum of fifteen (15) working days for review of each submittal by the Engineer. If the submittal must be delayed for coordination, the Engineer will inform the Contractor within the fifteen (15) working days scheduled for review.

G. No extension of Contract Time will be permitted because of failure to transmit submittals sufficiently in advance to permit processing on a timely basis.

1.04 ADMINISTRATIVE SUBMITTALS

A. Refer to other Division 1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to:

1. Permits
2. Applications
3. Performance and payment bonds
4. Insurance certificates
5. List of subcontractors
6. Schedules
7. Daily construction reports
8. Statement by Contractor and Employees (Act 34)
9. Installation certificates

B. The Schedule of Values submittal is included in Section “Applications for Payment”.

1.05 SHOP DRAWINGS

A. The Contractor shall submit to the Engineer shop drawings as required.

B. At the time of submission, the Contractor shall call to the Engineer’s attention, in writing, any deviations that the shop drawings may have from the requirements of the Drawings and Specifications.

C. If more than one resubmittal of a shop drawing is required due to the Contractor’s submission of products that do not meet the contract requirements, the Owner reserves the right to be compensated by the Contractor for costs incurred to perform additional reviews.

D. The Contractor shall submit the shop drawings marked as either “Submitted as Specified” or “Submitted as Equal to Specified”.

1. Where any article is specified by trade name or name of manufacturer with the clause “or equal”, it is intended to establish the quality of the article. If the Contractor proposes to use material of another manufacturer as an “or equal” to the specified material or equipment, all shop drawings shall conform to the following requirements, conditions and procedures:

a. Substitution of materials other than those specified will be permitted, providing, in the opinion of the Engineer, such material is equal to or better than that specified. The decision of the Engineer with respect to approval or disapproval of any material proposed to be substituted as an “or equal” is final. The Contractor shall have no claim of any sort by reason of such decision.

b. If the Contractor proposes to substitute materials or equipment as “or equal” to those specified, it shall be his responsibility to furnish complete, specific, detailed information from the manufacturer or supplier of the material or equipment he proposes to furnish, in which the requirements of the Contract Specifications are shown to be met. This shall consist of a point by point comparison of the Contract Specification requirements with the material proposed to be furnished. The burden of responsibility to furnish this information is with the Contractor. If incomplete or irrelevant data is submitted as evidence of compliance with the Contract Specifications, the data will be returned and the request for approval will be denied.

c. All suppliers and sub-contractors, including those listed as approved sources, must comply with all requirements as setforth in plans and specifications.

E. All shop drawing information must be submitted in a timely fashion to allow a thorough review by the Engineer and to ensure that delivery of the equipment coincides with the construction schedule. Failure of the shop drawings to comply with the specifications, requiring subsequent resubmittals, may adversely affect the construction schedule. Any such delays are solely the responsibility of the Contractor. The Owner and Engineer will not entertain or approve any claims by the Contractor for additional costs or extensions of contract time based on failure to obtain shop drawing approvals.

F. The Engineer’s comments will include specific details as to what or where the shop drawings do not comply with the Drawings or Contract Specifications. The Engineer shall review only such data and details as are transmitted to him by the Contractor. The Contractor shall coordinate between all suppliers and subcontractors.

G. Copies of the approved shop drawings will be included in operation and maintenance manuals.

H. The Engineer will retain two copies of each shop drawing.

I. The Contractor's attention is specifically directed to the fact that no items shall be fabricated, nor materials ordered, nor any construction performed prior to approval by the Engineer of shop drawings applicable thereto.

1.06 PRODUCT DATA

A. Submit only pages which are pertinent; mark each copy of standard printed data to identify pertinent products, referenced to Specification section and article number. Show reference standards, performance characteristics and capacities, wiring and piping diagrams and controls, component parts, finishes, dimensions, and required clearances.

B. Modify manufacturers' standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.

C. Manufacturers' Instructions: When required in individual Specification Sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, adjusting and finishing in quantities specified for product data.

1.07 SAMPLES

A. Submit full range of manufacturers' standard finishes except when more restrictive requirements are specified, indicating colors, textures and patterns, for Engineer selection.

B. Submit samples to illustrate functional characteristics of products, including parts and attachments.

C. Approved samples which may be used in the work are indicated in the Specification Sections.

D. Label each sample with identification required for transmittal letter.

E. Provide field samples of finishes at Project, at location acceptable to Engineer, as required by individual Specification Sections. Install each sample complete and finished. Acceptable finishes in place may be retained in completed work.

1.08 MANUFACTURERS' EQUIPMENT CERTIFICATION

A. A list of equipment for which the manufacturers' certification is required is included in this specification section.

B. At the time of submitting Shop Drawings, submit a completed certification in the form provided at the end of each specific equipment or system specification section, from each manufacturer of the equipment or system listed below attesting that the manufacturer has examined the Contract Drawings and Specifications and that the proposed equipment, component, or system meets or exceeds Contract Specifications, is suitable for its intended purpose and installation, and will provide satisfactory performance at the design criteria specified.

C. Applicable Equipment:

1. Submersible Pumps

1.09 CONSTRUCTION PHOTOGRAPHS

A. The Contractor shall submit monthly to the Engineer a minimum of six 8"x10" color photographs, with negatives, taken on or about the first of each month showing the actual construction progress of the work. Two prints of each negative are necessary, but the negatives should be sufficient in number to properly record the work. If acceptable to Funding Agency and Owner, digital photos will suffice.

B. Photographs shall be taken using a good quality camera and lens. Film size shall be 35 mm or larger. Prints shall be color, in focus, and of good color resolution; rejected photographs shall be re-shot.

C. The Engineer may require additional photographs, if, in his judgment, any submittal does not cover the total current project.

D. Provide a standard hard cover, 3-ring binder with clear plastic print-holder inserts. Label the cover including Owner's name, project title, number and location, name of design firm, name of Contractor, and Start-Work date. Provide additional binders and inserts as necessary.

E. Identify each print on the back listing the name of the project, contract number, Plan Sheet No; date and time of exposure, and orientation of view.

F. Costs of construction photographs shall be included in contract price.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 CONTRACTOR REVIEW

A. Review submittals prior to transmittal; determine and verify Engineer's dimensions, field measurements, field construction criteria, manufacturers' catalog numbers and conformance of submittal with requirements of Contract Documents.

B. Coordinate submittals with requirements of work and of Contract Documents.

C. Sign or initial each sheet of shop drawings and product data and each sample label to certify compliance with requirements of Contract Documents. Notify Engineer in writing, (on the transmittal or separate letter) at time of submittal, of any deviations from requirements of Contract Documents.

D. Do not fabricate products or begin work which requires submittals until return of submittal with Engineer acceptance.

3.02 SUBMITTAL REQUIREMENTS

A. Transmit submittals in accordance with approved progress schedule.

B. Quantities: Submittal shall be made in the following quantities unless additional quantities are indicated in the material specification section.

1. Shop Drawings: ELECTRONIC

2. Product Data: ELECTRONIC

3. Samples

a. Full Size: One

b. Product Variation Limitation: Samples as required to indicate variation in color, texture, pattern, or other characteristics.

C. Apply Contractor's stamp, signed or initialed, certifying Contractor's review of submittal; verification of products, field dimensions and field construction criteria; and coordination of information with requirements of work and Contract Documents.

D. Coordinate submittals into logical groupings to facilitate interrelation of the several items:

1. Finishes which involve Engineer selection of colors, textures or patterns.

2. Associated items which require correlation for efficient function or for installation.

3.03 ENGINEER'S ACTION

A. The Engineer will review and stamp the shop drawings in one of the following ways:

1. Approved

2. Approved As Noted (Resubmission Not Required)

3. Exceptions Noted (Resubmissions Required)

4. Rejected

5. Reviewed (Any comments are for information only)

6. Not reviewed

B. Shop drawings returned to the Contractor stamped as "Approved" or "Approved As Noted", shall not be returned to the Engineer. All notations made on shop drawings stamped "Approved As Noted" shall be corrected or followed by the Contractor in using that product in the project.

C. The Engineer will review a maximum of two shop drawing submittals for each piece of equipment. If additional submittals are required, the Contractor shall be

responsible for the costs incurred by the Engineer to review the additional submittals. The Owner will be reimbursed by the Contractor for this additional engineering cost by a credit Change Order.

3.04 OPERATING AND MAINTENANCE MANUAL

A. Upon completion of the work, and at least twenty days prior to the date set for final inspection and equipment operation the Contractor shall furnish for the Engineer's review one set of Operating and Maintenance Manuals for each facility in the project. This submittal is required before 90% payment to the Contractor is released.

B. Manuals shall include operating and maintenance information on all systems and items of equipment. The data shall consist of catalogs, brochures, bulletins, charts, schedules, working drawings corrected to as-built conditions and assembly drawings and wiring diagrams describing location, operation, maintenance, lubrication, operating weight, lubrication chart showing manufacturer-recommended lubricants for each rotating or reciprocating unit, and other information necessary for the Engineer to establish an effective operating and maintenance program. The following data shall also be included:

1. Title page giving name and location of facility.

2. Four eight-inch by ten-inch color pictures of the facility, views as directed by the Engineer.

3. Photographs (color) of each piece of equipment in place.

4. "Name Plate" data of all equipment.

5. Performance curves for all pumps installed.

6. Approved working drawings of each piece of equipment.

7. Manufacturers' cuts and dimension drawings of each piece of equipment and details of all replacement parts.

8. Manufacturers' erection, operation, and lubrication instructions for all equipment and apparatus.

9. Complete wiring diagrams of all individual pieces of equipment and systems including one line diagram; schematic or elementary diagrams; and interconnection and terminal board identification diagrams.

10. Complete piping and ductwork layout and interconnecting drawings.

11. A copy of all submittals shall be included in manual with tables and table of contents to properly organize submittals in sections.

C. All items noted in paragraph B that are of sheet size of 8-1/2 inches by 11 inches shall be bound in loose leaf 3-ring type binders with black plastic-coated or blue canvas covers. Binders shall be Vernon Line Royal Number R-6372 or Number R-372.

D. Working drawings 24-inches by 36-inches or similar in size shall be folded such that they can be bound into the 3-ring binder, their title block is exposed, and they can be folded out without being removed from the binder. Alternatively, they may be folded as described and placed in clear pockets which are bound in the

manual. Drawings descriptive of a single item of equipment shall be grouped together.

E. All working drawings included in the binders shall be those copies previously submitted for review and approval and shall bear the Engineer's stamp of approval and comments as originally noted thereon.

F. Subsequent to the Engineer's approval and return of the initial manual the Contractor shall submit four complete sets of manuals for distribution by the Engineer.

G. Final inspection and/or beneficial occupancy will positively not be undertaken until approved Operating and Maintenance Manuals have been submitted. Partial approvals will not be made.

3.05 AS-BUILT DRAWINGS

A. The Contractor shall keep one copy of all Contract Documents, including working drawings, at the site, in good order, and annotated to show all changes made during the construction process. These as-built drawings shall be available to the Engineer, kept current during the project, and shall be delivered to him upon completion of the project. If the Contractor fails to maintain the as-built drawings as required herein, progress payments will be withheld until proper as-built drawings have been revised and approved as current by the Engineer, or the Owner may at its option, contract for independent correction of working drawings to as-built conditions, and the cost of such contracted services will be deducted from monies retained under the provisions of the Contract Documents.

B. As-built drawings shall include, at a minimum:

1. Sewer Lines

a. Elevations of sewer manhole rim, invert of line in, and invert of line out.

b. Distance from manhole to service lateral connections.

c. For new systems, locations of the end of all installed lateral with reference ties as needed to assure ability to relocate.

d. Distances between manholes and reference ties to manholes as needed.

e. Length of service lateral installed.

f. Location of clean-outs with reference ties as needed.

g. Location, size, type and length of casing pipe.

h. Location, size and type of pipe installed.

i. Location, size, type and invert elevation of mainline clean-out with reference ties as needed.

2. Water Lines

   a. Location of all hydrants, valves and meters with reference ties as needed.

   b. Location of all water line with reference ties as needed.

   c. Length, size and type of all water line installed.

   d. Location, size and type of all house connections, tees and angles with reference ties as needed.

3. Utility Lines

   a. Location, size and type of all lines installed with reference ties as needed.

   b. Location, size and type of all pedestals, junction boxes, vaults, and pull boxes with reference ties as needed.

4. Roadways

   a. Location and elevation of centerline of roadway,

   b. Width and cross-slope of roadway.

   c. Location, size, type and slope of all culverts.

5. Water Tanks, Pump Stations, Treatment Plants, Basins, etc.

   a. All information necessary to describe location, configuration and composition of facility including utilities, equipment, drains, fencing, roadways and other related items.

6. Existing Utilities Encountered

   a. Location, size and type of utility encountered with reference ties as needed.

   b. Note any repairs made to damaged utilities.

   c. Location, size and type for any relocated utilities with reference ties as needed.

NOTE: Location must be established by shown distances, reference ties, or co-ordinates and not by physical placement on a map alone.

3.06 NAMEPLATES

A. All component parts of each item of equipment or device shall bear the manufacturer's nameplate, giving name of manufacturer, description, size, type, serial number, model number, electrical characteristics, and other data to facilitate maintenance or replacement. The nameplate of a subcontractor or distributor will not be acceptable. In addition to the manufacturer's nameplates,

all equipment, including items such as heating units, fans, pumps, compressors, and tanks shall be permanently identified by name and number corresponding to the as-built drawings with nameplates which shall be engraved laminated white on black finish phenolic nameplates. Data and installation shall be approved by the Engineer. Nameplate letter shall be minimum ¼ inch high etched white letters and beveled white trim. Nameplates for control center, and control and metering or instrument panels shall be provided with 3/8-inch high letters. Motors shall be identified by the same number as the driven unit. Identifying characters shall be not less than 2-inches high and shall be painted. Decals, Rotex, or Dymo field applied labels will not be acceptable. All nameplate data shall be reproduced in the Operating and Maintenance Manual.

B. Valve tags shall be provided, one for each valve, for identification, and the tag numbers shall agree with the valve numbers, on the as-built drawings. Valve tags shall be brass, 1-1/2 inches in diameter, with depressed black filled numbers not less than ¼ inch high. Tags shall be secured to valves with approved brass chain or S-hooks, to be easily read.

C. All exposed piping shall be identified by stenciling or pre-printed pipe markers at all control points, junction points and along each change of direction five feet or longer in length. The direction of flow and medium carried shall be labeled after all piping has been tested, approved, covered and painted.

END OF SECTION

CONTRACT:_____ SUBMITTAL NO.: _____

SPECIFICATION SECTION NO.: _____

CONTRACTOR:_____ Do not combine multiple sections together unless required by specifications

SUBMITTAL IDENTIFICATION & CONTRACTOR'S APPROVAL STATEMENT

DATE: _____ COPIES: _____ DRAWING SHEET NO.:_____ or

PARAGRAPH NO: _____

Description submittal contents: _____

Manufacturer and Address: _____

Subcontractor and Address: _____

Supplier and Address: _____

Remarks: _____

_____

_____

CONTRACTOR'S APPROVAL

_____ has reviewed and coordinated the submittal documentation and verifies that the
(Construction Company)
equipment and material meet the requirement of the Work and the Contract Documents. We accept sole responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data contained in the submittal as required by the Contract Documents.

Deviations from Specifications: ____ NO ___ YES – If Yes, List Deviations (use additional sheet if necessary)

Deviations: _____

_____

Approved

by:_____

Date:_____

This approval does not release subcontractor/vendor from the contractual responsibilities

THIS BOX FOR ENGINEER'S DATE STAMP

THIS BOX FOR ENGINEER'S SUBMITTAL STAMP

THIS PAGE LEFT BLANK

SECTION 01500

TEMPORARY FACILITIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. This Section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security, and protection for this Project.

2. Temporary construction and support facilities: Including installation, maintenance and removal are to be handled by the Contractor.

1.02 RESPONSIBILITIES

A. Contractor shall provide the following temporary construction, utilities, facilities, and controls for the use by the Engineer.

1. Sanitary facilities including drinking water

2. Rodent and pest control.

3. Environmental Protection.

B. Contractor shall be responsible for the implementation of safety programs and initiatives. These documents do not intend to define any Contractor's responsibility to safety. It is expected that the Contractor will perform their activities in a safe manner and in accordance to industry regulations including those imposed by OSHA. Similarly, these Specifications shall not be construed as defining security measures.

1.03 SUBMITTALS

A. Temporary Utilities: Submit reports of tests, inspections, meter readings and similar procedures performed on temporary utilities.

B. Implementation and Termination Schedule: Submit a schedule indicating implementation and termination of each temporary utility within 15 days of the date established for commencement of the work.

1.04 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to:

1. Building code requirements.

2. Health and safety regulations.

3. Utility company regulations.

4. Police, fire department and rescue squad rules.

5. Environmental protection requirements.

B. If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any Work to be inspected, tested or approved, the Contractor shall give the Engineer timely notice of its readiness and of the date arranged, so the Engineer may observe such inspection, testing or approval. The Contractor shall bear all costs of such inspections, test and approvals unless otherwise provided.

C. If, after commencement of the Work, the Engineer determines that any work requires special testing, he will, upon written authorization from the Owner, instruct the Contractor to order such special testing. If such special testing reveals a failure of the work to comply (1) with the requirements of the Contract Documents, or (2) with respect to the performance of the work with laws, ordinances, rules, regulations or orders of any public authority having jurisdiction, the Contractor shall bear all costs thereof, including Engineer's additional services made necessary by such failure; otherwise, the Owner shall bear such costs, and an appropriate supplement shall be issued.

D. Required certificates of inspection, testing or approval shall be secured by the Contractor and promptly delivered by him to the Engineer.

E. Neither the observations of the Engineer nor inspections, tests or approvals by persons other than the Contractor shall relieve the Contractor from his obligations to perform the work in accordance with the Contract Documents.

1.05 PROJECT CONDITIONS

A. Temporary Utilities: Prepare a schedule indicating dates for implementation and termination of each temporary utility. At the earliest feasible time, when acceptable to the Owner, change over from use of temporary service to use of the permanent service.

B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities or permit them to interfere with progress. Do not allow hazardous, dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

PART 2 - PRODUCTS

2.01 ROADWAYS

A. Existing Roadways: The Contractor shall maintain and clean, regularly, roadways, drives and parking areas within the site. Any damage caused by the use of these areas for construction purposes shall be repaired by the Contractor at his expense.

B. Temporary Roadways: The Contractor shall construct and maintain roadways and parking areas within the site, as required, in order to provide proper access to building or structure(s). The roadways and parking areas shall be constructed in accordance with base course specified and shall be kept in a usable condition

throughout the period of construction. Location(s) shall be coordinated with the Owner.

2.02 FIELD OFFICE

NOT USED

2.03 TEMPORARY TELEPHONE

NOT USED

2.04 SANITARY PROVISIONS

Contractor shall provide and maintain, in a neat and sanitary condition, suitable toilet accommodations for the use of persons on the Project, complying with the requirements or regulations of the governing body having jurisdiction thereof.

2.05 TEMPORARY UTILITIES AND FACILITIES

A. Use of electric service shall be arranged and maintained by Contractor.

B. The Contractor shall provide extension cords and hoses for extending the existing services as required for his own use.

2.06 TEMPORARY WATER SUPPLY

A. The Contractor shall, at his own cost and expense, provide, protect and maintain an adequate non-potable water supply, for construction use on the Project during the period of construction, either by means of the permanent water supply line or by the installation of a temporary water supply.

B. If there is a charge for water, said charge shall be paid by the Contractor.

2.07 TEMPORARY ELECTRICAL LIGHT AND POWER

A. The Contractor shall, at his own cost and expense, install, operate, protect, have inspected and maintain a temporary electric service for construction light and power.

B. The service to be provided, unless otherwise specifically provided, shall be a minimum 200 Amp service, single phase, three wire, 120/240 volts with fused safety switch protection and the necessary disturbing facilities and meter, if required.

1. Provide electric service required for building heat during dry-in.

2. All 120-volt, single phase, 15 Amp and 20 Amp receptacle outlets shall have ground fault circuit interrupter protection.

C. The Contractor, at all times, shall provide and pay for all maintenance, servicing, operation and supervision of the service and distributing facilities necessary for maintaining temporary heat and ventilation, after same is required in the building.

2.08 TEMPORARY HEAT AND VENTILATION

NOT USED

2.09 ADDITIONAL VENTILATION IN OCCUPIED AREAS

NOT USED

2.10 PROJECT IDENTIFICATION SIGNS

NOT USED

PART 3 - EXECUTION

3.01 INSTALLATION

A. Use qualified personnel for installation of temporary facilities. Locate facilities where they shall serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required when requested by the Engineer.

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

3.02 TEMPORARY UTILITIES

The Contractor shall furnish and install all equipment, wiring, accessories, etc. to maintain all temporary electric, telephone, gas, water and sewer utilities required for general construction, start-up, and initial operation of the plant improvements including those temporary utilities required for temporary offices of the Owner and Engineer and temporary facilities to keep the existing treatment plant in operation. Temporary utilities shall be provided throughout the construction period until Substantial Completion of the entire project. All costs for providing temporary utilities required for the general construction shall be paid by the Contractor and included in the Contract Price. The Owner will pay all utility costs associated with keeping the existing treatment plant facilities in operation during the construction period.

3.03 TEMPORARY UTILITY INSTALLATION

A. General: Engage the appropriate local utility company to install temporary service or connect to existing service. Where the company provides only part of the service, provide the remainder with matching, compatible materials and equipment; comply with the company's recommendations.

1. Arrange with the company and existing users for a time when service can be interrupted, where necessary, to make connections for temporary services.

2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.

3. Obtain easements to bring temporary utilities to the site, where the Owner's easements cannot be used for that purpose.

4. Use Charges: Costs or use charges for temporary facilities are not chargeable to the Owner or Engineer, and will not be accepted as a basis of claims for a Change Order.

B. Water Service: Install water service and distribution piping of sizes and pressures adequate for construction until permanent water service is in use. Installation, maintenance and removal are by the Contractor.

1. Disinfection: Disinfect temporary water piping prior to use.

C. Temporary Electric Power Service: Provide waterproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload protected disconnects, automatic ground fault interrupters and main distribution switch gear. Installation, maintenance and removal, including any fees, are by the Contractor. The Contractor shall be responsible for the monthly usage costs.

D. Temporary Lighting: Wherever overhead floor or roof deck has been installed, provide temporary lighting with local switching. Installation, maintenance and removal are by the Contractor.

1. Install, maintain, and operate temporary lighting that shall fulfill security and protection requirements, without operating the entire system, and shall provide adequate illumination for construction operations and traffic conditions.

E. Sewers and Drainage: If sewers are available, provide temporary connections to remove effluent that can be discharged lawfully. If sewers are not available or cannot be used, provide drainage ditches, dry wells, stabilization ponds and similar facilities. If neither sewers nor drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off the site in a lawful manner. Installation, maintenance and removal are by the Contractor, including any installation fees.

1. Filter out excessive amounts of soil, construction debris, chemicals, oils and similar contaminants that might clog sewers or pollute waterways before discharge.

2. Connect temporary sewers to the municipal system as directed by the sewer department officials.

3. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. Following heavy use, restore normal conditions promptly.

F. Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of storm water from heavy rains.

3.04 TEMPORARY CONSTRUCTION AND SUPPORT FACILITIES INSTALLATION

A. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.

1. Maintain temporary construction and support facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the Owner.

B. Provide incombustible construction for offices, shops and sheds located within the construction area or within 30 feet of building lines. Comply with requirements of NFPA 241.

C. Temporary Heat: Provide temporary heat required by construction activities, for curing or drying of completed installations or protection of installed construction from adverse effects of low temperatures or high humidity; select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.

D. Heating Facilities: Except where use of the permanent system is authorized, Contractor shall provide vented self-contained LP gas or fuel oil heaters with individual space thermostatic control. All heaters must be acceptable to the Fire Marshal.

1. Use of gasoline-burning space heaters, open flame, or salamander type heating units is prohibited.

E. Change, Storage and Fabrication Sheds: Install change, storage and fabrication sheds, sized, furnished and equipped to accommodate materials and equipment involved, including temporary utility service. Sheds may be open shelters or fully enclosed spaces within the building or elsewhere on the site.

F. Sanitary facilities include temporary toilets, wash facilities and drinking water fixtures. Comply with regulations and health codes for the type, number, location, operation and maintenance of fixtures and facilities. Install where facilities will best service the Project's needs. Use of pit-type toilets will not be permitted.

1. Provide toilet tissue, paper towels, paper cups and similar disposable materials for each facility. Provide covered waste containers for used material.

G. Wash Facilities: Contractor shall install wash facilities supplied with potable water at convenient locations for personnel involved in handling materials that require wash-up for a healthy and sanitary condition. Dispose of drainage properly. Supply cleaning compounds appropriate for each condition, except asbestos removal.

1. Provide safety showers, eye-wash fountains and similar facilities for convenience, safety and sanitation of personnel.

H. Temporary Enclosures: Provide temporary enclosure for protection of construction and existing building from exposure to inclement weather.

1. Where heat is needed and the permanent building enclosure is not complete, provide temporary enclosures where there is no other provision for containment of heat. Coordinate enclosure with ventilating

and material drying or curing requirements to avoid dangerous conditions and effects.

2. Install tarpaulins securely with incombustible wood framing and other materials.

3. Close openings through floor or roof decks and horizontal surfaces with load-bearing wood framed construction.

4. Where temporary wood or plywood enclosure exceeds 100 square feet in area, use UL-labeled fire retardant treated material for framing and main sheathing.

I. Temporary Lifts, Hoists, and Scaffolding: Contractor shall assume responsibility for hoisting materials and employees. Truck cranes and similar devices used for hoisting materials are considered Atools and equipment@ and not temporary facilities. Coordinate placement and use.

J. Project Identification and Temporary Signs: Prepare temporary signs of the size required; install signs where indicated to inform the public and persons seeking entrance to the Project. Support on posts or framing of preservative treated wood. Do not permit installation of unauthorized signs.

1. Temporary Signs: Prepare signs to provide directional information to construction personnel and visitors.

K. Collection and Disposal of Waste: Collect waste from the site daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80°F (27°C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material in a lawful manner. Dumpster shall be placed in locations directed by the Engineer.

3.05 PARKING AND TRAILER LOCATION

A. All construction traffic, including employee traffic, trucking, and delivery of materials and equipment, shall be controlled by the Contractor and shall enter the site only by routes prescribed by the Contractor. Access to the site by other routes will be prohibited.

B. The Contractor shall take all precautions to prevent tracking of mud and debris onto the highways and streets.

3.06 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Except for use of permanent fire protection as soon as available, do not change over from use of temporary security and protection facilities to permanent facilities until Substantial Completion.

B. Temporary Fire Protection: Until fire protection needs are supplied by permanent facilities, install and maintain temporary fire protection facilities of the types needed to protect against predictable and controllable fire losses.

1. Locate fire extinguishers where convenient and effective for their intended purpose.

2. Store combustible materials in fire-safe locations.

3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires. Prohibit smoking in hazardous fire exposure areas.

4. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.

C. Permanent Fire Protection: At the earliest feasible date in each area of the Project, complete installation of the permanent fire protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.

D. Barricades, Warning Signs and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed, provide lighting, including flashing red or amber lights.

E. Security Enclosure and Lockup: Contractor shall provide protection against vandalism, theft and similar violations of security; Owner shall not be responsible for costs associated with these occurrences.

F. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by means that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which product harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints.

3.07 OPERATION, TERMINATION AND REMOVAL

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

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.

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

2. Protection: Prevent water filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

C. Termination and Removal: Unless the Contractor or Engineer requires that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent

construction that may have been delayed because of interference with the temporary facility. Repair damaged work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of the party furnishing the facility

2. At Substantial Completion, clean and renovate permanent facilities that have been used during the construction period, including but not limited to:

   a. Replace air filters, and clean inside of ductwork and housings.

   b. Replace lamps that are burned out or noticeably dimmed by substantial hours of use.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 01600

MATERIAL AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. Products
2. Substitutions
3. Transportation and Handling
4. Storage and Protection
5. Testing of Equipment
6. Product Contamination

B. Related Requirements

1. General Conditions
2. Section 01010 - General Requirements
3. Section 01700 - Project Closeout

1.02 PRODUCTS (STANDARDS OF QUALITY)

A. Products include material, equipment, and systems.

B. Comply with Specifications and referenced standards as minimum requirements.

C. The materials, articles, devices, products, fixtures, form or type of construction in these Specifications are specified by trade name, manufacturer's name, catalog reference or by description, to establish the standard and quality and design desired, and shall not be interpreted as limiting competition.

D. Design, arrangement, details, utility requirements and dimensions shown on Drawings and included in Schedules and Specifications have been determined and established, after considerable study and planning, based on the criteria of the first named manufacturer. Other manufacturers named or substitutes are considered to be able to perform the same function but not necessarily have same design, arrangement, details, utility requirements and dimensions. Therefore, if a Contractor desires to use a manufacturer or product other than first named, he shall assume the responsibility of coordination and all costs or extra charges, including costs in connection with Work of other trades or separate Contracts, necessitated by their use.

E. Colors: Where indicated or specified as “color to be selected” or “color selected by the Engineer” the color will be selected from the full range of standard colors of the first named manufacturer or an equivalent color of other manufacturers.

1.03 SOURCE OF SUPPLY AND QUALITY OF MATERIALS

A. The source of supply of each of the materials must be approved in writing by the Engineer before delivery is started. Representative preliminary samples of the character and quantity prescribed shall be submitted by the Contractor, said samples being taken under the observation of the Engineer, for examination, and tested in accordance with the methods referred to herein. Only materials conforming to the requirements of these specifications and approved by the Engineer shall be used in the work. No materials, which, after approval, have in any way become unfit for use, shall be used. The Contractor shall notify the Engineer where and when he purchases fabricated or manufactured materials for the Contract, and such notice shall be given the Engineer in sufficient time to allow for inspection of such materials at the point of manufacture.

B. Unless a material has a satisfactory record of performance, the Engineer reserves the right to withhold approval of a new source of supply, even though it meets the specification requirements, until its qualities have been verified and proved in actual service.

C. Tests of all materials specified will be made in accordance with the latest official approved methods, effective as of the date of Contract, described in the Contract Documents. Where ASTM, AASHTO, ANSI, AWWA, or similar standards of national repute are stipulated, the reference shall be construed to be the latest effective specification.

D. The Contract drawings, specifications, and/or supplemental specifications indicate the name of manufacturer, trade name, model number or type of equipment or materials to be used as a standard for the Bidder's proposal. All bids shall be based on the equipment and materials specified. Reference to model number or catalog number is not intended to supersede the basic duty and performance requirements specified or indicated on the drawings. References made to a particular product or model of the manufacturer are made to identify a particular design quality, construction, arrangement or style.

E. The low Bidder shall submit, within ten (10) working days after opening of bids, a complete statement of the origin, composition and manufacture including manufacturer's name and catalog numbers of all materials and equipment to be used in the work to be performed under this contract. Submission and/or approval of this list of materials and equipment shall not, however, relieve the Contractor of submitting detailed working drawings on all equipment for approval nor shall it constitute prior approval of any specific item of equipment before the final detailed working drawings are submitted.

F. Failure of the Contractor to submit the list of materials within the ten (10) working day period shall forfeit the Contractor's right to make any change or substitution from the exact equipment specified and the Engineer shall have the right to select the material and equipment to be furnished.

G. Where a Contractor proposes to use a substitute item, the installation of which will require any redesign of the structure, partitions, foundations, piping, ductwork, wiring, controls, or of any other part of the project, all such redesign,

and all new drawings and detailing required therefore shall be prepared by a Registered Professional Engineer licensed to practice in the Maryland for the Contractor at the Contractor's expense for the approval of the Engineer. Where the substitution of any item or items requires a different quantity and arrangement of ductwork, piping, wiring, conduit, and equipment from that specified or indicated on the contract drawings, the Contractor shall include the total cost of such changes in his bid. Later requests for additional compensation for substitutes will not be considered. All equipment and materials named shall be furnished in full accordance with the contract drawings and specifications.

H. If the Contractor proposes to substitute materials or equipment as "equal" to those specified, it shall be the Contractor's responsibility to furnish complete, specific, detailed information from the manufacturer or supplier of the materials or equipment he proposes to furnish, in which the requirements of the contract specifications are shown to be met. This shall consist of a point-by-point comparison of the contract specification requirements with the material or equipment proposed to be furnished. In the event the contract specifications mention a model number and manufacturer in lieu of a detailed description and manufacturer, a point-by-point comparison of the equipment specified under the contract and that proposed to be substituted shall be furnished by the Contractor. The burden of responsibility in furnishing this information is with the Contractor. If incomplete or irrelevant data is submitted as evidence of compliance with this section of the specifications, the data will be returned to the Contractor and the request for approval will be denied.

I. All materials and equipment required for the work shall be new, of first-class quality, and shall be furnished, delivered, erected, connected, and finished in every detail, and shall be so erected and arranged as to fit properly into the building spaces. Where no specific kind of quality or material is given, a first-class standard article approved by the Engineer shall be furnished.

J. In cases where material, a device, or part of the equipment is referred to in the singular number, it is intended that such reference shall apply to as many items of materials, devices, or parts of the equipment as are required to complete the installation.

K. The Contractor shall submit written evidence from each equipment manufacturer showing the availability of factory authorized servicemen within a distance of 200 miles from the project site for all equipment to be provided.

L. When a material has been approved, no change in brand or make will be permitted unless:

1. The manufacturer cannot make satisfactory delivery; or

2. The material delivered fails to comply with the Contract requirements.

1.04 DEFECTIVE MATERIALS

All materials not conforming to the requirements of these Specifications will be deemed defective, and all such materials, whether in place or not, shall be removed immediately from the site of the work, unless otherwise permitted by the Engineer. No rejected material, the defects of which having been subsequently corrected, shall be used until approval has been given. Should the Contractor fail to comply with any order of the Engineer made under the provisions of this article, the Engineer shall have the authority

to remove and replace defective materials, and to deduct the cost of removal and replacement from any monies due or to become due the Contractor.

1.05 ADDITIONAL COSTS RESULTING FROM SUBSTITUTE MATERIAL OR EQUIPMENT

The Contractor shall comply with General Conditions regarding substitute material or equipment. Additional costs resulting from installation of approved substitute material or equipment including alterations in connecting piping or conduit, changes or alteration to foundations, anchor bolts, control systems, or other additional costs attributed to use of the substitute material or equipment shall be the sole responsibility of the Contractor.

1.06 TRANSPORTATION AND HANDLING

A. Transport products by methods to avoid product damage; deliver in undamaged condition in manufacturer’s unopened containers or packaging, dry.

B. Provide equipment and personnel to handle products by methods to prevent soiling or damage.

C. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

1.07 CONTRACTOR STORAGE AREA

A. The Contractor's storage area, for the placing of equipment, materials, inspector's and contractor's offices, and any additional space required for storage, shall be located by the Contractor at his expense.

B. The Contractor shall adhere to all state and local laws and regulations concerning environmental pollution control and abatement.

1.08 STORAGE AND PROTECTION

A. Store products in accordance with manufacturer’s instructions, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer’s instructions.

B. For exterior storage of fabricated products, place on sloped supports aboveground. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.

C. Store loose granular materials on solid surfaces in a well-drained area; prevent mixing with foreign matter.

D. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged and are maintained under required conditions.

1.09 EQUIPMENT STORAGE

A. The Contractor is required to provide a covered storage area for equipment delivered to the site. Electrical and instrumentation equipment shall be stored in a closed, conditioned storage area. All equipment delivered and stored on the

project site shall be in strict accordance with the equipment supplier's storage procedures.

B. The Contractor shall submit along with the shop drawing submittal for each piece of equipment the equipment manufacturer's recommended short term and long-term storage maintenance procedures. These procedures are to be implemented fully by the Contractor. Using the information submitted by the manufacturer, the Contractor shall prepare and submit for approval a schedule listing maintenance tasks and schedule dates for each task for each piece of equipment. The Owner's Representative will verify that the recommended procedures are being performed, and he along with the Contractor's representative will initial a log sheet when the maintenance task is completed. These storage maintenance procedures shall be performed from the time the equipment arrives on site until the equipment is placed into operation.

C. Motors with condensate heaters delivered to the site which are not installed within 30 days or motors installed but not operational within 30 days shall be wired to provide full operation use of the condensate heaters.

D. Lubricant drain piping, valves, end plugs and associated components required for servicing equipment including lubricants for storage, start-up and normal operation and desiccant bags for moisture protection of motors, actuators, and panels shall be furnished by the Contractor.

1.10 TESTING OF EQUIPMENT

A. After permanent heating, plumbing or electrical system and equipment have been installed, it shall be the responsibility of the Contractor installing such system and equipment to operate it for a satisfactory period of time as required by Engineer for proper testing and instruction of operating personnel.

B. Fuel, electricity and water, required for proper testing of permanent equipment and for the period of instructing personnel, shall be supplied by the Contractor performing the test or instruction.

1.11 START-UP AND PERFORMANCE TESTING

A. All utilities, supplies and materials required in connection with start-up and performance testing shall be provided and paid for by the Contractor. Laboratory testing services will be performed by a testing laboratory engaged and paid for by the Contractor and approved by the Engineer.

B. Potable water is available from the Owner's existing potable water distribution system. The cost associated with providing the potable water connection and the potable water including the cost for metered service throughout the construction period to Substantial Completion of the entire project shall be paid by the Contractor and included in the Contract Price bid.

C. The Contractor is responsible to fill tanks, sumps, and pits with clean water as required to fulfill performance testing requirements for pumps, aerators, mixers, blowers, etc.

1.12 VIBRATION AND INFRARED TESTING

NOT USED

1.13 PRODUCT CONTAMINATION

A. All products provided for this Project shall be completely free of asbestos and polychlorinated biphenyl (PCB).

B. Potable water systems and products accessible to public such as paint coatings shall be lead free.

C. Materials and adhesives shall be formaldehyde free.

D. The Contractor shall submit a certificate on company letterhead singed by the Project Superintendent and a Vice President indicating that materials provided for the Project are not contaminated by asbestos, polychlorinated biphenyl (PCB), lead or formaldehyde.

E. When required by specification sections, submit 6 copies of a “Certificate of Non-Contamination”. Certificate shall be prepared on the manufacturer’s letterhead, signed by a Vice President, and indicate that materials provided for the Project are not contaminated by asbestos.

F. Material Safety Certifications: The Contractor shall submit 6 copies of a letter from the manufacturer of each product used on this Project, stating that, at the time of its use and installation in the Project, the product posed no known health hazard to the occupant of the building as a result of exposure to the product.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED.

END OF SECTION

SECTION 01700

PROJECT CLOSEOUT

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies administrative and procedural requirements for project closeout, including but not limited to:

1. Inspection procedures.
2. Project record document submittals. (As-built Drawings)
3. Operating and maintenance manual submittal
4. Release of liens.
5. Submittal of warranties.
6. Final cleaning.
7. Letter of Acceptance from State Highway Administration, if applicable.
8. Consent of Surety for final payments.
9. Release from Maryland Department of Tax and Revenue.
10. Statement from Engineer that work has been inspected and completed in accordance with approved contract documents.
11. Final adjusting Change Order.

1.02 REQUIREMENTS OF REGULATORY AGENCIES

Conduct cleaning and disposal operation to comply with codes, ordinances, regulation, and anti-pollution laws.

1.03 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following. List exceptions in the request.

1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the work claimed as substantially complete. Include supporting documents for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
2. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.
3. Advise the Owner of pending insurance change-over requirements.

4. Submit to the Engineer specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.

5. Obtain and submit releases enabling the Owner unrestricted use of the work and access to services and utilities; include occupancy permits, operating certificates and similar releases.

6. Submit to the Engineer record drawings, maintenance manuals, and similar final record information.

7. Deliver spare parts, extra stock, and similar items to the Owner via the Engineer.

8. Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change-over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.

9. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.

1.04 FINAL ACCEPTANCE

A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.

1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.

2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.

3. Submit a certified copy of the Engineer's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Engineer.

4. Submit consent of surety to final payment.

B. Re-inspection Procedure: The Engineer will re-inspect the work upon receipt of notice that the work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Engineer.

1.05 RECORD DRAWINGS

A. The Contractor is required to keep an up-to-date set of Record Drawings (As-Constructed Drawings) for the project. In addition, the Contractor shall identify the location of all new piping installed, existing piping to remain and existing piping to be abandoned as it is installed or uncovered during the construction period. No trenching for piping shall be backfilled until the piping has been located by the Contractor. The Contractor shall also identify the location of all

buried or embedded conduits and duct banks including new work and existing to remain or to be abandoned as it is installed or uncovered during the construction. Up-to-date is defined as containing modifications for work performed within the past 30 days. The record drawing information shall include but not be limited to the following:

1. All dimensional changes. Degree of dimensioning shall equal that of the original drawing except for the yard piping and site electrical drawings. The Record Drawing dimensioning for the yard piping and site electrical (buried or embedded conduits and duct banks) drawings shall include as a minimum both horizontal locational dimensioning from above grade permanent structure and elevation at each location where the process piping and electrical work enters or leaves a structure and at each change in direction. In addition, where the buried process piping and electrical work parallels the wall of a structure, horizontal dimension from the structure and elevation shall be provided at a minimum of two locations.

2. Electrical breaker designations for each circuit such as receptacles, lights, heaters, etc.

3. All internal piping valve and fitting modifications. Degree of detail shall be equal to that of the original drawing.

4. All structural reinforcement modifications.

5. All electrical conduit size and routing wire size and wiring quantity modifications, wiring number and tagging assignments.

6. All site work modifications such as roadways, sidewalks, grading, etc.

B. The Engineer will review the status of the Contractor's record drawings on a monthly basis. If the record drawings do not meet the requirements stated above, 10% of the succeeding progress payments, in addition to the normal contract retaining, will be withheld until such time as the record drawings are brought into compliance.

C. The Contractor shall make the record drawings available to the Engineer whenever requested for reproduction by the Engineer so that he can begin preparation of the final record drawings to be supplied to the Owner.

D. At the end of the project, the Contractor's record drawing set shall be turned over to the Engineer.

1.06 RECORD DOCUMENT SUBMITTALS

A. General: Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Engineer's reference during normal working hours.

B. Record Drawings: A clean, undamaged set of blue or black line prints of Contract Drawings will be maintained by the Contractor. The Contractor shall mark the set to show the actual installation where the installation varies from the work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately. Where Shop Drawings are used, record a cross-reference

at the corresponding location on the Record Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

1. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the work.

2. Mark new information that is important to the Owner but was not shown on Contract Drawings or Shop Drawings.

3. Note related Change Order numbers where applicable.

4. Organize Record Drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set. Upon completion of the work, submit Record Drawings to the Engineer for the Owner's records.

C. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record-keeping and submittals in connection with actual performance of the work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to the Engineer for the Owner's records.

1.07 GUARANTEES, CERTIFICATES, OPERATION AND MAINTENANCE MANUALS

A. During the course of the work and within 6 weeks after approval of Shop Drawings, Contractor shall collect and assemble six (6) copies each of the guarantees, manufacturers' specification sheets and/or working drawings, operation and maintenance instructions, parts list including exploded views, recommended safety procedures, and recommended list of spare parts. The Contractor shall submit all copies, with an itemized listing, to the Engineer.

B. Operation and Maintenance Manuals shall include all mechanical and electrical equipment specified herein including heating, ventilation, air conditioning and lighting equipment.

C. Operation and Maintenance Manuals shall include all electronically operated features of the building and all equipment specified in these Specifications.

D. The Operation and Maintenance Manuals shall be assigned a value of 10% of the equipment cost, and this assigned amount will be retained from progress payments until the manuals are submitted to and approved by the Engineer and the equipment is delivered to the site.

E. Furnish Operation and Maintenance Manuals on 8-1/2" x 11" sheets or booklets, loose bound in 3-ring binders with front and back page lifters, with binder contents indicated on the front and spine of the binder cover. All loose sheets shall be in vinyl page protectors with reinforced binding edge. Furnish drawings included in the manuals on 11" x 17" sheets laminated and folded to 8-1/2" x 11" or folded and placed in vinyl "envelope pockets" incorporated into the binder. All materials in manuals shall be original print quality manufacturer's literature. Photo static copies of printed materials are not acceptable. Provide an index of the contents of each manual or a master index for a system consisting of several manuals. Provide printed and laminated, reinforced index tabs for each manual.

Indexed sections to include Installation, Start-up, Operation, Troubleshooting, Maintenance, Parts List, Recommended Spare Parts and Miscellaneous Components. Submit no less than four (4) copies.

F. Include a detailed description of function of each principal component, procedures for starting, operation, overhaul and maintenance. Include safety precautions, test procedures and a catalog cross-reference to commercially available parts.

G. Submit a Preventive Maintenance and Lubrication Schedule for the equipment furnished which specifically explains the duties to be fulfilled by the Owner during the guarantee period. Manufacturer's recommended lubricant plus two equal substitutes for all material, shall be included in the O&M Manuals.

1.08 RELEASE OF LIENS

A. The Contractor shall deliver to the Engineer a blanket release of liens covering all work performed under this Contract, including that of subcontractors, sub-subcontractors, vendors, and other suppliers of materials and labor. Execute the release of liens on documents similar to AIA Document G706, "Contractor's Affidavit of Payment of Debtors and Claims", and AIA Document G706A., "Contractor's Affidavit of Release of Liens".

B. The forms shall be executed by the authorized officer and notarized. All required attachments shall be included as noted on AIA Document G706. If exceptions are listed in either AIA Document G706 or Document G706A, the Contractor shall furnish bond satisfactory to the Owner for each exception.

1.09 PROJECT CLOSEOUT SUBMITTALS

A. Submit two copies of Project Closeout submittals bound in three-ring binders, clearly labeled to the type of submittal. Provide pocket folders for folded information.

B. Submittals shall be submitted within ten days of Substantial Completion and prior to final Application for Payment.

1. Exception: Operation and Maintenance Manuals shall be submitted within six weeks after approval of shop drawings or within ten days of Substantial Completion, whichever is earlier.

2. Refer to Sub-section 1.07.

C. Warranties and Bonds

1. Obtain warranties and bonds, executed in duplicate by responsible subcontractors, suppliers, and manufacturers.

2. Except for items put into use with the Owner's permission, leave date of beginning of time of warranty until the date of Substantial Completion is determined.

3. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual; identify the number and title of the Specification Section in which product is specified.

4. Separate each warranty or bond with index tab sheets keyed to Table of Contents. List subcontractor, supplier, and manufacturer, with name, address and telephone number of responsible principal.

PART 2 - PRODUCTS

2.01 CLEANING MATERIALS

A. Use only those materials which will not create hazards to health or property, and which will not damage finishes and surfaces.

B. Use only materials and methods recommended by manufacturer of material being cleaned.

PART 3 - EXECUTION

3.01 CLOSEOUT PROCEDURES

A. Operating and Maintenance Instructions: Each installer of equipment that requires regular maintenance shall arrange to meet with the Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items.

1. Operation and maintenance manuals
2. Record documents
3. Spare parts and materials
4. Tools
5. Lubricants
6. Fuels
7. Identification systems
8. Control sequences
9. Hazards
10. Cleaning
11. Warranties and bonds
12. Maintenance agreements and similar continuing commitments.

B. As part of instruction for operating equipment, demonstrate the following procedures:

1. Start-up
2. Shutdown
3. Emergency operations
4. Noise and vibration adjustments
5. Safety procedures

6. Economy and efficiency adjustments

7. Effective energy utilization

C. Training by factory representatives shall be videotaped by the Contractor in a DVD format, and the tapes then turned over to the Engineer upon completion of training.

3.02 INITIAL OPERATION

The Contractor shall place the completed Project, equipment and systems into initial operation. The schedule and sequence of the initial operation procedures shall be included in the Project Schedule. Coordinate the initial operation procedures with the Owner's operating personnel.

3.03 FINAL CLEANING

A. All final cleaning shall be performed by the Contractor, unless otherwise specified.

B. Remove temporary protection and labels not required to remain.

C. Clean surfaces free of grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from sight-exposed interior and exterior surfaces, bringing them to a state or readiness for Owner occupancy.

D. Clean transparent glossy materials to a polished condition; remove foreign substances. Polish reflective surfaces to a clear shine.

E. Vacuum clean carpeted and similar soft surfaces as specified.

F. Clean, wash, and polish resilient and hard-surfaced floor as specified.

G. Clean surfaces of equipment; remove excess lubrication.

H. Clean plumbing fixtures, food service equipment, hospital equipment, and similar equipment to a sanitary condition.

I. Electrical Devices and Lighting:

1. Clean light fixtures, lamps and lenses.

2. Clean the faces of all electrical devices and cover plates for same, including power receptacles, switches, computer outlets, computer and TV outlets, TV outlets, telephones, communication speakers, fire alarm speakers, fire alarm pull stations, fire alarm flashing lights, smoke detectors, clocks, speaker volume control switches, security system motion detectors, and fire alarm horns.

3. Clean the fronts of all electrical panelboards and the main distribution switchboard.

J. Remove waste, foreign matter and debris from roofs, gutters, areaways and drainage systems.

K. Remove waste, debris, and surplus materials from site. Clean grounds; remove stains, spills, and foreign substances from paved areas and sweep. Rake clean other exterior surfaces.

L. Clean permanent filters of ventilating equipment and replace disposable filters when units have been operated during construction; in addition, vacuum clean ducts, blowers and coils for every three months' use; replace or clean strainers, dirt legs, etc.

3.04 TERMINAL INSPECTION

A. Two months prior to expiration of the one year guarantee period, the Contractor shall make an inspection of the work in the company of the Engineer and the Owner. The Engineer and the Owner shall be given no less than five days' notice prior to the anticipated date of terminal inspection.

B. Where any portion of the work has proven to be defective and requires replacement, repair or adjustment, the Contractor shall immediately provide materials and labor necessary to remedy such defective work and shall execute such work without delay until completed to the satisfaction of the Engineer and the Owner, even though the date of completion of the corrective work may extend beyond the expiration date of the guarantee period.

C. The Contractor shall not be responsible for correction of work which has been damaged because of neglect or abuse by the Owner nor the replacement of parts necessitated by normal wear in use.

END OF SECTION

SECTION 02050

DEMOLITION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included

1. Removal of selected existing equipment and structures, relocation of selected equipment, and modifications to existing structures necessary for installation of new equipment.

2. Items not listed in the salvage schedules shall become the property of the Contractor and be removed by him or reused when authorized; equipment and materials not retained by Owner and not to be reused shall be legally disposed of off-site by Contractor.

3. Items listed in the salvage schedule, found in paragraph 3.04 of this specification section, shall remain the property of the Owner. They shall be carefully removed by the Contractor and delivered to the storage location designated by the Owner. Take all necessary precautions to insure against damage to existing work to remain in place, to be reused, or to remain the property of the Owner, and any damage to such work shall be repaired or replaced as approved at no additional cost to the Owner.

B. Related Work Specified Elsewhere

1. Section 02300 – Earthwork

2. Section 02485 - Fine Grading Top Soil & Compacting

3. Section 09910 - Painting

1.02 SUBMITTALS

A. Obtain, pay for, and submit all permits required for execution of demolition work including the following:

1. Permits and notices authorizing building demolition.

2. Certificates of severance of utility services.

3. Permit for transport and disposal of debris.

4. Demolition procedures and operation sequence.

B. Permits for Disposal Of Debris

1. Arrange for legal disposal of debris and obtain written agreements with the owners of the property where the debris shall be deposited.

2. Submit two copies of each agreement releasing the Owner from all

responsibility in connection with the disposal of the debris.

1.03 COORDINATION

A. Utility Removal: Arrange with utility companies for changes in their equipment, and capping of pipes and wiring as required.

B. Schedule disruption of utilities or facilities with the Owner a minimum of 48 hours in advance of shut-down.

C. Maintaining Traffic

1. Do not close or obstruct public streets or passageways without permission from authorities having jurisdiction.

2. If required by authorities, provide alternate routes around closed or obstructed traffic ways.

1.04 JOB CONDITIONS

A. Existing Conditions: Survey existing work and examine the Contract Documents to determine extent of demolition work.

B. Protection

1. Includes but not limited to erecting barriers, dust partitions, fences, guard rails, enclosures, chutes and shoring as required to protect structures and utilities remaining intact.

2. Protect any trees, plants, grass and other landscaping from damage. Replace any trees, plants or other landscaping materials designated to remain that are damaged during the work under this Contract.

3. Protect the interior of the building and all materials and equipment from the weather at all times. Replace materials and equipment damaged by weather at no additional cost to the Owner.

4. Control activities to prevent the spread of dust to occupied portions of the building and avoid nuisance in surrounding areas.

5. Take necessary precautions to insure against damage to existing materials or equipment to remain in place, to be reused, or to remain the property of the Owner. Repair or replace damaged materials and equipment at no additional cost to the Owner.

PART 2 – PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 PREPARATION

A. Preparation

1. Verify the extent of demolition work to be performed with the Engineer.

2. Verify that structures, equipment or spaces to be demolished are isolated, unoccupied and discontinued in use.

3. Arrange for and verify termination of utility services, including removing meters and capping lines.

4. Remove items scheduled to be salvaged for Owner and place in designated storage area.

3.02 DEMOLITION

A. Demolition

1. Demolish structures in accordance with demolition procedures submitted.

2. Maintain area outside in as clean condition as possible during progress of demolition work.

3. Care shall be taken in partial removal of existing masonry or stonework, where new work shall be tied-in to achieve “tooth-effect”, by removal of each whole unit along its horizontal and vertical mortar joints.

4. Remove masonry necessary for required opening.

5. Make straight-sided rectangular openings, with masonry power saw, only where authorized.

6. Existing utilities shall be removed as indicated; when utility lines are encountered that are not indicated on the Drawings, the Owner and Engineer shall be notified.

7. Use of explosives will not be permitted.

8. Limit dust to lowest practicable level.

9. Do not use water to extent causing flooding, contaminated runoff or icing.

10. Fill basement excavation and voids with compacted soil. Use of broken brick and masonry shall be prohibited.

11. Backfill in accordance with Section 02300 (if backfilling required).

12. Grade surface to adjacent contours and slope to drain.

13. Repair damage to adjacent structures.

14. Remove all clamps, brackets, supports, hangers, conduits, controls, wire,

etc. associated with equipment/pipe indicated to be removed and patch all areas to match adjacent areas.

15. Abandoned lines shall be capped with mechanical flanges.

3.03 DISPOSAL

A. Disposal

1. Remove demolition debris to designated disposal area promptly.

2. Do not store or burn materials on-site.

3. Disposal areas shall be approved by authorities having jurisdiction.

4. Disposal of all debris and demolition items shall be at the cost of the Contractor.

5. It is the Contractors responsibility to dispose of all debris and demolition items at authorized regulated disposal sites.

3.04 SALVAGE SCHEDULE

A. Contractor shall refer to plans for salvage items.

END OF SECTION

SECTION 02230

CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Work of This Section Includes, But Is Not Limited To:

1. Clearing

2. Grubbing

3. Stripping and stockpiling topsoil

4. Debris disposal

B. Related Work Specified Elsewhere

1. Section 02300 - Earthwork

2. Section 02311 - Finish Grading and Seeding

3. Section 02315 - Trenching, Backfilling & Compacting

C. Definitions

1. Clearing is defined as the removal of trees, brush, down timber, rotten wood, rubbish, trash, any other vegetation, and objectionable material at or above original ground elevation not designated to be saved; clearing also includes removal of fences, walls, guard posts, guard rail, signs, and other obstructions interfering with the proposed work.

2. Grubbing is defined as the removal from below the surface of the natural ground of stumps, roots and stubs, brush, organic materials, and debris.

1.02 JOB CONDITIONS

A. The Contractor may clear all obstructions within the property except those specifically indicated on the Contract Drawings or specified to be saved or restored.

B. Obstructions specifically designated to be saved or restored will be marked by the Engineer.

1.03 SUBMITTALS

A. Burning Permits: Submit two copies of each on-site burning permit if such permits are required by local jurisdictional authorities.

B. Permits for Disposal of Debris

1. Arrange for disposal of debris resulting from clearing and grubbing to locations outside the Owner's property and obtain written agreements with the owners of the property where the debris will be deposited.

2. Submit two copies of the agreement with each property owner releasing the Owner from responsibility in connection with the disposal of the debris.

PART 2- PRODUCTS

2.01 MATERIALS

A. Temporary Fencing

1. Undamaged picket snow fence, 4' high, formed of wooden slats, tightly woven with wire cable or other plastic fencing as approved by Engineer.

2. Soil-set fence posts, stubbed “T” type, 6' high.

PART 3 - EXECUTION

3.01 PREPARATION

A. Mark areas to be cleared, the areas to be grubbed, and items to be saved with stakes, flags, paint or plastic colored ribbon for the approval of the Engineer.

B. Protect benchmarks, property corners, utilities, existing trees, shrubs and other landscape features designated for preservation with temporary fencing or barricades satisfactory to the Engineer.

C. No material shall be stored or construction operation carried on within 4 feet of any tree to be saved or within the tree protection fencing.

3.02 UTILITY RELOCATIONS

Inform utility companies, individuals and others owning or controlling facilities or structures within the limits of the work which have to be relocated, adjusted or reconstructed in sufficient time for the utility to organize and perform such work in conjunction with or in advance of the Contractor’s operations.

3.03 CLEARING

A. Confine clearing to within the property.

B. Fell trees in a manner that will avoid damage to other trees, shrubs, and other installations which are to be retained.

C. Where stumps are not required to be grubbed, flush-cut to the ground elevation.

3.04 GRUBBING

A. Grub areas within the construction limits to remove roots and other objectionable material to a minimum depth of 12".

B. Remove all stumps within the cleared areas except those designated to be saved as indicated on the Plans.

3.05 STRIPPING AND STOCKPILING TOPSOIL

A. Strip topsoil to whatever depth it may occur from areas to be excavated, filled, or graded and stockpile at a location approved by the Engineer for use in finish grading.

B. The topsoil is the property of the Owner and shall not be used as backfill. Topsoil shall not be removed from the site unless otherwise authorized by the Engineer.

3.06 DEBRIS DISPOSAL

A. Trees, logs, branches, brush, stumps, trash, rubbish, and other debris resulting from clearing and grubbing operations shall become the property of the Contractor unless specified otherwise on plans or by Engineer and shall be legally disposed of.

B. Do not deposit or bury on the site debris, resulting from the clearing and grubbing work.

C. Debris may be burned on-site if local ordinances allow open-air burning, if required permits are obtained, and if burning operations are conducted in compliance with local ordinances and regulations.

3.07 RESTORATION

A. Repair all injuries to bark, trunk, limbs, and roots of remaining plants by properly dressing, cutting, tracing and painting, using approved arboricultural practices and materials.

B. Replace trees, shrubs and plants designated to be saved which are permanently injured or die during the life of the Contract as a result of construction operations with like species acceptable to the project Owner.

C. Remove protective fences, enclosures and guards upon the completion of the project.

D. Restore guard posts, guard rail, signs and other interferences to the condition equal to that existing before construction operations.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 02240

DEWATERING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope

1. Work consists of all necessary provisions for designing, furnishing, installing, maintaining, operating and removing temporary dewatering systems as required to lower and control water levels and hydrostatic pressures during construction; disposing of pumped water; constructing, maintaining, observing and, except where indicated or required to remain in place, removing of observation wells; and instrumentation for control of the system.

2. Dewatering includes lowering the water table and intersecting seepage which would otherwise emerge from the slopes or bottom of the excavation; increasing the stability of excavated slopes; preventing loss of material from beneath the slopes or bottom of the excavation; reducing lateral loads on sheeting and bracing; improving the excavation and hauling characteristics of sandy soil; and preventing rupture or heaving of the bottom of an excavation.

3. All dewatering measures are to be designed as to not impact the water table or the existing environmental conditions outside the limits of the project site. Professional services, such as soil or geotechnical licensed engineers, shall be utilized by Contractor as warranted and cost of such services shall be incidental to project.

4. Instrumentation for control of the dewatering system includes required design by professional furnishing, installing and operating piezometers as well as reading and logging of water levels in the observation wells.

B. Related Work Specified Elsewhere May Include But Is Not Limited To:

1. Section 02300: Earthwork

2. Section 02315: Trenching, Backfilling and Compacting

1.02 QUALITY ASSURANCE

A. Codes, Regulations, Reference Standards and Specifications

1. Codes and regulations of the jurisdictional authorities.

2. ASTM: C33, D1785, D2466, D2564, and D3653.

B. Design a dewatering system which will:

1. Effectively reduce the hydrostatic pressure and lower the groundwater levels below excavation;

2. Develop a substantially dry and stable subgrade for the prosecution of subsequent operations;

3. Not result in damage to adjacent properties, building, structures, utilities and other work (any damage shall be the responsibility of the contractor and contractor shall pay for all repairs); and

4. Assure that after initial pumping, no soil particles will be present in the discharge.

C. Methods may include trenching, sump pumping, single or multiple stage well point systems, eductor and ejector type systems, deep wells, and combinations thereof.

D. Locate dewatering facilities only where they will not interfere with utilities and construction work to be done by others. Locate dewatering wells not less than 5 or more than 20-feet from the first observation well. Sumps shall be located outside of areas that will support structures.

E. Modify dewatering procedures, which cause, or threaten to cause, damage to new or existing facilities, so as to prevent further damage. The Contractor is responsible for determining the modifications to be made, which shall be at no additional expense to the Owner.

F. Comply with the requirements of Sediment Control promulgated by jurisdictions having authority. When water is to be diverted into a storm drain, provide settling basins or other approved apparatus as required to reduce the amount of fine particles, which may be carried into the drain. If a storm drain becomes blocked or its capacity restricted due to dewatering operations, make arrangements with the jurisdictional agency and clean the drain at no additional expense to the Owner.

1.03 SUBMITTALS

Submit the following for the approval by the Engineer in accordance with Section 01300 and with the additional requirements as follows, prior to installation of the system.

A. Certification: Signed and sealed by Professional Engineer licensed in the State of Maryland specializing in this type of design, certifying that dewatering operations as designed and installed are in compliance with requirements of Contract Documents and governing codes. Professional Engineer shall schedule sufficient number of visits to the site to enable verification that the system as installed meets the requirements of the Contract Documents.

B. The proposed type of dewatering system, including relief of hydrostatic head and maintenance of the excavation in a dewatered and in a hydrostatically relieve condition.

C. Arrangement, location and depths of the components of the system.

D. A complete description of equipment to be used, with installation, operation, and maintenance procedures.

E. Standby equipment and power supply.

F. Location, details, and size of berms, dikes, observation wells/ piezometers, sumps and discharge lines, including their relation to water disposal ditches.

G. Types and sizes of filters.

H. Location, types, details and depths of well points if needed.

I. Signed and sealed design calculations demonstrating adequacy of the selected system and equipment.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials and Techniques: Contractor's option, as approved.

PART 3 - EXECUTION

3.01 DEWATERING

A. Accomplish dewatering in accordance with approved working drawings. Keep the Engineer advised of any changes made to accommodate field conditions and, on completion of the dewatering system installation, revise and resubmit working drawings.

B. Organize dewatering operations to lower the groundwater level in excavations as required for prosecution of the work, and to provide a stable, dry subgrade for the prosecution of subsequent operations. Remove ground water including water from such sources as springs, seepage, leakage, perched water and surface water from such sources as rain, snow, run-off, accident spillage and liquid mud, from whatever source.

C. Maintain the water level at such lower elevations until no danger to the structure can occur because of buildup of excessive hydrostatic pressure, and in any event maintain the water level a minimum of 2-feet below the bottom of the excavation, unless otherwise permitted by the Engineer. If "quick" condition destroys bearing capacity of soil strata, lower foundations and other building elements as needed and as directed by the Geotechnical Engineer to obtain suitable soil bearing strata at no additional cost to the owner.

D. If approved by the Engineer, the extent of dewatering may be reduced, for units designed to withstand uplift pressure, to maintain the water level a minimum of five feet below the prevailing level of backfill as it is being placed, provided such water level does not result in uplift pressures in excess of 80 percent of the downward pressure produced by the weight of the structure and backfill in place.

E. If required the Contractor will be required to construct temporary dikes that will surround open excavations to prevent inundation during precipitation events.

F. Pumps: Maintained in continuous operating condition with additional stand by equipment in event of malfunction or increased water conditions.

1. Pump discharge from dewatering operations shall be filtered through a portable sediment tank or other acceptable filtering method.

2. The pumped water from the excavation site area shall be disposed off the site at no additional cost to the owner.

3.02 OBSERVATION WELLS/ PIEZOMETERS

A. Observation wells maybe used as primary basis for determining compliance with the dewatering requirements of this section.

B. Install observation wells of the types shown on the approved work drawings at the locations, and to the depths, approved or required by the Engineer.

C. Drill holes for observation wells of the size and depth indicated, and case with temporary casing. Use water as the drilling fluid. Make a log of the soils encountered during drilling and deliver it to the Engineer.

D. Flush all cased holes with clean water through an approved bit. Flush until the discharge water is free of soil particles.

E. Maintenance of observation wells is the responsibility of the Contractor.

F. Replace damaged or destroyed observation wells within 48 hours, unless otherwise approved by the Engineer, at no additional expense to the Owner.

G. Expose and cut off observation wells within the excavation area as excavation proceeds, but continue to maintain them as specified.

H. Removal of Observation Wells

1. Remove observation wells only when so required by the Engineer.

2. Remove observation wells outside the excavation area to an elevation five feet below finished surface grade. Backfill voids and restore the surface to a condition approved by the Engineer.

3. Remove observation wells inside the excavation area to the subgrade and seal the hole with grout.

3.03 RECORDS

A. Observe and record the average flow rate and time of operation of each pump used in the dewatering system.

Where necessary provide appropriate devices, such as flow meters, for observing the flow rates. Submit the data, on a form furnished by the Engineer, during the period that the dewatering system is in operation.

B. Observe and record the elevation of groundwater in piezometers and previously installed observation wells on a form furnished by the Engineer, during the period that the dewatering system is in operation. Sound the depth to the bottom of each piezometer and observation well on a monthly basis to assure that fine soil particles are not penetrating the screen to build up in the standpipe. Submit observation records within 24 hours of reading, on a regular basis as required by the Engineer.

C. During initial period of the dewatering, make required observations on a daily basis. If, after a period, dewatering operations have stabilized, reduce observations to longer intervals as approved by the Engineer.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 02300

EARTHWORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work to be performed under this section includes, but is not limited to, the furnishing of all materials, labor, tools, and equipment necessary to complete excavation, including blasting, and backfilling for structures, site backfilling, select backfill, installation of geotextile fabric, stripping, shoring, benching, and placing topsoil necessary for the complete and satisfactory completion of this item of work.

B. Related Work Specified Elsewhere

1. Section 01300 - Submittals

2. Section 02230 - Clearing and Grubbing

3. Section 02240 - Dewatering

4. Section 02311 - Finish Grading and Seeding

5. Section 02315 – Trenching, Backfilling & Compacting

C. Classification of Excavation

All excavation work under this Contract shall be unclassified, and includes excavation and removal of all soil, rock, fill, and all other materials encountered of whatever nature.

D. Controlled blasting is a method used to remove rock in which the various elements of the blast, hole size, depth spacing, burden, charge size, explosive charge weight per delay, distribution, and delay sequence, are carefully balanced and controlled to provide a distribution of the charge that will fracture the rock so it may be excavated to the required contours and minimize over-break and fracturing of the rock beyond the contour line. Smooth wall blasting, pre-splitting, cushion blasting and line drill are examples of operations included in the term “controlled blasting”.

E. Test boring information if available is included in *Appendix A – Test Boring Logs* contained in the Contract 1 Specifications for review. Contractor shall place no reliance on this information for new construction, and shall verify existing subsurface conditions to his own satisfaction.

1.02 QUALITY ASSURANCE

A. Testing Agency: In-situ density testing will be performed by an independent soils testing laboratory engaged and paid for by the Contractor and approved by the Engineer.

B. Referenced Standards

1. American Society for Testing and Materials (ASTM)

a. D1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort

b. D2487 Standard Practice for Classification of Soils for Engineering Purposes (USCS)

c. D698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort

d. D1556 Test Method for density and Unit Weight of Soil in Place by the Sand Cone Method

e. D2922 Test Method for Density of Soil and Soil Aggregate in Place by Nuclear Methods

2. OSHA Standards for Trench Safety Standards

C. Density Testing

1. Conduct density test at locations as directed by the Engineer during backfilling operations.

2. Determine density by ASTM D1556 or ASTM D2922

1.03 JOB CONDITIONS

A. The locations shown for utilities are approximate. Proceed with caution in the areas of existing utilities and expose them by hand or other excavation methods acceptable to the utility owner.

B. Erect sheeting, shoring, and bracing as necessary for protection of persons, improvements, and excavations.

C. Furnish and maintain barricades, signs and markings for excavated areas.

D. Select and install a system of dewatering to accomplish groundwater control in excavations.

E. Preserve, protect and maintain operable existing drainage ways, drains and utilities.

F. Determine safe slopes of excavations for the earth materials encountered.

G. Maintain bench marks, monuments, and other reference points. Replace any disturbed or destroyed bench marks.

H. Storage and Transport of Explosives

Proper building or magazines, with separate compartments for detonators in suitable positions for the storage of explosives in the manner and quantities to be approved, shall be provided by the Contractor. Separate vehicles or vessels for detonators shall also be used for the transportation of explosives. All explosives shall be delivered to the site in vehicles that are in compliance with state and local codes and regulations. The prevention of any unauthorized use or improper use of any explosives brought onto the site shall be the responsibility of the Contractor

and only experienced licensed shot firers shall be employed to handle the explosives for the purposes of the Work.

The relevant security regulations dealing with the storage, handling, and transport of explosives shall comply with all applicable federal, state, and local codes.

The quantity of explosives on the job site shall at all time be limited to that required to complete one day's work. All explosives on the job site shall be stored in locked, heavy, shockproof containers. Detonators and explosives shall be inventoried at the end of each work day. Any missing items shall be immediately reported to the proper authorities and to the Engineer.

1.04 SUBMITTALS

A. General: Submit in accordance with Section 01300.

B. Certificates

1. Submit a Certificate of Compliance, together with supporting data, from the materials supplier attesting that the composition analysis of backfill materials meets specification requirements.

2. Compaction Equipment List: Submit a list of all equipment to be utilized for compacting, including the equipment manufacturer's lift thickness limitations.

3. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

a. Classification according to ASTM D 2487 of each on-site and borrow soil material proposed for fill and backfill.

b. Laboratory compaction curve according to ASTM D 1157 for each on-site and borrow soil material proposed for fill and backfill.

C. Submit signed and sealed Shop Drawing and Calculations for Sheeting and Shoring for review and approval of the Engineer. The sheeting and shoring shall be designed by a structural engineer licensed in the State of Maryland who has a minimum of 5-years of experience with the design of similar support of excavation structures. This submittal should also include the Contractor's sequence of construction.

D. The Contractor shall appoint qualified and competent licensed shot firers for the planning and design of a Master Blasting Plan, geotechnical matters, and use of explosives. The staff shall be appointed to specified positions to be responsible for the duties necessary to carry out excavation by the method of blasting. Blasting Contractor Documentation shall be submitted to the Engineer for approval documenting that the Blasting Contractor has at least 5-years of experience and evidence of the satisfactory completion of at least five blasting programs or operations comparable in scope to this work. The Blasting Contractor shall submit documentation of licensing required by County, State, Federal or other regulatory authorities having jurisdiction. The Blasting Contractor shall apply for and obtain all required blasting permits, and shall submit documentation to the Engineer.

The staff shall be full time on site and each appointed personnel shall work exclusively on duties relating to their position.

The appointed staff shall be responsible for taking possession of explosives on site, having pre-blast surveys performed as required, compiling of the Master Blasting Plan, preparation of the design for the blast holes drilling pattern, supervision of the drilling, establishing the explosive design, preparation of the wiring and firing sequence plan and supervision of the loading, wiring, and firing of all blasts.

The appointed staff shall also undertake accurate recording of all information regarding the drilling and blasting o a “Drilling and Blasting Record Sheet” and the explosive type, weight, and delay on a “Load Record Report.” The format of said record sheets and reporting shall be to the approval of the Engineer.

The appointed staff shall attend each month or at more frequent intervals as required by the Engineer, a meeting on safety and other relevant aspects of the excavation works by blasting which will also be attended by the Engineer’s Representative. The first meeting shall be held prior to and within 1-week of the first blasting, minutes of each meeting shall be maintained and submitted to the Engineer’s representative within 24-hours.

The Contractor shall submit in writing his blasting proposals to the Engineer’s Representative for approval at least 1-week before an initial blast and at least 48-hours before any subsequent blasts.

E. Blasting Data and Reports

Before using explosives obtain written permission form the Engineer and submit a rock removal plan including working drawings and data ten working days in advance of proposed blasting, for information only, showing blasting design and monitoring thereof, prepared and certified by a Professional Engineer registered in the State of Maryland experienced in blasting operations.

PART 2 - PRODUCTS

2.01 MATERIALS - GENERAL

A. On site or imported natural soils as approved by Engineer.

B. Suitable fill material is defined as earth fill or rock fill required materials necessary to raise the grade from an existing elevation or prepared foundation elevation to the finished elevation indicated in the Contract documents. Suitable fill materials shall meet the following:

Site FILL:

- USCS Classification of: CL, ML, CL-ML, SM, SC, SP, SW, GM, GC, GP, or GW
- Free from topsoil, organic matter, debris, cinders, or frozen material
- Total content of gravel or rock fragments larger than ½” shall not exceed 30-percent by weight of the mass

Select FILL:

- USCS Classification of: SM, SC, SP, SW, GC, GP, or GW
- Liquid Limit less than or equal to 40
- Plastic Index less than or equal to 10
- Free from topsoil, organic matter, debris, cinders, or frozen material
- Total content of gravel or rock fragments larger than ½-inch shall not exceed 30-percent by weight of the mass

2.02 PERVIOUS MATERIAL/ SELECT STONE FILL

A. Compacted stone at locations indicated in the Contract Documents.

B. Stone shall be granular material and shall comply with AASHTO #57.

2.03 GEOTEXTILE FABRIC

Geotextile fabric, also referred to as filter cloth, is to be installed under and around pervious material, or as directed by the Engineer. The filter cloth shall be placed over the newly exposed subgrade, prior to placement of pervious material, and shall conform to the following requirements:

Fabric Property	Test Method	Minimum Value
Grab tensile strength	ASTM D4632	300 lb
Grab tensile elongation	ASTM D4632	15%
Trapezoidal tear strength	ASTM D4533	110 lb.
Puncture strength	ASTM D4833	110 lb.
Permittivity	ASTM D4491	0.05 sec^{-1}
Apparent Opening Size	ASTM D4751	0.15 mm

2.04 SOURCE OF MATERIALS

A. Use materials for fill which were excavated for the construction of structures or utilities on the project site if they meet the material requirements specified in Section 2.01. If sufficient material meeting these requirements is not available from required excavation, obtain requisite material from other sources.

B. Use only material which has been approved as to quality, location of source and zone of placement in the fill.

C. The Engineer has the right to reject material at the job site by visual inspection, pending sampling and testing.

2.05 SHORING MATERIALS

Props, shores, jacks, needles, braces, sheeting, cribbing, tie backs, and similar items of proper size, and in good serviceable condition. Do not use materials that are unsuitable for indicated purposes, or which are severely damaged.

PART 3 - EXECUTION

3.01 PREPARATION AND LAYOUT

A. Establish and identify required lines, levels, contours and datum.

B. Maintain bench marks, monuments and other reference points.

C. Protect trees, shrubs, lawns and other features remaining as portion of final landscaping.

D. Construct and implement sediment and erosion control procedures including upstream diversions.

E. Stripped topsoil from the project site should be stockpiled for reuse and temporarily seeded and mulched if not used within seven days and immediately install sediment and erosion protection as required.

3.02 ROUGH GRADING

A. Rough grade to uniform contours; form foundations for embankments and load bearing fills.

B. Construct the finished subgrade to vary not more than 1-inch above or below the elevation shown.

C. Rough grade to prevent ponding of water in any area; install temporary swales if necessary to improve surface drainage.

D. Complete embankment slopes to vary not more than 6-inches from the slope line shown.

E. In situ areas indicating sponginess and instability during earth moving operations shall be excavated and prepared to receive acceptable fill materials as specified; material excavated due to unsuitability shall be removed from site.

F. Excavated subsoil materials to be used for fill materials shall be approved by Engineer; materials rejected by Engineer shall be removed from the site.

3.03 FOUNDATION PREPARATION OF LOAD BEARING AREAS

A. A load bearing area is defined as an area supporting loads of a structure or pavement area subject to motor traffic.

B. The entire exposed natural soil of the load bearing area shall be proof-rolled with no less than 5 complete coverages of vibratory compaction equipment (minimum of (1) 10,000-lb. smooth drum roller capable of a combined active and passive pressure of 30,000-lbs); all soft spots or irregularities within the natural soil, disclosed as the proof-rolling progresses, shall be excavated to sound material and then backfilled or leveled to grade as hereinafter specified; Project Engineer shall be so advised by Contractor that additional excavation is necessary to achieve satisfactory proof-rolling; additional excavation required will be paid for by a Change Order.

C. All backfill shall be compacted to 95% of maximum dry density at ±2% optimum moisture as determined by ASTM D1557 in areas to support floor slabs and footings and within 2(H):1(V) of the building foundation. All other areas should be backfilled to 92% of maximum density at ±2% optimum moisture as determined by ASTM D1557.

3.04 SHORING, SHEETING AND BRACING

A. The design of sheeting and shoring shall be the responsibility of the Contractor. Responsibility for the performance of shoring methods and devices, including slopes, if any, shall lie entirely with the Contractor. Correction of settlement and damage to persons and property due to settlement shall be the responsibility of the Contractor.

Any damage to persons, property, roads, and utilities, due to settlement, movement, or other conditions caused by inadequate support work, shall be made good by the Contractor as directed by the Engineer at no additional cost to the owner.

B. Install shoring, sheeting and bracing to comply with Federal, State and local code requirements. Responsibility for the safety of the work, personnel and structures rests solely with the Contractor.

C. Place bottom of excavation support system deep enough to allow for subsequent excavations of footings, structural elements, and pits, without affecting stability of support system or causing detrimental effect to subgrade of above.

D. Follow the excavation closely with sheeting and shoring placement.

E. Perform excavation for the installation of sheeting carefully to minimize the foundation of voids.

F. If unstable material is encountered during excavation, take measures to contain it in place and prevent ground displacement.

G. Have sufficient quantity of material on hand at all times for sheeting, shoring, bracing and other operations for the protection of the work and for use in case of accident or emergency.

H. Leave sheeting and shoring in place as long as possible, compatible with the placing and compacting of backfill.

I. Optional Methods

1. Change methods of support, if approved by the Engineer, to accommodate unforeseen conditions.

2. Any suggestions that the Contractor may have to expedite work of this Section to promote greater safety, or insure more practical or efficient installation, will be considered for approval.

3. The Contractor shall be responsible for entire work, regardless of methods specified or used. Take practical precautions to insure complete safety and sufficiency of work under this section and of related or adjacent work.

3.05 EXCAVATION - GENERAL

A. Excavate to the neat lines or setback lines for mixed face conditions and grades indicated on the Contract Drawings. Material excavated will be unclassified.

B. Excavate in sequence and stages which will not subject permanent or temporary structures, installations, or surfaces to unstable conditions.

C. Excavate as required to provide sufficient working space to permit placing, inspection, and completion of the structures.

D. Shape excavations accurately to the cross-sections and grades indicated.

E. Support the sides of excavations as specified or required.

F. Keep excavations free from water.

G. Where excess excavation is required to remove unsuitable material at bottom of foundation or structure excavations, fill to foundation/structure bearing or bottom of pervious material elevation with select stone fill material; properly compact select stone fill by methods acceptable to the Engineer to 95% of the maximum dry density at ±2% of the optimum moisture as determined by modified Proctor test (ASTM D1557).

H. If rock is exposed at design footing grades, the rock shall be over-cut one foot and replaced with select stone fill.

I. Fill all openings and fractures in the excavation bottom and sides with cement grout. Obtain Engineer's written approval of the foundation excavation before placing any foundation stone bedding or concrete.

J. The Contractor's failure to maintain dewatering operations for structure excavations shall not be a basis for payment for removal and replacement of unsuitable materials.

3.06 ROCK EXCAVATION

A. Use of Explosives

1. The use of explosives will be permitted for rock excavation only under conditions herein. Rock outcrops may be blasted only with the written approval of the Engineer.

2. The Contractor shall notify the Engineer 72-hours prior to starting blasting operations. Any public or private companies must be notified sufficiently in advance to enable the companies to take such steps, as they may deem necessary to protect their property from damage.

3. When the use of explosives is necessary for the prosecution of the work, the Contractor shall use extraordinary care so as not to endanger life or property.

B. Rock Excavation Requirements

1. Rock excavation employing methods other than the use of explosives shall be submitted to the Engineer for approval. A detailed description of the means, methods, equipment, and materials used, and methods for limiting ground motion and airblast shall be submitted to the Engineer. Regardless

of the methods for rock excavation, the Contractor shall conform to the requirements for the use of explosives or blasting, as described herein.

2. Prior to drilling and blasting, the Contractor shall meet the requirements of all submittals. Submittals to the Engineer of the Blasting Schedule, of the Blasting Plans, of all blasting operations, and of blasting products,

   and compliance by the Contractor with provisions for protection of life and property shall not relieve the Contractor of the responsibility or liability for the safety of persons and property.

   The Contractor is responsible for blasting in a safe manner, for producing smooth and sound rock surfaces at the lines of excavation; and for controlling damage and vibration. The Contractor's submittals to the Engineer shall not constitute nor shall they be construed to be a guarantee by the Engineer that the desired results will be achieved. Submittals to the Engineer shall not relieve the Contractor from the responsibility complying with the requirements of these specifications.

3. Where rock removal is necessary, the Contractor shall engage the services of a Vibration Consultant, who shall be approved by the Engineer, to advise on explosive charge weights per delay and to analyze results from seismographic recordings. The Vibration Consultant representative should be a licensed professional engineer or geologist with a minimum of 5 years of experience and have managed similar types of blasting activities for a minimum of 5 projects. The Contractor shall submit the credentials of the qualified Vibration Consultant 30-days prior to any blasting activities to the Engineer for approval. The Contractor shall employ only personnel qualified by training and experience to perform vertical wall trenching by blasting in high damage potential areas, close to, above and below ground structures, including pipelines and utilities. All individual blasts shall be kept to a practical minimum as determined by seismograph recordings analyzed by the Vibration Consultant. The Contractor shall maintain close supervision of the blasting personnel and ensure that all Federal, State and local blasting regulations, explosive manufacturer's instructions and requirements of the Vibration Consultant are complied with.

C. Blasting Plan

In each distinct individual blasting area where pertinent factors affecting blasting vibrations and their effects in the area remain the same, the Contractor shall submit a blasting plan of the initial blasts to the Engineer for approval. The plan must consist of hole size, depth, spacing, burden, type of explosive, type of delays, delay sequence, maximum amount of explosive on any one delay period, depth of rock, and depth of overburden if any. Maximum hole diameter on any blast shall not exceed 2 ½-inches; no more than one hole can be fired on the same delay period; explosives with minimum propagating characteristics shall be used; and all blasts shall be initiated at the hole having the most relief.

The Contractor shall monitor the existing vibrations in the area of blasting during normal business hours when blasting will be used for a minimum of 2-hours per day for 1-week prior to blasting to determine the existing noise within the area to be monitored.

The blasting plan shall contain complete details on the drilling blasting patterns and controls to be used, including the following information as a minimum:

1. Station limits a plan location of proposed shot

2. Plan and section views of proposed drill pattern, including blasthole spacing, blasthole diameters, blasthole angles, lift height, and subdrill depth

3. Loading diagram showing type and amount of explosives, primers, initiators, and location depth of stemming

4. Initiation sequence of blastholes, including delay times and delay system

5. Manufacturer's data sheets for all explosives, primers, and initiators to be employed

6. Location of all blasting zones signs

7. Type of monitoring used to ensure no one enters the blasting area

8. Public alert and warning system

9. Proposed location of seismic instruments and sound level meters

10. Anticipated blasting schedule, indicating days of week and time of day

11. Planned use of blasting mats and other protective measures

12. Additional information, as needed and appropriate

D. Blasting Schedule

The Blasting Contractor shall develop a Blasting Schedule detailing the date, time and location or proposed blasts. The Blasting Schedule shall be published in a local newspaper and submitted to the Engineer for information and record purposes at least 10-days, but not more than 20-days, before the start of the blasting program.

Should a change occur to the schedule, it shall be re-published and re-distributed. The Blasting Contractor shall also provide a Blasting Schedule to any public utilities, private residence, or others possibly affected. Blasting operations shall be restricted to between the hours of 8:00 AM. and 5:00 PM., Monday through Friday. The Engineer must approve any variation to this restriction in writing.

E. Pre-Construction Meeting

The Engineer will review the required submittals for conformance with the Contractor Drawings and Specifications. Within 30-days after receipt of the submittals, the Engineer will notify the Contractor of any additional information required and/or changes necessary to meet the contract requirements. Any parts of the submittals that are unacceptable will be rejected and the Contractor shall resubmit changes for re-evaluation. All procedural approvals given by the Engineer shall be subject to trial in the field and shall not relieve the Contractor of the responsibility to satisfactorily complete the work in this specification. Prior to

construction, the Contractor shall arrange a pre-construction meeting with the Engineer to discuss rock excavation procedures for this project.

F. Test Blasts

Design and conduct a test blasting program with the objective of establishing the type and weight of charge, spacing and delays, etc., which will avoid overbreak of the excavation face and which are commensurate with the peak allowable particle velocity and sound level. Conduct a test blasting program at the beginning of the operation, and when material of different characteristics is encountered. Become familiar with the stratigraphic sequence of rocks that will be exposed in each cut. Match the sonic velocity of rock with the velocity of detonation of the explosive used to create the desired rock fragmentation.

Upon completion of test blasting, expose the test area for the Engineer to examine and evaluate the results and for the blasting Contractor to determine the spacing and cartridge strength to be used for the full-scale blasting operation.

The Engineer's acceptance or approval of the test blasting program and techniques and procedures associated with the test blasting program or production blasting will not relieve the Contractor of his responsibilities to employ appropriate safety measures, and exercise proper supervision of the blasting operations. The contractor is solely responsible for damage or injury to persons, property, or utilities as a result of the use of explosives. Perform all necessary repairs in a satisfactory manner, to roadway, dwellings, utilities, or any property damage as a result of blasting at no cost to the Owner.

For existing utilities, monitor particle velocities at the edge of the right-of-way nearest the blast.

After each test blast, review the particle velocities and sound levels documented and evaluate rock breakage. Make adjustments to the blasting procedures, and conduct subsequent test blasts until the desired rock breakage occurs within allowable values of peak particle velocity. Establish the relationship of the scale distance concept with respect to peak particle velocity to control ground vibration. If any test blast results in damage or injury to property, person or utility, immediately cease all blasting activity until written permission to resume is received from the owner.

G. Prevention of ‘Flyrock’

All blasts shall be designed to prevent ‘flyrock’. The Contractor shall use adequate, good quality stemming materials. Wherever necessary, as determined by the Engineer, the covering of blasts, with blasting mats or adequate dirt cover will be required.

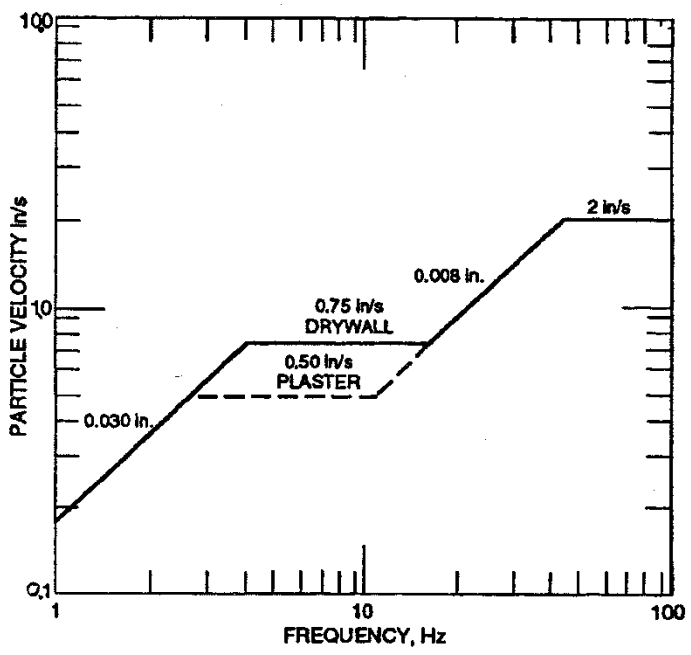
The Engineer reserves the right at any time to reduce explosive amounts, change blasting patterns on any blasting, or eliminate blasting in certain areas should conditions warrant. Nothing presented herein in any way relieves the Contractor of any responsibility of any damage to the existing pipelines or other structures or utilities in the area of blasting.

H. Seismograph, Blasting Records, and Pre-blast Surveys

The Contractor shall provide a minimum of one seismograph to measure and record ground motion caused by each subsequent blast detonated under the Contract. The seismograph shall be attached or located immediately adjacent to the nearest structure or dwelling, or on top of the nearest pipeline, as approved by the Engineer. The seismograph equipment shall be an Instantel Blastmate DS 677, or equivalent, capable of producing a permanent record of the three components of the ground motion in terms of particle velocity and the air blast in decibels. The instrument shall be capable of internal dynamic calibration. The record of each blast shall consist of the seismograph records identified by instrument number, location of the instrument positively identified, date, time and location of the blast, amount of explosive used, maximum explosive charge weight per delay period and all other data necessary to control the blasting operations. These records, as a formal report, shall be made available to the Engineer as required. Preliminary records of blasting and vibrations shall be submitted within 24-hours of blasting. Pre-blasting surveys will be provided as required by applicable law at no additional cost to the Owner.

I. Rock Excavation Vibration Limits

All blasting operations should be monitored in accordance with the Office of Surface Mining (OSM) Method 3 and the following figure.



Modification of the blasting method and reduction of the explosive weight per delay shall be used to ensure that the above limits are met.

Even though there might be buildings, pipelines or other structures closer to the blast than the monitoring location (for example, a dwelling foundation), the Contractor will not be relieved of responsibility for any damage sustained to the buildings, pipelines or structures.

J. Crossing under Existing Pipelines

If rock removal is required when crossing under existing pipelines, a rigid steel or wood beam shall be provided to support the pipeline and the bearing points of this beam should be outside the 45° influence line from the nearest point of the blast. A wood buffer shall be placed below the existing pipeline (in addition to conventional blasting mats) in order to prevent damage to the pipeline by flyrock.

K. Blasting Adjacent to Utilities

Blasting shall not be performed closer than 10-feet to existing water, gas, sewer or conduit utilities unless such facilities have been completely exposed, definitely located, and then backfilled prior to the blast. In any case, blasting shall be no closer than 2-feet from accurately located existing utilities, 10-inch or smaller diameter and no closer than 5-feet from utilities larger than 10-inch diameter.

L. Pre- and Post-Construction Surveys

1. Prior to starting and subsequent to completing any work, the Contractor shall retain the services of a qualified Professional Engineer licensed in the state of Maryland to make a detailed inspection of all buildings, structures, roadways, landscaping and related surface improvements within 150-feet of all blasting.

2. The inspection shall include notes, measurements, photographs, and a DVD (with audio sound track) of all facilities prior to the start of construction. The audio description of the inspection shall include the date, time, weather conditions, address/stationing/location, brief description of the facility and description of physical conditions encountered. The inspection should also include documentation of existing damage and other factors (both inside and outside) which could be affected by blasting.

3. With the owner's permission, install crack monitors such as Avongard or approved equal in areas of existing cracks in structures as directed by the Engineer. Upon installation of crack monitors, obtain three baseline readings. The Contractor should monitor all crack monitors installed for a minimum of 1 week prior to all blasting operations and daily during blasting operations.

4. The Contractor shall notify and obtain written permission from the property owner(s) to enter upon said properties for the purpose of making these survey inspections. In the event that access for the purpose of determining the condition of the property is refused by the owner, the Contractor shall notify the Engineer in writing and may be relieved of the responsibility for making said survey inspections with respect to the property to which access is denied.

5. A copy of all notes, measurements, photographs, DVD, reports and data relative to existing conditions of each respective property as found by the pre-construction survey, shall be forwarded to each property owner. Two identical copies shall be submitted to the Engineer.

6. The maximum allowable noise level at any inhabited building may not exceed 110-decibels peak when measured by an approved instrument having a flat frequency response over the range of 6 to 200-Hertz. The maximum allowable noise limit at any uninhabited building may not exceed 120-decibels. When blasting is of a continuous nature, 124 to 130-decibels shall be within the caution range. When the noise levels are consistently within the caution range, the rock removal procedures shall be changed to reduce the decibel level on the next rock removal procedure.

M. Safety

The Contractor shall provide an approved system of warning and preparing the general public and all site personnel of an impending blast by both audible and visual means and shall ensure that the blasting area is cleared of all personnel immediately prior to blasting. This system shall comply with all statutory requirements. The Contractor's attention is drawn to the need to devise adequate system for warning and clearing the public from specified areas during blasting operations and to prevent persons entering the blasting area.

Automotive and pedestrian traffic within at least 150-feet. is to be stopped just prior to firing. This operation is to be carried out in close cooperation with the Police Department and in such a way as to cause minimum traffic delay.

Traffic warning and signage shall be in accordance with MUTCD requirements.

All operations involving explosives shall be suspended on the approach of a thunderstorm and shall not be resumed until the storm has clearly passed.

Blasting screens shall be erected to conform with the permit conditions. Public roads, private roads and property adjacent to the site and services within the site area shall be protected by rock fall fences which will be subjected to the Engineer's approval.

In all such cases particular attention should be paid to the requirements stated above and the effects on these structures and installations shall be closely monitored and the quantities of explosives limited accordingly.

Drilling rigs for shot holes shall be of the hydraulic type fitted with efficient silencers and with means of dust suppression.

N. Slurry Explosives

The pump truck from which any explosives are dispensed into the drilled holes shall be equipped with an accurate flow meter or similar measuring/recording device in order to accuracy monitor and control the volume of explosives dispensed at each position.

Milli-second delay detonators shall be used in all blasting locations. The use of long second delay detonators shall be limited. Sequential timers may be used only on the direction of the Blasting Engineer and with the approval of the Engineer and then only by persons suitably qualified and under the control of the Contractor's Engineer.

After a charge has been wired and tested, gunny sacks shall be placed over the charged holes: blasting mats shall then be placed on top of the charge and sand bags placed on the blasting mats.

O. Scaling and Stabilization

Rock on the cut face that is loose, hanging, or creates a potentially dangerous situation during or upon completion of the excavation in each lift shall be removed or stabilized. No drilling for the next lift shall be carried out until this work is completed.

Slopes throughout the span of the contract shall be scaled at such frequency as required to remove all hazardous loose rock or overhangs. Stabilization shall be performed at Contractor's own expense if caused by the Contractor' blasting operations.

3.07 EXCAVATION WITHIN LOAD BEARING FILL AREAS

A. After completion of the fill placement and compaction specified under this Specification and as approved by the Project Engineer, footing excavation can begin.

B. Footing Inspections: The Engineer shall inspect the footing excavations for the building foundations; and shall verify that the design bearing pressures are available and that no loose pockets exist beneath the bearing surfaces of the footing excavations.

C. Backfilling:

1. Any excavation (such as for utilities, walls, footings, etc.) done within the select fill area shall be backfilled with select fill material with placement and compaction as described in this Section.

2. Where select backfill is placed against walls, either (1) the difference in elevation of the top of the controlled fill on either side of the wall shall not be allowed to exceed 1-foot or (2) the wall shall be adequately braced.

3.08 BACKFILL STRUCTURES

A. Do not commence backfilling around any structure until such structure has been examined and approved by the Engineer.

B. Do not place backfill until the requirements for concrete curing and waterproofing have been complied with and, if required, until the test cylinders for the particular structure indicate that the concrete has attained the compressive strength specified.

C. When backfilling against structures and where applicable, place backfill material in equal lifts and to similar elevations on opposite sides of structures in order to equalize opposing horizontal pressures. Place material in uniform increments over fill area.

D. Protect structures from damage by construction activity, equipment, and vehicles. Repair or replace damaged structures to the satisfaction of the Owner.

E. See Section 3.03.D for compaction.

3.09 BENCHING

When fill is to be placed against the sides of the excavation the slopes on which the fill is to be placed shall be continuously benched at right angles to the ground surface. The benching operation shall be done as the embankment is brought up in layers. Benching shall be a minimum width of 5 feet. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous excavation. Material conforming to backfill requirements cut from the benches shall be compacted along with the new fill material.

3.10 DISPOSAL OF EXCAVATED MATERIAL

Surplus excavated materials shall become the property of the Contractor and be removed from the project site. Surplus excavated materials is defined as: 1. Excess excavated unsuitable materials, and/or 2. Excess excavated suitable materials.

3.11 MOISTURE CONTROL

A. Control moisture content of fill materials to ±2% of the optimum moisture content as determined by ASTM D1577; material that is too wet may be spread and scarified on the fill surface and permitted to dry, until the moisture content is within specified limits; when fill material is too dry, sprinkle each layer of the fill and work moisture into the material until a uniform distribution within the specified limits is obtained; if, in the opinion of the Project Engineer, the top surface of a partial fill section becomes too dry to permit a suitable bond, scarify loosen the dried surface, dampen the loosened material and compact the moistened material.

B. Keep the top plane of load bearing fill areas under construction sloped for drainage; when rain or inclement weather is expected, flat roll the top of embankment to seal it.

3.12 SURFACE DRAINAGE

A. Intercept and divert surface drainage away from the excavation by the use of dikes, curb walls, ditches, pipes, sumps or other means.

B. Design surface drainage systems so that they do not cause erosion on or off the site, or cause unwanted flow of water.

C. Remove the surface drainage system when no longer required.

D. Remove debris and restore the site or sites or original condition.

3.13 DRAINAGE AND DEWATERING OF EXCAVATED AREAS

A. Dewatering of excavations shall be done in accordance with Section 02140

B. Provide and maintain ditches to collect surface water and seepage which may enter the excavations and divert.

C. Dispose of precipitation and subsurface water clear of the work. Comply with provisions of the Sediment and Erosion Control Plan.

E. Backfill drainage ditches and sumps when no longer required with granular material or other material as approved by the Project Engineer.

3.14 FINISHING

A. On completion of the work, clean ditches and channels and finish the site in a neat and presentable condition. Slope areas to provide positive drainage.

B. Place topsoil and seed all areas disturbed by construction as specified in Section 02485, Finish Grading and Seeding, unless otherwise indicated.

3.15 PLACEMENT OF PERVIOUS MATERIAL

A. Grade pervious material smooth and even, free of voids, compacted, and to required thickness and elevation; provide final grades within a tolerance of ½-inch when tested with a 10-foot straightedge.

B. Compaction shall continue until all compaction marks are eliminated and the course is thoroughly and properly compacted.

C. The Geo-textile Fabric shall be placed in accordance with manufacturers specifications.

3.16 TESTING AND INSPECTION

A. Inspect and test construction of embankments, fills, backfill, and subgrades and certify to the Owner conformance in all particulars relating to specification requirements.

B. Scheduling

1. Inspection Agency shall be on site at all times when operations are scheduled and no Earthwork will be permitted in their absence.

2. Contractor to provide at least 48-hours notice of scheduled work.

C. Responsibility of Inspection Agency

1. Certification of subgrade preparation and suitability.
2. Moisture content and field density test on all layers of material placed.
3. Certification of degree of compaction attained in material placed.
4. Verification of subgrade capacity.
5. Approval of all materials used.

D. Make results available to the Owner and the Engineer within 24-hours upon completion of testing.

E. Prior to final payment to the Contractor, the Inspection Agency shall certify that all Work has been performed in accordance with the Specifications.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 02311

FINISH GRADING AND SEEDING

PART 1 – GENERAL

1.01 DESCRIPTION

A. The Work of This Section Includes, But Is Not Limited To

1. Placing topsoil
2. Soil conditioning
3. Finish grading
4. Seeding
5. Maintenance
6. Termite Control

B. The “Seeding Restoration Table” shown on the Contract Drawings lists specified seeding restoration requirements.

C. Related Work Specified Elsewhere

1. Section 02230 - Clearing and Grubbing
2. Section 02300 - Earthwork
3. Section 02315 - Trenching, Backfilling & Compacting

1.01 QUALITY ASSURANCE

A. Source Quality Control:

1. Packaged Products shall indicate the manufacturer's guaranteed analysis on each package and arrive on site as originally packaged and unopened.

1.03 REFERENCES

A. American Society for Testing and Materials, ASTM C 602, Specification for Agricultural Liming Materials.

B. American Association of State Highways and Transportation Officials, AASHTO M 140, Emulsified Asphalt.

1.04 SUBMITTALS

A. Test Reports: Submit laboratory test reports of the soil analysis and supplement recommendations to the Engineer for approval prior to adding any soil supplements to the topsoil.

1. Laboratory reports shall recommend both grade and application rates of fertilizer and such other soil supplements as required.

2. Take sufficient quantity of topsoil samples to give a representative analysis of on-site topsoil and topsoil from outside sources, if any.

B. Soil Supplement Product Certification: Submit certificates certifying such products to have a guaranteed analysis in conformity with the Engineer approved laboratory soil supplement recommendations report.

C. Seed Certification: Submit certificates or certifying tags indicating lawn seed mixture, seed purity percentage, seed germination percentage and weed seed content percentage to certify conformity with the Specifications.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver packaged products to the site in unopened containers with labels intact and legible.

B. Store packaged products in such a manner to prevent moisture damage and other forms of contamination.

1.06 SITE CONDITIONS

A. Environmental Requirements: Do not perform Work of this Section when soil or weather conditions are unsuitable. Unsuitable conditions include moisture saturated or frozen in place soil and precipitation present or occurring during the Work.

B. Seeding Dates: The following dates shall govern except when environmental conditions warrant, the Engineer may extend the seeding dates.

1. Spring: March first to June first.

2. Fall: August first to October first.

C. Existing Conditions: Following performance of related construction and prior to Finish Grading do such debris removal and site leveling as necessary in preparation for Finish Grading. Dispose of such debris in a lawful manner off site.

D. Dust Control: Exercise the necessary means and methods to control dust on the site as well as in the off-site work areas where Top-soiling and Finish Grading are required.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Topsoil: Use fertile, friable, natural, productive surface soil such as is available on site. Use topsoil free of subsoil, clay, stones or similar hard objects larger than two inches in greatest dimension and partially disintegrated debris and materials toxic or harmful to growth.

2.02 SOIL SUPPLEMENT MATERIALS

A. Agricultural Liming Materials: Products containing calcium and magnesium compounds capable of neutralizing soil acidity and containing not less than 80 percent of total carbonates. Use liming materials meeting requirements of ASTM Designation C602 and conforming to applicable state liming material regulations.

B. Fertilizer: Commercial fertilizer of uniform composition, free-flowing and in conformity with applicable state fertilizer laws.

1. Analysis: As recommended by laboratory soil supplement recommendations report.

2.03 LAWN AND SEED MATERIALS

A. Grass Seed: New crop seed, furnished in sealed packages with proof of correct mixture evidenced, age of seed indicated and compliance with applicable state regulations evidenced if required.

B. Mixture No. 1:

Species in Mix	Mix Percent by Weight	Min Percent Purity	Min Percent Germination	Max Percent Weed Seed
Red Fescue (Festuca ruba) (Illahee strain)	30	95	85	0.50
Kentucky Bluegrass (Poa pratensis)	50	85	80	0.40
Red Top (Agrostis alba)	3	90	90	0.75
Perennial Ryegrass Lolium perenne)	17	90	90	0.50

C. Lawn Mulch: Straw Stalks of any threshed grain or tall hay grass stalks free from seed bearing stalks or roots harmful to lawn growth. Mulch material containing noxious weeds, decomposed material or brittle weed material is not acceptable.

D. Mulch Binder: Emulsified asphalt conforming to the requirements of AASHTO M 140, Grade RS-1 and which does not contain solvents or other diluting agents toxic to plant life.

2.04 FERTILIZER

A. Liquid formulations may be used in lieu of dry formulations, provided the rate of application is adjusted to apply the same quantities of nitrogen, phosphorus and potassium per unit area as specified for dry formulations.

B. Contractor may submit soils samples to an approved laboratory for fertilizing recommendations.

2.05 LIME

Apply lime in accordance with manufacturer's rate table or soil sample analysis.

2.06 INOCULANT

A. Inoculate leguminous seed before seeding with nitrogen fixing bacteria culture prepared specifically for the species.

B. Do not use inoculant later than the date indicated by the manufacturer.

C. Protect inoculated seed from prolonged exposure to sunlight prior to sowing.

D. Reinoculate seed not sown within 24 hours following initial inoculation.

2.07 EROSION CONTROL FABRIC

A. Shall be a knitted construction of yarn with uniform openings interwoven with strips of biodegradable paper, furnished in rolls with 4-mil opaque polyethylene base as protection for outdoor storage.

B. Fabric 0.2 pound per square yard.

2.08 JUTE MATTING

Shall be heavy weight, minimum 0.9 pound per square yard, jute mesh with 1" opening.

2.09 FABRIC/MATTING ANCHORS

Staples for fastening fabric to ground shall be minimum 11 gauge wire, “U” shaped, with a 1" crown and 6" legs.

2.10 MULCHING MATERIALS

A. Mulches for seeded areas shall be one, or a combination, of the following:

1. Timothy hay or mixed clover and timothy hay, or wheat, or oat straw; thoroughly threshed.

   a. Cured to less than 20% moisture content by weight.

   b. Containing no stems of tobacco, soybeans, or other coarse or woody material, free of mature seed bearing stalks or roots of prohibited or noxious weeds.

2. Wood Cellulose

   a. Containing no growth or germination-inhibiting substances.

   b. Green-dyed and air-dried.

   c. Packages not exceeding 100 pounds.

   d. Moisture Content: 12% $\pm$ 3%

   e. Organic Matter (Dry oven basis) 98.6% $\pm$ 0.2%

   f. Ash Content: 1.4% $\pm$ 0.2%

   g. Minimum Water-Holding Capacity: 100%

3. Mushroom Manure:

a. Organic origin, free of foreign material larger than 2" and substances toxic to plant growth.

b. Organic Matter: 20% minimum

c. Water-Holding Capacity: 120% minimum

d. pH: 6.0

B. Mulch Binders

1. Emulsified Asphalt AASHTO M140, Grade SS-1.

2. Cut Back Asphalt AASHTO M81, RC 250.

3. Nonasphaltic Emulsion - Natural Vegetable Gum Blended with Gelling and Hardening Agents

4. Polyvinyl Acetate Emulsion Resin, Containing 60% (± 1%) total Solids by Weight.

2.11 SOIL TREATMENT MATERIALS

A. Chemicals

1. Soil treatment chemicals shall be one of the following:

a. Dursban TC: To be used at a concentration of 1.0%, applied in water emulsion.

b. Dragnet TC: To be used at a concentration of 0.5%, applied in water emulsion.

c. Pryfon 6: To be used at a concentration of 0.75% applied in water emulsion.

2. Soil treatment chemicals used shall be mixed in the following proportions:

a. Dursban TC: 1.0% water emulsion, 2 gallons of Dursban TC per 98 gallons of water.

b. Dragnet TC: 0.5% water emulsion, 1.25 gallons of Dragnet TC per 98.75 gallons of water.

c. Pryfon 6: 0.75% water emulsion, 1 gallon of Pryfon 6 with 96 gallons of water.

PART 3 – EXECUTION

3.01 PREPARATION

A. Prepare subsoil surface for finish grading by dressing and shaping to provide for the uniform placement of topsoil.

B. Prepare subsoil surface for top-soiling by loosening to a depth of four inches and dressing and shaping to provide for the uniform placement of topsoil.

C. Remove surface rock or other foreign objects exceeding 3/4 - inches in greatest dimension. Dispose of such rock and debris in a lawful manner off site.

3.02 PERFORMANCE

A. Placement: Place topsoil over areas indicated for new grading contours. However, before topsoil placement, construction work in top-soiled areas shall have been completed. Observe precautions as follows:

1. Do not place topsoil over areas indicated to receive paving or walkways.

2. Do not work topsoil while frozen or wet. Do not work topsoil in a dusting condition but moisten same to prevent a dust nuisance.

3. Scarify subsoil to a depth of two inches for bonding topsoil with subsoil.

4. On sloped areas, work topsoil into subsoil to blend so as to eliminate slip-planing between the two soils; but leave a sufficient cover of topsoil to insure seed germination. Perform such blending of soils by ridging or serrating the subsoil on the slopes.

5. Place topsoil as needed for dressing-up minor depressions due to settling and erosion and to eliminate other minor irregularities.

B. Finished Elevations and Lines: Grade top-soiled areas of the site to within a tolerance of plus or minus one-tenth of a foot of the elevations and lines indicated and in accordance with the following:

1. Grade a uniform longitudinal fall in swales and other surface drainage areas to provide a drainage flow line that can easily be maintained and traversed with normal lawn maintenance equipment.

3. Establish finish grade of topsoil 1/2 to 3/4 inch below top of abutting walks or paving to provide positive drainage of same.

4. Do not finish grade topsoil to a depth less than six inches nor greater than 12 inches.

5. Leave finish grade surfaces free of objectionable material larger than 3/4 - inches in greatest dimension. Dispose of such objectionable material in a legal disposal area off site.

C. Compaction: Compact finish grades as the final operation using a light roller weighing not over 120 pounds per foot-width of roller.

D. Tillage: Till finish graded soil over areas indicated for lawn regardless of type of lawn work performed. Use equipment and methods common to such work, and till soil to a two inch depth minimum.

E. Soil Supplement Addition: The soil supplements for lawn areas, as required according to the Engineer approved laboratory test reports, may be incorporated into the soil during tillage operations.

F. Seeding: Sow seed mixtures when air current is low and not more than five days after soil supplements have been applied. Sow seeds in two applications using either mechanical power seeders or mechanical hand seeders. Sow one-half of the seed mixture in one direction over designated areas and the remainder at right angles to the first sowing. Seeding rates as follows:

1. Grass Seed Mixture: Five pounds per 1,000 sq. ft. area.

G. Seed Cover: Imbed seed mixtures into topsoil 1/4 inch using a light drag or rake and moving in directions parallel to the contour lines. Immediately after dragging or raking, compact seeded areas using a cultipacker or similar design lawn roller, weighing 60 to 90 pounds per linear foot of roller, and roll at right angles to existing slopes.

H. Contractor Option: Seeding and soil supplement application may be performed by the hydroseeding method. However, rates of application, methods and equipment shall receive Engineer's prior approval.

I. Lawn Mulching: Evenly apply mulch over seeded areas not more than 48 hours after seeding. Start mulching at windward side of relatively flat areas, or at the upper part of slopes. Spread mulch in a total coverage at a depth not less than 1-1/2 inches nor more than three inches.

I. Mulch Binding: Immediately following mulch spreading, apply mulch binder to anchor mulch to the soil. The number of passes over the mulch as needed to secure it firmly shall not exceed three passes with maximum applied binder not exceeding 10.0 gallons per 1,000 square feet.

3.03 MAINTENANCE

A. Maintenance operations shall begin immediately after seeding and shall continue throughout the construction time and guarantee period.

1. Seeded Areas: Keep seed moist continually for proper germination and water thereafter as necessary to prevent drying out or burning. Reseed areas not showing a prompt catch of grass, correct depressions and irregularities and reseed; repeat until a complete coverage is obtained. Cut seeded areas at required intervals to maintain grass at a maximum height of 2 1/2 inches.

B. At conclusion of maintenance period, the Engineer shall make an inspection of the lawn work to determine condition of acceptance. Make such additional repairs as required by the Engineer. Perform such work at no expense to the Owner.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 02315

TRENCHING, BACKFILLING, AND COMPACTING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Work of This Section Includes, But Is Not Limited To

1. Trench excavation, backfill and compaction
2. Support of excavation
3. Pipe bedding requirements
4. Control of excavated material
5. Restoration of unpaved surfaces

B. Related Work Specified Elsewhere

1. Section 02311 - Finish Grading and Seeding
2. Section 02535 - Pipe and Pipe Fittings

C. Applicable Standard Details

1. Pipe Bedding Details
2. Pipe Trench Detail
3. Concrete Cradle and Encasement Details
4. Thrust Block for Vertical Bends
5. Thrust Block for Bends, Tees, and Caps

1.02 QUALITY ASSURANCE

A. Testing Agency: Density testing shall be performed by an independent soils testing laboratory engaged and paid for by the Contractor and approved by the Engineer.

B. Referenced Standards

1. American Society for Testing and Materials (ASTM)

a. D698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort

b. D1556 Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method

c. D1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort

d. D2922 Test Methods for Density of Soil and Soil Aggregate in Place by Nuclear Methods

C. Density Testing

1. Conduct one test for each 1,000 linear feet of pipeline. Conduct density tests at locations as directed by the Engineer during backfilling operations.

2. Determine density by ASTM D1556 or ASTM D2922 in areas other than State Highways and Shoulders.

1.03 SUBMITTALS

A. General: Submit in accordance with Section 01300.

B. Certificates

1. Submit, prior to delivery of the material to the job site, a Statement of Compliance from the materials supplier, together with supporting data, attesting that the composition analysis of pipe bedding and select material stone backfill materials meets specification requirements. Should a change in source of materials be made during construction, submit a new Statement of Compliance from the new source for approval before the material is delivered to the job site.

2. Submit certified density testing results from the soils testing laboratory.

C. Compaction Equipment List: Submit a list of all equipment to be utilized for compacting, including the equipment manufacturer's lift thickness limitations.

D. Agreements with Property Owners: Prior to storing or disposing of excavated materials on private property, submit a copy of the written agreement with the property owner.

1.04 JOB CONDITIONS

A. Classification of Excavation: All excavation work performed under this contract is unclassified, and includes excavation and removal of all soil, shale, rock boulders, fill, and all other materials encountered of whatever nature.

B. Protection of Existing Utilities and Structures:

1. Take all precautions and utilize all facilities required to protect existing utilities and structures. Advise each Utility at least 3 working days in advance of intent to excavate, do demolition work and give the location of the job site. Request cooperative steps of the Utility and suggestions for procedures to avoid damage to its lines.

2. Advise each person in physical control of powered equipment used in excavation or demolition work of the type and location of utility lines at

the job site, the Utility assistance to expect and procedures to follow to prevent damage.

3. Immediately report to the Utility and the Engineer any break, leak or other damage to the lines or protective coatings made or discovered

during the work and immediately alert the occupants of premises of any emergency created or discovered.

4. Allow free access to Utility personnel at all times for purposes of maintenance, repair and inspection.

PART 2 - PRODUCTS

2.01 PIPE BEDDING MATERIAL

Bedding Material: Clean granular material meeting the requirements of AASHTO M 43 size No. 8 on detail or as approved by the Engineer.

2.02 BACKFILL MATERIAL

A. Granular material conforming to the Uniform Soil Classification Groups GW, GP, SW or SP that will completely pass a (1 1/2") sieve and that will compact readily when the usual methods of tamping are used. It shall conform to the requirements of AASHTO M 43, size number 57 and have a maximum Los Angeles Abrasion (LA) test (AASHTO T-96) of 50%.

B. Suitable Backfill Material

1. From top of pipe bedding material to 24" over top of pipe

a. Material excavated from the trench if free of stones larger than 2" in size and free of wet, frozen, or organic materials.

2. From 24" above pipe bedding to subgrade elevation

a. Material excavated from the trench if free of stones larger than 6" in size and free of wet, frozen, or organic materials.

C. Unsuitable Backfill Material: where the Engineer deems backfill material to be unsuitable and rejects all or part thereof due to conditions prevailing at the time of construction, remove the unsuitable material and replace with select material stone backfill as specified in paragraph 2.02A or suitable foreign backfill material.

PART 3 - EXECUTION

3.01 MAINTENANCE AND PROTECTION OF TRAFFIC

A. Coordinate the work to ensure the least inconvenience to traffic and maintain traffic in one or more unobstructed lanes unless closing the street is authorized.

B. Maintain access to all streets and private drives.

C. Provide and maintain signs, flashing warning lights, barricades, markers, and other protective devices as required to conform to construction operations and to keep traffic flowing with minimum restrictions.

D. Comply with State and local codes, permits and regulations.

3.02 CUTTING PAVED SURFACES

A. Where excavation includes breaking a paved surface, make cuts in a neat uniform fashion forming straight lines parallel with the centerline of the trench. Cut offsets at right angles to the centerline of the trench. Saw cut concrete surfaces; saw cut other hard surfaces or make straight cuts with jackhammer. No paving shall be broken except that which has been previously cut.

B. Protect edges of cut pavement during excavation to prevent raveling or breaking; square edges prior to pavement replacement.

3.03 BLASTING

No blasting will be permitted without prior written approval of Engineer

3.04 TRENCH EXCAVATION

A. Topsoil Stripping and Stockpiling: Strip topsoil encountered during trench excavation to its full depth and stockpile for reuse.

B. Depth of Excavation

1. Gravity Pipelines: Excavate trenches to the depth and grade shown on the profile drawings for the invert of the pipe plus that excavation necessary for placement of pipe bedding material.

2. Pressure Pipelines:

a. Excavate trenches to the minimum depth necessary to place required pipe bedding material and to provide 4' from the top of the pipe to the finish ground elevation, except where specific depths are otherwise indicated on the Contract Drawings.

b. Where unsuitable bearing material is encountered in the trench bottom, continue excavation until the unsuitable material is removed, solid bearing is obtained or can be established, or concrete cradle can be placed. If no concrete cradle is to be installed, refill the trench to required pipeline grade with pipe bedding material or other material approved by Engineer.

c. Where the Contractor, by error or intent, excavated beyond the minimum required depth, backfill the trench to the required pipeline grade with pipe bedding material or crusher run as directed by Engineer.

C. Width of Excavation

1. Excavate trenches to a width necessary for placing and jointing the pipe and for placing and compacting bedding and backfill around the pipe.

2. Shape trench walls completely vertical from trench bottom to at least 24" above the top of pipe.

3. For pressure pipeline fittings, excavate trenches to a width that will permit placement of concrete thrust blocks. Provide original earth

surfaces for thrust blocks that are perpendicular to the direction of thrust and are free of loose or soft material.

4. Where rock is encountered in the sides of the trench, remove the rock to provide a minimum clearance between the pipe and rock of 6".

D. Length of Open Trench: Do not advance trenching operations more than 50' ahead of completed pipeline. No open trench shall be left overnight without approval of Engineer and adequate safety safeguards.

3.05 SUPPORT OF EXCAVATION

A. Support excavations with sheeting, shoring, and bracing or a “trench box” as required to comply with Federal and State laws and codes. Install adequate excavation supports to prevent ground movement or settlement to adjacent structures, pipelines or utilities. Damage due to settlement because of failure to provide support or through negligence or fault of the Contractor in any other manner shall be repaired at the Contractor’s expense.

B. Withdraw shoring, bracing, and sheeting as backfilling proceeds unless otherwise directed by the Engineer.

3.06 CONTROL OF EXCAVATED MATERIAL

A. Keep the ground surface within a minimum of 2' of both sides of the excavation free of excavated material.

B. In areas where pipelines parallel or cross streams, ensure that no material slides, is washed, or dumped into the stream course. Remove cofferdams immediately upon completion of pipeline construction.

C. Maintain accessibility to all fire hydrants, valve pit covers, valve boxes, curb boxes and other utility controls at all times. Keep gutters clear or provide other satisfactory facilities for street drainage. Do not obstruct natural watercourses. Where necessary, provide temporary channels to allow the flow of water either along or across the site of the work.

E. Provide temporary barricades to prevent excavated material from encroaching on private property, walks, gutters, and storm drains.

3.07 DEWATERING

A. Keep excavations dry and free of water. Dispose of precipitation and subsurface water so as to not disrupt or re-saturate the work area.

B. Maintain pipe trenches dry until pipe has been jointed, inspected, and backfilled, and concrete work has been completed. Prevent trench water from entering pipelines under construction.

C. Intercept and divert surface drainage away from excavations. Maintain storm drainage facilities, gutters, and natural surface watercourses open and in operation. Provide and install temporary facilities to maintain excavations free of water as required. Design surface drainage systems so as to not cause erosion on or off the site, or cause unwanted flow of water. When mechanical equipment

is utilized to control water conditions, provide and maintain sufficient standby units onsite.

D. Comply with Federal and State requirements for dewatering to any watercourse, prevention of stream degradation, and erosion and sediment control. Comply with the Sediment and Erosion Control Plan whether required control and prevention methods are explicitly shown on plans or not.

3.08 PIPE BEDDING REQUIREMENTS

Refer to Drawings.

3.09 PIPE LAYING

Lay pipe as specified in the appropriate Section of these Specifications for pipeline construction.

3.10 THRUST RESTRAINT

Provide pressure pipe with concrete thrust blocking or use restrained joint fittings at all bends, tees, valves, and changes in direction, in accordance with the Specifications, Contract Drawings, Standard Details, and pipe manufacturer recommendations.

3.11 BACKFILLING TRENCHES

A. After pipe installation and inspection, backfill trenches from trench bottom or from the top of pipe bedding material, whichever is greater, to 12" above the crown of the pipe with specified backfill material hand placed and carefully compacted with hand-operated mechanical tampers in layers of suitable thickness to provide specified density around and under the haunches of the pipe. Backfill and compact the remainder of the trench with specified backfill material.

B. Lift thickness Limitations

1. In no case shall maximum lift thickness placed exceed the maximum limits specified by the pipe manufacturer's recommendations. However, if the Contractor' equipment manufacturer's lift thicknes recommendation is followed and the specified density is not obtained, the Contractor shall, at his own expense, remove, replace, and retest as many times as is required to obtain the specified density.

2. Compact each layer of material to 95% of the maximum density at $\pm$ two percent ($\pm$2%) of the optimum moisture content as determined by ASTM D698.

3. Notwithstanding the specified requirements for trench backfill compaction, trenches that settle below the surrounding grade prior to final completion shall be filled to surrounding grade level with appropriate materials.

3.12 UTILITY MARKING TAPE

Install detectable utility marking tape as specified in Section 15060 above all plastic pipelines, 12"-18" below final grade.

3.13 DISPOSAL OF EXCAVATED MATERIAL

Excavated material remaining after completion of backfilling shall remain the property of the Contractor, removed from the construction area and legally disposed.

3.14 RESTORATION OF UNPAVED AREAS

A. Restore unpaved surfaces disturbed by construction to match the final grade shown on the Contract Drawings.

B. Restore grassed areas in accordance with Section 02311, Finish Grading and Seeding.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 02370

EROSION CONTROL DURING CONSTRUCTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. General

Drawings and general provisions of the Contract, including General and Supplementary conditions and Division 1 specification sections, apply to this section.

B. Referenced Sections

1. Section 02311 – Finish Grading and Seeding.

1.02 DESCRIPTION OF WORK

The contractor shall provide the soil erosion controls as specified herein. The cost of all erosion control measures shall be included in the appropriate Bid Items described in the Prices to Include. The Owner shall be responsible for obtaining the necessary General NPDES Permit(s) for construction of the erosion and sediment control during construction. **Contractor is responsible for securing and permitting off-site waste and borrow areas.**

1.03 QUALITY ASSURANCE

A. Scheduling

Where erosion is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise temporary erosion control measures will be required between successive construction stages. These erosion control measures shall be maintained in effective operating condition during construction until final grading and seeding occurs. Special attention must be given to dewatering activities to minimize release of silt-laden water off-site. The sediment free flows shall only be released into storm sewers, stream channels, or other stabilized drainage receptors and not onto exposed soils or any other site where flows could cause further erosion.

B. Dust Control.

Dust generation shall be minimized, including wetting down of paved and unpaved areas during the construction activities.

C. Operation Limits

The Engineer will delineate the area of excavation and backfilling operations in progress commensurate with the Contractor's capability and progress in keeping the finished grading, mulching, seeding, and other such temporary or permanent control measures current in accordance with the specifications. Should seasonal

limitations make permanent control measures unrealistic, temporary erosion control measures including seeding and mulching shall be taken immediately. Surplus excavated material and equipment storage is prohibited within 200 feet of any stream bank, in wooded areas, or in other environmentally sensitive areas. Surplus excavated materials shall be disposed of at site approved by the Owner.

D. Site containment

Site access will be limited and protected by the Contractor to prevent off-site tracking of soil and sediment by construction traffic. Any off-site tracking of soil and sediment will be cleaned up immediately to prevent any sedimentation escaping off-site.

E. Conflicts

1, In the event of conflict between these requirements and pollution control laws, rules, or regulations of other Federal or State or local agencies, the more restrictive laws, rules, or regulations shall apply.

2. Notes or specific requirements listed on plans shall govern if more restrictive than these specifications.

F. Reference Standards

1. MDE – Maryland department of the Environment

2. MD SHA – Maryland Department of Transportation State Highway Administration

3. Soil Conservation Service (Natural Resources Conservation Service)

1.04 SUBMITTALS

NOT USED

1.05 JOB CONDITIONS

A. General

The contractor shall limit the surface area of erodible earth material exposed by the clearing and grubbing, excavation, and backfill operations and provide permanent or temporary control measures to prevent contamination of adjacent streams or other water courses, lakes, ponds, or other areas of water impoundment. Such work will involve the use of temporary and/or permanent mulches, mats, seeding or other control and contain devices or methods necessary to control erosion and sedimentation. If work is suspended for any reason, the Contractor shall maintain the soil erosion and sedimentation controls in good operating condition during the suspension of the work. Also, when the suspension of work is expected to exceed a period of 7 days, the Contractor shall temporary seed, fertilize, and mulch all disturbed areas left exposed when the work is stopped.

B. Permanent Erosion control

The Contractor shall incorporate all permanent erosion control features into the project at the earliest practicable time. Except where future construction operations will damage slopes, the Contractor shall perform the permanent fertilizing, seeding and mulching as soon as substantial areas can be made available. This will require the establishing of final grades and application of fertilizer, seeding and mulching. No areas where construction is completed shall be left for longer than 7 days without, as a minimum, temporary fertilizer seeding and mulching. Any disturbed area that will not be actively under construction for a period of 7 days or more shall be temporarily stabilized immediately by fertilizer, seeding and mulching.

1.06 DELIVERY, STORAGE, AND HANDLING

NOT USED

1.07 SPECIAL WARRANTY

NOT USED

PART 2 - PRODUCTS

2.01 FERTILIZER, SEED AND MULCH

A. General

All products utilized for erosion control purposes shall be provided in accordance with the requirements of specifications.

PART 3 - EXECUTION

3.01 FERTILIZER, SEED AND MULCH

A. General

All erosion control work shall be executed in accordance with specifications.

3.02 SEDIMENT BARRIERS

A. Filter Barriers (FB)

The filter barrier may be constructed using burlap or standard strength synthetic filter fabric. It is designed for low or moderate flows not exceeding 1 cfs.

1. The height of a filter barrier shall be a minimum of 15 inches and shall not exceed 18 inches.

2. Burlap or standard strength synthetic filter fabric shall be purchased in a continuous roll and cut to the length of the barrier to avoid the use of joints (and thus improve the strength and efficiency of the barrier).

3. The stakes shall be spaced a maximum of 3 feet apart at the barrier location and driven securely into the ground (minimum of 8 inches).

4. A trench shall be excavated approximately 4 inches wide and 4 inches deep along the line of stakes and upslope from the barrier.

5. The filter material shall be stapled to the wooden stakes, and 8 inches of the fabric shall be extended into the trench. Heavy-duty wire staples at least 1/2 inch shall be used. Filter material shall not be stapled to existing trees.

6. The trench shall be backfilled and the soil compacted over the filter material.

7. If a filter barrier is to be constructed across a ditch line or swale, the barrier shall be of sufficient length to eliminate end flow, and the plan configuration shall resemble an arc or horseshoe with the ends oriented upslope.

8. Filter barriers shall be removed when they have served their useful purpose, but not before the upslope area has been permanently stabilized.

B. Silt Fence (SF)

The silt fence uses a standard strength or extra strength synthetic filter fabrics. It is designed for situations in which only sheet or overland flows are expected.

1. The height of a silt fence shall not exceed 36 inches (higher fences may impound volumes of water sufficient to cause failure of the structure).

2. The filter fabric shall be purchased in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are necessary, filter cloth shall be spliced together only at a support post, with a minimum 6-inch overlap, and securely sealed.

3. Posts shall be spaced a minimum of 10 feet apart at the barrier location and driven securely into the ground (minimum of 12 inches). When extra strength fabric is used without the wire support fence, post spacing shall not exceed 6 feet.

4. A trench shall be excavated approximately 4 inches wide and 4 inches deep along the line of posts and upslope from the barrier.

5. When standard strength filter fabric is used, a wire mesh support fence shall be fastened securely to the upslope side of the posts using heavy duty wire staples at least 1 inch line, tie wires or hog rings. The wire shall extend into the trench a minimum of 2 inches and shall not extend more that 36 inches above the original ground surface.

6. The standard strength filter fabric shall be stapled or wired to the fence, and 8 inches of the fabric shall be extended into the trench. The fabric shall not extend more than 36 inches above the original ground surface. Filter fabric shall not be stapled to existing trees.

7. When extra strength filter fabric and closer post spacing are used, the wire mesh support fence may be eliminated. In such a case, the filter fabric is stapled or wired directly to the posts with all other provisions of item No. 6 applying.

8. The trench shall be backfilled and soil compacted over the filter fabric.

9. Silt fences shall be removed when they have served their useful purpose, but not before the upslope area has been permanently stabilized.

C. Maintenance

1. Silt fences and filter barriers shall be inspected immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately.

2. Should the fabric on a silt fence or filter barrier decompose or become ineffective prior to the end of the expected useable life and the barrier is still necessary, the fabric shall be replaced promptly.

3. Sediment deposits should be removed after each storm event. They must be removed when deposits reach approximately one-half the height of the barrier.

4. Any sediment deposit remaining in place after the silt fence or filter barrier is no longer required shall be dressed to conform with the existing grade, prepared and seeded.

3.03 MATTING

Matting shall be provided on all final slopes 3:1 or greater and bottom of drainage ditches.

3.04 TOP SOIL STOCKPILES

The Contractor may stockpile topsoil in accordance with these plans and specifications. The Contractor shall provide temporary drainage diversion of runoff around the stockpile to control soil erosion and in accordance with MDSHA's Standard Construction Drawings. Stockpiled topsoil shall be protected through the use of temporary seeding and mulching or covering such as with anchored straw mulch. Silt barriers shall be installed down gradient of these areas on contour and with their ends up slope of the contour to prevent silt-laden runoff from entering waterways or storm sewers. Within 7 days of completion of construction, any remaining soil shall either be removed or permanently stabilized.

3.05 STREAM BANKS

If construction results in the disturbance of a stream bank, it shall be restored, graded, seeded and mulched in accordance with the specifications immediately upon completion of the work crossing the stream.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 02485

FINE GRADING, TOPSOIL AND SEEDING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

The Contractor shall provide all labor, material, equipment and other services necessary to place topsoil, fine grade, fertilize, lime, seed and mulch all graded, cleared, grubbed or otherwise disturbed areas, in accordance with the Contractor Drawings and Specifications.

1.02 RELATED WORK

A. Section 02370 – Erosion Control During Construction

1.03 QUALITY ASSURANCE

A. Seed shall conform to the formula(s) contained herein. All seed shall be certified as to content and to be free of noxious weed seeds. In the absence of certifications on each package, the suppliers shall furnish an affidavit stating that materials provided conform to the specification requirements. Certification labels and/or affidavits shall be submitted to the Engineer.

B. Copies of delivery tickets for all materials including, but not limited to; lime, fertilizer, seed and mulch used for seeding under this contract shall be submitted to this Engineer.

1.04 SUBMITTALS

Submit the items following for the approval by the Engineer in accordance with Section 01300.

A. Submit all seed mixture certifications which include % purity, % germination, and % weed seed.

B. Source of lime product including particle size and carbonate content.

C. Fertilizer formulation and source.

D. Permanent soil stabilization matting specifications.

PART 2 – PRODUCTS

2.01 TOPSOIL

A. Topsoil shall be furnished from an approved source on-site.

B. Topsoil shall be natural, friable, agricultural soil, possessing characteristics representative of topsoil in the vicinity that sustain vigorous plant growth.

C. Topsoil shall be free from stones, roots, toxic substances and other foreign matter which might be detrimental to plant growth. Topsoil shall meet the Maryland State Highway Administration Specifications for Construction, Section 920.01

2.02 LIME

A. Ground agricultural limestone shall contain not less than 55% total carbonates and shall be ground to fineness such that at least 90% will pass a No. 10 mesh screen and at least 50% will pass a No. 100 mesh screen. Courser material will be accepted provided the specified application rates are increased proportionally on the basis of the quantities passing the 100-mesh screen. No additional payment will be made for increased quantities.

2.03 FERTILIZER

A. Fertilizer use shall be formulated as 10-10-10 (nitrogen, phosphorus and potassium) respectively. Fertilizers shall be free flowing, uniform in composition and suitable for application with approved standard equipment.

B. Fertilizer shall be delivered in bags or other containers labeled with composition and/or analysis plus the name, trademark and warranty of the producer.

2.04 SEED

A. All seed shall be certified and labeled, tagged or marked per accepted horticultural practice and shall comply with all current state and federal regulations. Seed shall be furnished in sealed standard containers. Seed which becomes wet, moldy or otherwise damaged in transit and/or storage will not be acceptable and will be replaced at no additional cost to the Owner.

B. Seed and seed mixes shall be furnished with a certification from the seed company stating:

Type of Seed
Percentage of Mixture
Purity
Germination
Weed Seed

C. Seed for disturbed areas in existing hay fields shall be Orchard Grass with 95% purity, 80% Germination, 0.75% weed seed. Orchard grass seed shall be applied at the rate of 10 lb. Per 1000 SF.

D. The seed mix to be applied in all areas except hayfields shall have the following requirements:

	% Purity	% Germination	% Weed Seed	LB per acre
Kentucky 31	90	80	0.75	4.5
Annual Rye	95	85	0.75	20.0
Orchard Grass	90	80	0.75	20.0
Timothy	90	80	0.75	6.0
White Clover	90	80	0.75	3.6
Red Clover	90	80	0.75	6.0
Alsike Clover	90	80	0.75	5.5

2.05 MULCH

A. Straw mulch shall be un-weathered, un-chopped small grain straw. Oat straw is not acceptable as it may contain viable seeds which may produce serious competition for desired species. Straw shall be dry and free of mold, noxious weeds, grass seeds, or other objectionable materials.

B. Wood cellulose mulch shall be natural wood fiber without toxic substances or foreign matter, packaged in air-dry containers capable application with power spray equipment, and shall have a minimum pH of 9.0 in distilled water.

C. Permanent soil stabilization matting shall be open weave synthetic machine produced mat consisting of synthetic non-degradable fibers or elements of uniform thickness and distribution of weave throughout. Netting shall be extruded plastic having a maximum mesh opening size of 2x2 inch, sufficiently bonded or sewn on 2-inch centers along the longitudinal axis of material to prevent separation of the net from parent material for the life of the product.

PART 3 – EXECUTION

3.01 PREPARATION

A. All ground surfaces to be treated shall be cleared of stones, roots, debris and other material which might hinder proper grading and tillage to a depth of not less than three inches (3") so that the loosened surface will readily bond with the topsoil.

B. Areas to be seeded shall be graded as sown on the drawings and/or as specified herein. All surfaces shall be left in an even and properly completed condition to prevent the formation of depressions where water may stand.

3.02 TOPSOIL, LIME AND FERTILIZER

A. Topsoil shall be as specified, spread to a compacted depth of four inches (4") for areas to be seeded and shall be raked to a smooth uniform surface and compacted with a lawn roller weighting not less than 90 lbs. Per foot of roller width. Any bumps or depressions which develop shall be leveled or filled and rolled until a satisfactory surface is obtained.

B. Lime, as specified, shall be applied at the rate of 50 lbs. Per 1000 ft. Fertilizer, as specified, shall be applied at the rate of 20 lbs. Per 1000 ft. Lime and Fertilizer shall be raked or harrowed into the topsoil within two (2) days of application.

3.03 SEEDING

A. The seed mix, as specified, shall be applied at the specified rate and covered to an average uniform depth of 1/4 inch by means of a brush harrow, rake, cultipacker or approved device.

B. Straw mulch shall be spread uniformly over seeded areas at the rate of 115 lbs. Per 1000 sq. ft. It shall be anchored with the chemical tacker, Terra Tack MP as manufactured by Grass Growers of Plainfield, New Jersey or approved equal at a rate of 100 lbs. of dry chemical material per acre. Mixing shall be per the manufacturer's instruction.

C. Wood cellulose mulch, as specified, shall be applied evenly at the rate of 50 lbs. Per 1000 square feet.

D. Where shown on plans, place permanent soil stabilization matting in ditches and channels. Follow installation guidelines as specified in Detail B-4-5-C of the Maryland Standards and Specifications for Soil Erosion and Sediment Control.

3.04 SEEDING SEASONS

A. The normal seasonal dates for seeding shall be:

Spring Season - March 1 to June 15
Fall Season - August 1 to October 1

B. Seeding at times other than specified above will be allowed only upon written approval.

C. Seeding shall not be allowed when the average wind is more than 5 mph, when the ground is excessively wet, frozen or otherwise untillable.

D. Upon approval of the seeding and mulching operation, the Contractor shall be relieved of any further responsibility, except for damage which may be caused by the Contractor's forces.

END OF SECTION

SECTION 02535

PIPE AND PIPE FITTINGS
(PUMP STATIONS AND PLANTS)

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work of this section includes, but is not limited to

1. Gravity Flow Piping

2. Pressure Flow Piping

B. Related work specified elsewhere

1. Section 02315 - Trenching, Backfilling and Compacting

2. Section 15080 - Valves and Piping Specialties

3. Section 15950 – Testing Piping System

C. Applicable Standard Details

1. R.C.P Load Table

2. Pipe Bedding Details

3. Concrete Cradle and Encasement Detail

4. Thrust Block for Vertical Bends

5. Thrust Block for Bends, Tees and Caps

D. Pipe and pipe fitting products used for each service shall be as shown on the scheduled included in this Section.

1.02 QUALITY ASSURANCE

A. Install piping to meet the requirements of state and local building codes.

B. Materials contaminated with gasoline, lubricating oil, liquid or gaseous fuels, aromatic compounds, paint solvent, paint thinner, or acid solder will be rejected.

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Shop Drawings and Product Data: Submit shop drawings and manufacturer's catalog information for pipe materials, including but not limited to:

1. Piping layout

2. Pipe hangers, supports, guides and anchors

3. Pipe wall sleeves and seals

4. Pipe coupling adapters

C. Ductile Iron Pipe

1. Where restrained joints are utilized in lieu of thrust blocking, submit restrained joint calculations in conformance with DIPRA Standards establishing lengths of restrained joint piping required.

2. Submit restrained joint details and materials being utilized.

3. Submit layout drawings showing piece numbers and locations. Also, indicate restrained joint locations.

D. Manufacturer's Instructions: Submit manufacturer's instructions for installation of adapters and assembly of mechanical and push-on joints, including the manufacturer's maximum recommended deflection per joint.

E. Certificates: Submit certification from each product manufacturer attesting that the pipe, pipe fittings, joints, joint gaskets and lubricants meet or exceed specification requirements.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. During loading, transporting, unloading, and storage on site, exercise care to prevent damage to piping materials.

B. Do not drop pipe or fittings.

C. Store materials on site in enclosures or under protective coverings.

D. Assure that materials are kept clean and dry; do not store materials directly on the ground.

PART 2 – PRODUCTS

2.01 Ductile Iron (DIP):

A. Pipe: ANSI A21.50 and ANSI A21.51, 350 psi working pressure (to 20-inch diameter).

B. Wall Thickness Class (Buried): Class 51 except as noted otherwise on drawings.

C. Wall Thickness Class (Exposed): Class 53 except as noted otherwise on Drawings.

D. Fittings: Ductile iron AWWA C153, rated for 350 psi working pressure, mechanical joint.

E. Joints:

1. Rubber-Gasket Joints (Buried): ANSI A21.11.

a. For buried pipe installation, provide either push-on or mechanical joints except where other types of joints are indicated on the Drawings or required by the Specifications.

b. Provide rubber gaskets suitable for conveying potable water.

2. Flanged Joints (Exposed): ANSI A21.15.

a. Unless indicated otherwise on the Drawings, use flanged joints for pipe and fittings installed inside of structures.

b. Gaskets: 1/8 in. thick rubber full face type conforming to ANSI A21.11.

c. Bolts: ANSI B18.2.1.

d. Nuts: ANSI B18.2.2.

F. Pipe and Fittings Lining: All ductile iron pipe and fittings shall be cement lined double thickness in accordance with ANSI/AWWA C104/A21.4.

G. Pipe and Fittings Coating: Factory coated exterior with an asphaltic coating; minimum 1 mil dry film thickness. Coating material and application conforming to AWWA C110, C115 and C151.

H. Pipe and fittings must be by the same manufacturing group.

2.02 STEEL PROCESS PIPE

A. Pipe

1. ASTM A134, straight seam, electric fusion arc-welded. (pipe larger than 16").

2. ASTM A135, electric resistance welded pipe, Grade (A) (B). *Grade A (Flanging and Bending) (pipe size 2" - 30").

3. ASTM A139, electric fusion (arc) welded steel pipe, Grade B. (size 4" and over).

B. Fittings

1. ASTM A105, forging, carbon steel, for piping components.

2. ASTM A 181, forgings, carbon steel, for general purpose piping, Class 70.

C. Shop Coatings - Pipe, Fittings and Flanges: Minimum SSPC-SP6 with SSPC-Paint 20, type II, organic zinc-rich primer.

2.03 BLACK AND GALVANIZED STEEL PIPE (GENERAL USE)

A. Pipe: ASTM A53, Seamless. Schedule 40, unless otherwise indicated on the contract drawings.

B. Fittings

1. Threaded: Malleable Iron, ANSI B16.3, 150# Class

2. Flanged: Cast Iron, ANSI B16.1, 125# Class

3. Socket Welded: Forged Steel, ANSI B16.11.

C. Flanges: AWWA C 207.

D. Unions: Threaded, Forged Carbon Steel, MSS SP-83.

2.04 COPPER PIPE

A. Pipe: ASTM B42, Seamless, Regular Weight, Temper H80

1. H80 - Hard Drawn, 1/8" - 2" dia.

B. Tubing: ASTM B88, Seamless, Temper H, Type K

C. Fittings

1. Wrought Copper and Bronze, Solder Joint: ANSI B16.22

2. Cast Bronze, Solder Joint, Pressure: ANSI B16.18

3. Cast Bronze, Threaded: ANSI B16.15, 125# Class

4. Bronze Flanges/Flange Fittings ANSI B16.24, 150# Class

5. Cast Bronze, for Flared Copper Tube: ANSI B16.26

D. Brazing Filler Material: AWS 5.8.

E. Brazing Flux: Federal Specification O-F-499, Type B.

F. Soldering Flux: Federal Specification O-F-506, Type I.

G. Joints in copper tubing or pipe shall be made using 95-5 tin-antimony solder conforming to ASTM B32.

2.05 POLYVINYL CHLORIDE (PVC) PROCESS PIPE (12" NOMINAL PIPE SIZE AND SMALLER)

A. ASTM D2241, PVC 1120 (12454-B) or PVC 1220 (12454-C) or PVC 2120 (14333-D); SDR- 26, 160 psi.

B. ASTM D1785, Schedule 80, with fittings conforming to ASTM D2467

C. AWWA C900, Class 12454-A or 12454-B; DR 18, 150 psi; with C.I./I.P.S. equivalent outside diameter.

D. Push-on Joints Using Flexible Elastromeric Seals: ASTM D3139

E. Elastromeric Seals (Gaskets) : ASTM F477

2.06 POLYVINYL CHLORIDE (PVC) PROCESS PIPE (LARGER THAN 12" NOMINAL PIPE SIZE)

A. Gravity Sewer Pipe and Fittings

1.	Pipe 15" Diameter and Smaller:	ASTM D3034, SDR-35.
2.	Pipe 18" to 27" Diameter:	ASTM F679, SDR-35
3.	Flexible Elastomeric Seals:	ASTM D3212
4.	Seal Material:	ASTM F477

2.07 POLYETHYLENE (PE) PROCESS PIPE

A. Pipe: ASTM D1248, Type III, Category 5, Class C, PE3408 SDR 11 or as shown on plans.

B. Fittings: ASTM D3261, PE3408 SDR 11, Butt Heat Fusion Polyethylene Plastic Fittings.

2.08 CAST IRON SOIL PIPE

A. Pipe and Fittings: ASTM A74, Service Class. Hub and Spigot or Double-Hub.

B. Joints: Lead Caulked or Double-Seal Compression Gaskets

1.	Gaskets:	ASTM C564
2.	Jute Packing:	Federal Specification HH-P-117, Type II
3.	Lead:	Federal Specification QQ-C-40, Type 1

2.09 PIPE ACCESSORIES

A. Wall Sleeves and Wall Pipes

1. Cast Iron: ASTM A48, Class 30B

2. Ductile Iron: ASTM A536, Grade 60-40-18

3. Mechanical Joint, ANSI/AWWA C111/A21.11

4. Integral cast intermediate wall collar

B. Wall Seals

1. Assembly of synthetic rubber links connected with corrosion resistant bolts; when the bolts are tightened, Delrin plastic pressure plates compress the rubber links to fill the annular space between the pipe and the wall sleeve to form a watertight seal.

2. All wall seals located in penetrations through new walls that are below grade shall be installed in a cast iron wall sleeve that conforms to the requirements of this specification section or installed in a steel wall sleeve. This steel wall sleeve shall consist of a piece of standard weight steel pipe with an integral steel anchoring collar. This anchoring collar shall be 1/4" thick, shall project 3" beyond the pipe outer wall and shall be welded to the pipe around its entire periphery. No sleeves are required if hole is core drilled through a new or existing concrete wall.

C. Flange Adapters

1. For connecting plain-end pipe to flanged valves, fittings and pumps, constructed of ductile iron with 125 lb. flange drilling; anchor to plain-end pipe by means of setscrews conforming to ANSI B16.1. Provide with Buna-N gasket. Temperature range -20°F to 150°F; working pressure as follows:

   a. 2" to 12" - 175 psi

   b. 14" to 24" - 150 psi

2. Setscrews shall prevent pullout up to working pressure specified plus 100 psi surge pressure.

D. Flange Coupling Adapters

1. For joining plain-end pipe to flanged valves, fittings and pumps.

2. Mechanical Joint, ANSI/AWWA C111/A21.11. Provide all flanged coupling adapters with anchor studs.

E. Coupling Adapters

1. Factory pre-assembled couplings for plain-end pipe.

2. Double-ring, steel followers, rubber compounded wedge-gasketed, steel flared middle ring type mechanical joint, ANSI/AWWA C111/A21.11.

F. Transition Couplings

1. To connect pipes of different outside diameters.

2. High-grade steel middle ring with ductile iron follower flanges with rubber compounded wedge section gaskets. Mechanical Joint, ANSI/AWWA C111/A21.11.

2.10 DETECTABLE UNDERGROUND UTILITY MARKING TAPE

A. Tape shall consist of a minimum 5-mil (0.005") overall thickness, with no less than a 35 gauge (0.00035") solid aluminum foil core. The foil must be visible from BOTH sides. The layers shall be laminated together with the extrusion lamination process, not adhesives. Further, there shall be NO inks or printing extending to the edges of the tape. The adhesive will NOT contain any dilutants, pigments or contaminants and is specially formulated to resist degradation by elements normally encountered in the soil. All printing shall be encased to avoid ink rub-off.

B. Test Data:

Property	**Method**	**Value**
Thickness	ASTM D2103	5.0 mils
Tensile strength	ASTM D 882	25 lbs/inch (5500 psi)
Elongation	ASTM D 882-88	<50% at break
Printability	ASTM D 2578	>50 dynes/cm^2
Flexibility	ASTM D 671-81	Pliable hand
Inks	Mfg. specs.	Heat set Mylex
Message repeat	Mfg. specs.	Every 20"
Foil	Mfg. specs.	Dead soft/annealed
Top layer	Mfg. specs.	Virgin PET
Bottom layer	Mfg. specs.	Virgin LDPE
Adhesives	Mfg. specs.	>30%, solid 1.5#/R
Bond strength	Boiling H_2O @ 100^{o}C	5 hours w/o peel
Colors	APWA code	See below

C. Color code shall be as follows:

1. Safety Red: Electric power, distribution and transmission and municipal electric systems.

2. High Visibility Safety Yellow: Gas and oil distribution and transmission, dangerous materials, product and steam.

3. Safety Alert Orange: Telephone and telegraph systems, police and fire communications, and cable television.

4. Safety Precaution Blue: Water systems and slurry pipelines.

5. Safety Green: Sanitary and storm sewer systems.

6. Safety Brown: Force mains, reclaimed water lines and effluent reuse lines.

7. Alert Purple: Reclaimed non-potable water lines.

PART 3 - EXECUTION

3.01 PREPARATION

A. Perform trench excavation to the line and grade indicated on the Contract Drawings and as specified in Section 02221, TRENCHING, BACKFILLING AND COMPACTING.

B. Unless otherwise indicated on the Drawings, provide a minimum cover of 3'-0" above the top of piping laid in trenches.

C. Provide pipe bedding as specified in Section 02315 for each type of pipe used.

D. Provide bedding for all PVC and other plastic pipe or shown on drawings or approved by Engineer. Place aggregate in a manner to avoid segregation, and compact to the maximum practical density so that the pipe can be laid to the required tolerances.

3.02 LAYING PIPE IN TRENCHES

A. Give ample notice to the Engineer in advance of pipe laying operations.

B. Use laser alignment equipment during pipe laying operations.

C. Lower pipe to trench using handling equipment designed for the purpose to assure safety of personnel and to avoid damage to the pipe; do not drop pipe.

D. Lay pipe proceeding upgrade with the bell or groove pointing upstream.

E. Lay to a uniform line with the barrel of the pipe resting solidly in bedding material throughout its length; excavate recesses in bedding material to accommodate joints, fittings and appurtenances; do not subject pipe to a blow or shock to achieve solid bedding or grade.

F. Lay each section of pipe in such a manner as to form a close concentric joint with the adjoining section and to avoid offsets in the flow line.

G. Pipe Joining

1. Clean and inspect each pipe and fitting before joining; assemble to provide tight, flexible joints that permit movement caused by expansion, contraction and ground movement.

2. Use lubricant recommended by the pipe or fitting manufacturer for making joints.

3. If unusual joining resistance is encountered or if the pipe cannot be fully inserted into the bell, disassemble joint, inspect for damage, re-clean joint components, and reassemble joint.

H. Assemble mechanical joints in accordance with ANSI/AWWA C111/A21.11, Appendix A; if satisfactory seating of the joint is not obtained at maximum torque, disassemble the joint, re-clean, and reassemble using a new gasket.

I. Push-On Joints

1. Assemble push-on joints in accordance with the recommendations of the pipe manufacturer.

2. On field-cut pipe, file or grind the spigot to resemble the pipe as manufactured so that the spigot end will slip into the socket intact without hindrance or cause gasket damage.

3. Install spigot end to full depth of socket.

4. Prior to installation, mark the spigot end of field-cut pipe with the insertion depth.

J. Check each pipe installed as to line and grade in place; correct deviation from grade immediately; deviation from the required designed grade and alignment will be cause for rejection.

K. Do not deflect joints in pressure piping more than the maximum recommended by the pipe manufacturer.

L. Place sufficient backfill on each section of pipe, as it is laid, to hold pipe firmly in place.

M. Clean the interior of the pipe as the work progresses; where cleaning after laying is difficult because of small pipe size, use a suitable swab or drag in the pipe and pull forward past each joint immediately after joining has been completed.

N. Keep trenches and excavations free of water during construction.

O. When the work is not in progress, and at the end of each workday, securely plug ends of pipe and fittings to prevent trench water, earth or other substances from entering the pipe or fittings.

3.03 THRUST RESTRAINT

Provide pressure pipeline and restrained joints or concrete thrust blocking at all bends, tees, and changes in direction; construction concrete thrust blocking in accordance with Standard Details. If restrained joints are utilized, submit design calculations showing determination of restrained lengths and submit joint restraint details. Method of joint restraint shall utilize devices specifically designed for the application for which manufacturer's data is available for the application. Submit manufacturer's literature for approval.

3.04 CRADLES AND ENCASEMENT

Provide concrete cradle and encasement for pipeline where approved by Engineer; construct in accordance with Standard Detail.

3.05 BACKFILLING TRENCHES

A. Backfill pipeline trenches only after examination of pipe laying by the Engineer.

B. Backfill trenches as specified in Section 02221, Trenching, Backfilling and Compacting.

C. Install detectable utility marking tape above all plastic pressure pipeline, 12" to 18" below final grade.

3.06 INTERIOR PROCESS PIPING INSTALLATION

A. Pipe Layout in Building

1. Coordinate work to prevent interference between architectural, structural, electrical and mechanical features; the Contract Drawings are generally diagrammatic due to their small scale.

2. Provide such offsets, fittings and other items as may be required to suit conditions.

3. Do not place joints or fittings over switchboards, panels, motors or other electrical equipment.

4. The completed installation shall present a neat, orderly appearance; do not block openings or passageways; run piping parallel to the walls of buildings or structures.

5. Provide clearance between piping, walls, floors, machinery and equipment to prevent the transmission of noise and vibration.

6. Orient handwheels, levers, valve operators and other valve actuators for convenience of operation; set gate valves with the stem above the horizontal.

7. Cut pipe to measurements established at the site and install without springing or forcing; make changes in direction with fittings.

8. Connect ferrous piping to non-ferrous piping with dielectric couplings.

B. Equipment Connections

1. Make connections to pumps and other equipment in a manner to eliminate strains on piping and equipment.

2. Install unions or flanges adjacent to equipment and wherever their use will facilitate removal of equipment.

C. Wall Sleeves and Wall Pipes

1. Provide pipes passing through concrete construction with wall sleeves or wall pipes having an integral cast or welded intermediate wall collar, as indicated on the contract drawings.

2. Set wall sleeves and wall pipes of the required size during construction of the wall, foundation or slab.

D. Wall Seals

1. Provide watertight wall seals between pipe and wall sleeve where pipes penetrate building walls, foundations or slabs.

2. Annular space between pipe and wall sleeve shall be sealed with mechanical seal consisting of interlocking synthetic rubber links shaped to fill the space and assembled with bolts and a pressure plate under each bolt head and nut, and when squeezed the rubber links shall form a watertight seal with the pipe sleeve.

E. Flanged Joints

1. Tighten flange bolts so that the gasket is uniformly compressed and sealed; do not distort flanges; do not exceed manufacturer's recommended maximum torque.

2. Leave flange bolts with ends projected 1/8" to 1/4" beyond the face of the nut after tightening.

F. Flange Adapters and Flange Coupling Adapters

1. Flange Adapters: Tighten flange adapter setscrew with torque wrench to manufacturer's recommended tightening torque.

2. Flange Coupling Adapters: Drill hole in plain-end of process pipe at each anchor stud location. Tighten anchor stud fully so that anchor stud protrudes into drilled hole, thereby preventing lateral movement of the pipe.

G. Threaded Joints: ANSI B2.1, NPT

Cut threads full and clean with sharp dies; ream ends of pipe after threading and before assembly to remove burrs; leave not more than three pipe threads exposed at each connection; use joint compound or thread tape on the male thread only.

H. Solder Joints

1. Ream or file pipe to remove burrs; clean and polish contact surfaces of joints.

2. Apply flux to both male and female end; insert end of tube into fittings full depth of socket.

3. Bring joint to soldering temperature, in as short a time as possible, forming continuous solder bead around entire circumference of joint.

I. Solvent Cemented Joints (PVC): Make joints in pipe and fittings in accordance with the procedures and techniques in ASTM D2855.

J. Fusion Welded Joints (PE): Make joints in pipe and fittings in accordance with the procedures and techniques in ASTM D2657 or ASTM D3261 as applicable.

3.07 PIPE SUPPORTS

A. Support piping from structural construction using pipe hangers, pipe riser clamps and pipe clamp hangers in conjunction with beam clamps, brackets or other equipment as dictated by structure construction.

B. Trapeze hangers approved by the Engineer may be used where several horizontal pipes run closely parallel; secure pipes on trapeze hangers to prevent sideway motion.

C. Install supports for piping 2-1/2" and greater in diameter in accordance with manufacturers recommendations or specifications contained herein, whichever is more stringent; support piping under 2-1/2" diameter as specified herein.

D. Vertical Piping

1. Secure at sufficiently close intervals to keep pipe in alignment and to support weight of pipe and its contents.

2. Support vertical iron and steel pipe on maximum 5'-0" centers with steel pipe riser clamps.

3. Support vertical copper tubing at no more than 10'-0" spacing, using plastic coated steel pipe riser clamps or pipe clamp hangers at end of runs and at intermediate points as installation dictates.

4. Support vertical plastic pipe at 4'-0" centers, using plastic coated pipe riser clamps or pipe clamp hangers at end of runs and at intermediate points as installation dictates.

E. Horizontal Piping

1. Support at sufficiently close intervals to prevent sagging, thrust restraint, and vibration.

2. Install hangers or supports at ends of runs or branches and at each change of direction or alignment.

3. Install steel clevis-type pipe hangers for horizontal iron and steel pipe on maximum 10'-0" centers.

4. Install steel clevis-type pipe hangers for copper tubing on 6'-0" centers for 1-1/4" size and smaller, and on 10'-0" centers for copper tubing larger than 1-1/4" size.

5. Install plastic coated ring-type pipe hangers for horizontal plastic pipe on maximum 4'-0" centers, close to every joint, at ends of each branch, and at each change in direction or elevation; hangers shall not compress, distort, cut or abrade plastic piping and shall permit free movement of the pipe.

F. Pipe Bracing: The Contractor is responsible for properly bracing piping against lateral movement or sway. The Engineer shall review with the Contractor and approve method of bracing of piping at each location prior to Contractor proceeding with the installation of the bracing. Bracing shall be installed at all locations where sway is anticipated and as directed by the Engineer.

3.08 CUTTING AND PATCHING

A. Do not cut and patch existing structures without prior permission from the Engineer.

B. Perform cutting and patching where indicated in the contract drawings. Patch to match adjacent finishes.

3.09 TESTING

Test piping systems as specified in Section 15190.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 02732

SANITARY SEWER FORCE MAINS

PART 1 – GENERAL

1.01 RELATED WORK

A. Trenching, Backfilling and Compacting

B. Division 3 – Concrete

1.02 QUALITY ASSURANCE

A. Design Criteria:

1. Use only one type and class of pipe in any continuous force main between structures, unless otherwise indicated on the Drawings.

2. Use pipe and fittings designed to withstand imposed trench loadings and conditions at the various locations.

1.03 REFERENCES

A. American National Standards Institute:

1. ANSI A 21.4, Cement-Mortar Lining for Cast-Iron and Ductile-Iron Pipe and Fittings for Water.

2. ANSI A 21.10, Gray-Iron and Ductile-Iron Fittings, 2 through 48 inches, for Water and Other Liquids.

3. ANSI A 21.11, Rubber Gasket Joints for Cast Iron and Ductile Pressure Pipe and Fittings.

4. ANSI A 21.15, Flanged Cast-Iron and Ductile-Iron Pipe with Threaded Flanges.

5. ANSI A 21.50, Thickness Design of Ductile-Iron Pipe.

6. ANSI A 21.51, Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lines Molds for Water or Other Liquids.

7. ANSI B 1.1, Unified Inch Screw Threads.

8. ANSI B 16.1, Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

9. ANSI B 16.21, Nonmetallic Gaskets for Pipe Flanges.

10. ANSI B 18.2.1, Square and Hex Bolts and Screws, including Askew Head Bolts, Hex Cap Screws, and Lag Screws.

11. ANSI B 18.2.2, Square and Hex Nuts.

B. American Society for Testing and Materials

1. ASTM A 47, Specification for Malleable Iron Casting.

2. ASTM A 48, Specification for Gray Iron Castings.

3. ASTM A 167, Specification for Stainless and Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Fusion-Welded Unfired Pressure Vessels.

4. ASTM A 183, Specification for Carbon Steel track Bolts and Nuts.

5. ASMT A 240, Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Fusion-Welded Unfired Pressure Vessels.

6. ASMT A 283, Specification for Low and Intermediate Tensile Strength Carbon Steel Plates of Structural Quality.

7. ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.

8. ASTM B 85, Specification for Aluminum-Alloy Die Castings.

9. ASTM B 371, Specification for Copper-Zinc-Silicon Alloy Rod.

10. ASTM B 438, Specification for Copper-Base Sintered Bearings (Oil-Impregnated).

11. ASTM B 584, Specification for Copper Alloy Sand Castings for General Applications.

12. ASTM D 2241, Specification for Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR).

13. ASTM D 2321, Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.

14. ASTM D 2774, Recommended Practice for Underground Installation of Thermoplastic Pressure Piping.

15. ASTM D 3139, Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

16. ASTM F 477, Specifications for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

17. ASTM A 615, Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

18. ASTM C 139, Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.

19. ASTM C 478, Specification for Precast Reinforced Concrete Manhole Sections.

20. ASTM C 923, Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.

21. ASTM D 3034, Specifications for Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.

22. ASTM D 4104, Specification for Propylene Plastic Injection and Extrusion Materials.

C. American Water Works Association:

1. AWWA C 105, Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids.

2. AWWA C 509, Resilient-Seated Gate Valves, 3 through 12 NPS, for Water and Sewage Systems.

3. AWWA C 550, Protective Interior Coatings for Valves and Hydrants.

4. AWWA C 600, Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances.

5. AWWA C 900, Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch through 12-inch, for Water.

1.04 SUBMITTALS

A. Shop Drawings and Product Data: Furnish completely dimensioned shop drawings, cuts or other data as required to provide a complete description of piping, piping specialties, and valves.

B. Certifications:

1. Certified records or reports of results of shop tests, such records or reports to contain a sworn statement that shop tests have been made as specified. Certification to be sworn by and bear the seal of a Registered Professional Engineer.

2. Manufacturer's sworn certification that pipe will be manufactured in accordance with specified reference standards for each pipe type.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

Transport, handle, and store pipe materials and other products specified herein a manner recommended by the respective manufacturers to prevent damage and defects.

1.06 SITE CONDITIONS

A. Environmental Requirements (Force Main Construction):

1. Keep trenches dewatered until pipe joints have been made and concrete cradle and encasement, if any, have cured.

2. Under no circumstances lay pipe in water or on bedding containing frost.

3. Do not lay pipe when weather conditions are unsuitable, as determined by the Engineer, for pipe laying work.

PART 2 – PRODUCTS

2.01 PIPE AND PIPE FITTINGS

A. Ductile Iron (DIP):

1. Pipe: ANSI A 21.50 and ANSI A 21.51, 350 psi working pressure (to 20-inch diameter).

2. Wall Thickness Class (Buried): Class 51 except as noted otherwise on drawings.

3. Wall Thickness Class (Exposed): Class 53 except as noted otherwise on Drawings.

4. Fittings: Gray iron or compact ductile iron, Class 250 meeting ANSI/AWWA C153/A21.53, C111/A21.11, and C104/A21.4.

5. Joints:

a. Rubber-Gasket Joints (Buried): ANSI A 21.11:

1. For buried pipe installation, provide either push-on or mechanical joints except where other types of joints are indicated on the Drawings or required by the Specifications.

2. Provide rubber gaskets suitable for conveying domestic sewage.

b. Flanged Joints (Exposed): ANSI A 21.15:

1. Unless indicated otherwise on the Drawings, use flanged joints for pipe and fittings installed inside of structures.

2. Gaskets: 1/8-inch-thick rubber full face conforming to ANSI A 21.11.

3. Bolts: ANSI B 18.2.1

4. Nuts: ANSI B 18.2.2

6. Pipe and Fittings Lining: All ductile iron pipe and fittings shall be cement lined double thickness in accordance with ANSI/AWWA C104/A21.4.

7. Pipe and Fittings Coating: Factory coated inside and out with an asphaltic coating; minimum 1 mil dry film thickness. Lining material application conforming to AWWA C110, C115 and C151.

B. Polyethylene Encasement

1. Encasement shall be in tube form manufactured of virgin polyethylene material conforming to ASTM D1248.

2. Minimum nominal material thickness is 8 mils.

3. Material and installation methods shall be in accordance with AWWA C105.

4. Provide joint tape suitable for buried installation per manufacturers.

C. Polyvinyl Chloride Pipe and Fittings (PVC)

1. Pipe: ASTM D 2241, ASTM D 1784, AWWA C900, AWWA C909, AWWA C111, UNI-B-1. Must meet U.L. and F.M. Standards.

2. Pressure Class 165 psi.

3. Pipe Joints: Push-on or compression type, joint performance ASTM D 3139, rubber gasket suitable for potable water service ASTM F 477.

4. Each joint of pipe shall be hydrostatically tested at the factory before shipment.

5. Mechanical joint fittings in sizes 4" through 24" shall meet the requirements of AWWA C153.

6. Cement lining - all fittings shall be cement lined double thickness in accordance with ANSI A21.4. AWWA C111 - Latest revision.

7. Pipe shall have a four to one safety factor for pressure.

8. Certifications of Compliance of the above specifications and standards shall be required from the manufacturer before acceptance of delivery or award of contract.

D. Polyethylene Pipe

1. Material – PE pipe materials shall conform to ASTM D 3350 (PE3408) with a cell classification of 335433C.

2. Joints – PE pipe joints shall be thermally joined in conformance with ASTM D2657.

3. Dimensions – All PE pipe shall be SDR 11.

4. Certificate – A manufacturer's certificate that the PE material and pipe was manufactured and tested in accordance with the appropriate ASTM specification shall be furnished to the Owner prior to installation of the pipe.

2.02 PIPING SPECIAL TIES

A. Concrete Buttresses: All horizontal and vertical bends shall be anchored with concrete buttresses detailed on the Contract Drawings.

1. Concrete: Class B as specified in Section 3 – Cast in Place Concrete.

2. Reinforcing: As specified in Section 3 – Concrete Reinforcement.

B. Restrained Joints: All force mains placed in casing pipe shall be equipped with Mega-lug style joint restraints on each joint.

C. Casing Insulators: All force main placed in casing pipe shall be equipped with plastic casing insulators placed to firmly position the force main within the casing pipe.

D. Locator/Marker Tape: Manufactured of plastic material with a metallic core suitable for burial. Tape shall be 6-inches wide and have the imprint **Caution Buried Force Main Below.** The tape shall not rely on an unbroken electrical circuit for locating and shall be manufactured by the Allen System Inc, or Terratap Detectable as manufactured by Griffolyn Co.

PART 3 – EXECUTION

3.01 INSPECTION

A. Inspect each section of pipe and each pipe fitting before laying in conformance with the inspection requirements of the appropriate referenced standard.

B. Remove rejected pipe from the Project.

3.02 PREPARATION

A. General:

1. Clean piping interior prior to laying pipe and following pipe laying.

2. Keep open ends of piping and pipe attachment openings capped or plugged until actual connection or actual pipe testing.

3. Excavate trenches in rock at least 25-feet in advance of pipe laying. Protect pipe ends from blasting.

B. Earthwork for Force Main Installation: Perform earth work for force main installation as specified in Section 2.7.

3.03 FORCE MAIN CONSTRUCTION METHODS

A. General Requirements: Use proper and suitable tools and appliances for the proper and safe handling, lowering into trench and laying of pipes.

1. Lay pipe proceeding upgrade true to line and grades given. Lay bell spigot pipe with bell and upgrade.

2. Unless indicated otherwise, piping shall be installed with not less than 4'-0" of cover.

3. Exercise care to insure that each length abuts against the next in such manner that no shoulder or unevenness of any kind occurs along inside bottom half of pipe line.

4. No wedging or blocking permitted in laying pipe unless by written order of Engineer.

5. Before joints are made, bed each section of pipe full length of barrel with recesses excavated so pipe invert forms continuous grade with invert of pipe previously laid. Do not bring succeeding pipe into position until the preceding length is embedded and securely in place.

6. Dig bell holes sufficiently large to permit proper joint making and to insure pipe is firmly bedded full length of its barrel.

7. Walking or working on completed force main, except as necessary in tamping and backfilling, not permitted until trench is backfilled one-foot deep over top of pipes.

8. Take up and re-lay pipe that is out of alignment or grad, or pipe having disturbed joints after laying.

9. Take up and replace with new, such in-place pipe section found to be defective. Replacement work at Contractor's expense.

10. Concrete Thrust Blocks: Provide concrete thrust blocks for all fittings, and at all locations where horizontal and/or vertical deflections are made in the joints of the force mains. Use Class B concrete. Thrust block of design indicated on Detail Drawing.

B. Joints: Make joints in joining of pipe materials in strict accordance with manufacturer's installation instructions and such included reference standards.

1. Make joints absolutely watertight and immediately repair detected leaks and defects. Methods of repair subject to Engineer's approval.

C. Field Repair of Damaged Cement Linings:

1. Cut out the damaged lining to the metal. Cuts should have square edges.

2. Thoroughly clean and wet the cut-out area and adjoining lining.

3. Prepare mortar mix of 3 parts Portland Cement, 2 parts clean sand (free of Clay and screened through a No. 20 screen) and necessary water for a 5" to 8" slump. Mortar must be used within one hour of mixing.

4. Spread mortar mix evenly to a thickness of 3/16" over the area to be patched. Once mortar has been firm, finish it with water using a 3" to 4" soft bristle brush.

5. Cover repaired area with wet burlap or canvas for at least 24 hours to allow proper curing.

D. Laying Ductile Iron Pipe: Installation and Joint assembly according to AWWA C 600, and as follows:

1. Where necessary to field cut pipe use approved pipe cutter, milling cutter or abrasive wheel saw.

2. Push-on Joints: To make ductile cast iron pipe push-on joints, properly seat sealing gaskets

3. Mechanical Joints: To make ductile iron pipe mechanical joint, position sealing gasket and gland for bolting and then enter the spigot into pipe bell end until joint line is visible. Tighten bolts evenly maintaining approximate distance between gland and face of flange at all points around the socket. Do not exceed pipe manufacturer's specifications for maximum torque applied to bolts.

4. Flanged Joints: For DIP flanges shall be faced true, fitted with gaskets, and drawn up square and tight to insure full gasket flow and satisfactory seal.

3.05 FIELD QUALITY CONTROL

A. General Requirements: Conduct tests specified herein so that each force main installed in the Project is tested to the Engineer's satisfaction:

1. Provide tools, materials (including water), apparatus and instruments necessary for force main testing.

2. Conduct tests of every kind in the presence of and to the satisfaction of the Engineer.

3. Provide an extra pressure gauge of known accuracy to frequently check test equipment and apparatus.

4. Hydrostatic testing equipment and associated testing apparatus subject to Engineer's approval.

5. When the length of the force main exceeds 1,000 feet, test the force main in sections, the length of each section to be determined by the Engineer.

B. Cleaning Prior to Tests: Before tests are conducted, clean piping.

C. Line Acceptance Test: In accordance with Section 15950 of these specifications.

D. Repair and Retest: When force main or sections of force main fails to meet test requirements specified previously, determine source or sources of leakage and repair or replace defective material, and if a result of improper workmanship, correct such. Conduct such additional tests required to demonstrate that force main meets specified test requirements.

E. Include costs for above stated tests in unit or lump sum price of prices bid for the work as no separate payment will be allowed for Line Acceptance Test.

F. The contractor may elect to make a leakage test prior to backfilling the trenches, for his own purposes; however, the leakage tests of the force mains or sections

thereof for acceptance shall be conducted after the backfilling of the trenches has been completed.

G. The Owner reserves the right to retest at his expense, any piping through the duration of the Construction Period:

1. Contractor shall make repairs as Work of this Contract to piping found defective by such Owner conducted tests.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 02750

DRIVEWAYS, PARKING AREAS, AND WALKS

PART 1 - GENERAL

1.01 RELATED DRAWINGS

A. General

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.02 DESCRIPTION OF WORK

A. General

The Contractor shall provide the labor, tools, equipment, and materials necessary to construct the driveways, parking areas, and walks in accordance with plans and as specified herein.

1.03 QUALITY ASSURANCE

A. Codes and Standards

Perform all work in placement of driveways, parking areas, and walks in compliance with applicable requirements of governing agencies having jurisdiction.

B. Testing Laboratory

Engage a testing laboratory acceptable to the Engineer to perform subgrade inspection tests.

1.04 SUBMITTALS

A. Transmittals

Furnish samples, manufacturer's product data, test reports, and materials certifications as required for materials and mix design.

1.05 JOB CONDITIONS

A. This contract requires work to be done within a residential area, we cannot interfere with homeowner’s driveways during construction.

1.06 DELIVERY, STORAGE, AND HANDLING

NOT USED

1.07 SPECIAL WARRANTY

NOT USED

PART 2 - PRODUCTS

2.01 MATERIAL

A. Aggregate: Aggregate shall meet the specifications of MDSHA.

B. Prime Coat: Prime coat shall be RT-2, RT-3, MC70, or MC250 in accordance with MDSHA.

C. Tack Coat: Tack coat shall be RC-250, RS-1, or SS-1h in accordance with MDSHA.

D. Asphalt Concrete: Asphalt concrete shall be in accordance with MDSHA.

E. Concrete with Portland Cement: Concrete shall be in accordance with Division 3 of these specifications or MDSHA.

F. Expansion Joint: Expansion joints shall be 1/2-inch thick pre-molded, non-extruding type.

PART 3 - EXECUTION

3.01 GENERAL

A. Topsoil

Topsoil shall be removed in accordance with plans and specifications.

B. Subgrade

1. Foreign Material - All loose and foreign materials shall be removed and the subgrade shall be compacted and free of ruts and standing water when the base material is placed.

C. Slope

Driveways, parking areas, and walks shall be sloped to drain away from buildings and structures. Driveways in open areas shall have a center crown. Cross slope for driveways and walks shall be 1/4 inch per foot.

D. Existing Pavement

Driveways, parking areas, and walks shall conform to the grade of existing pavements or walks unless modifications are shown on the plans or required by the specification. Where it is necessary to disturb existing Portland cement concrete pavements or walks, the concrete shall be saw cut in neat, straight lines. The depth of saw cut shall be at least 2 inches. Where it is necessary to disturb existing asphalt concrete pavements or walks, the asphalt concrete shall be line cut with straight vertical edges by saw cutting. All cut bituminous surfaces shall be sealed with a bituminous material.

3.02 PAVEMENT

NOT USED

3.03 ASPHALT WALKS

NOT USED

3.04 CONCRETE WALKS

A. Concrete Walks

Concrete walks shall be 4 inches thick, except on driveways which will be 6 inches set on a 4-inch compacted aggregate base.

B. Finish

Concrete shall be float or broom finished to match adjacent surface with a tooled joint every 4 feet and an expansion joint every 20 feet.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 03301

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies cast-in-place concrete, including reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.02 SUBMITTALS

A. General: In addition to the following, comply with submittal requirements in ACI 301.

B. Product Data: For each type of product indicated.

C. Design Mixtures: For each concrete mixture.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment.

B. Source Limitations: Obtain each type of cement of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

C. Comply with ACI 301, "Specification for Structural Concrete," including the following sections, unless modified by requirements in the Contract Documents:

1. "General Requirements."

2. "Formwork and Formwork Accessories."

3. "Reinforcement and Reinforcement Supports."

4. "Concrete Mixtures."

5. "Handling, Placing, and Constructing."

D. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

E. Testing Agency: Testing of concrete shall be by an independent testing agency, acceptable to the Owner and authorities having jurisdiction. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1 according to ACI CP-1, or an equivalent certification program.

1. An inspection and testing agency shall be employed by the Contractor to inspect and test all concrete as to mix, strength and other matters pertaining thereto, as directed by the Engineer.

2. The duties, responsibilities and minimum requirements of the inspection and testing agency shall be in accordance with ASTM E329.

3. Inspection and testing services shall be paid for by the Contractor.

PART 2 - PRODUCTS

2.01 FORMWORK

A. Furnish formwork and formwork accessories according to ACI 301.

2.02 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615, Grade 60, deformed, with fusion bonded epoxy powder coating in accordance with ASTM D3963. Coating shall be a bright color in contrast to the color of reinforcement steel and rust.

B. Plain-Steel Wire: ASTM A82, as drawn.

C. Welded Wire Reinforcement: ASTM A1064, furnish in flat sheets.

2.03 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout Project:

1. Portland Cement: ASTM C150, Type I/II.

B. Normal-Weight Aggregate: ASTM C33, graded, 1-1/2-inch nominal maximum aggregate size.

C. Lightweight Aggregate: ASTM C330, 1-inch nominal maximum aggregate size.

D. Water: ASTM C94; potable.

2.04 ADMIXTURES

A. Air-Entraining Admixture: ASTM C260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494, Type A.

2. Retarding Admixture: ASTM C494, Type B.

3. Water-Reducing and Retarding Admixture: ASTM C494, Type D.

4. High-Range, Water-Reducing Admixture: ASTM C494, Type F.

5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494, Type G.

6. Plasticizing and Retarding Admixture: ASTM C1017, Type II.

2.05 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

2.06 CONCRETE MIXTURES

A. Comply with ACI 301 requirements for concrete mixtures.

B. Normal-Weight Concrete – 4,500 psi: Prepare design mixes, proportioned according to ACI 301, as follows:

1. Minimum Compressive Strength: 4,500 psi at 28 days, unless noted otherwise.

2. Maximum Water-Cementitious Materials Ratio: 0.45.

3. Slump Limit: 4 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

4. Air Content: Maintain within range permitted by ACI 301.

C. Normal-Weight Concrete – 3,500 psi: Prepare design mixes, proportioned according to ACI 301, as follows:

1. Minimum Compressive Strength: 3,500 psi at 28 days.

2. Maximum Water-Cementitious Materials Ratio: 0.50.

3. Slump Limit: 4 inches for concrete with verified slump of 2 to 5 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

4. Air Content: Maintain within range permitted by ACI 301.

2.07 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94, and furnish batch ticket information.

1. When air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.

2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.

3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

2.08 WATERSTOPS

A. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets for proper positioning of waterstop in forms at time of concrete placement, and for embedding in concrete to prevent passage of fluids through joints. The waterstops shall be wired to the reinforcement in accordance to the manufacturers recommendations. If no manufacturer recommendations are available then the waterstop shall be wired a maximum of four (4) feet on center. The waterstop shall be installed with factory fabricated corners, intersections, and directional changes. Provide at all construction, contraction and expansion joints and at other joints as indicated on the Contract Drawings.

1. Available Manufacturers:

a. Bometals, Inc.

b. Greenstreak.

c. W. R. Meadows, Inc.

d. Paul Murphy Plastics Co.

e. Progress Unlimited, Inc.

f. Or approved equal.

i. Profile: Tee, as indicated.

B. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

1. Available Products:

   a. Colloid Environmental Technologies Company; Volclay Waterstop-RX.

   b. Concrete Sealants Inc.; Conseal CS-231.

   c. Greenstreak; Swellstop.

   d. Henry Company, Sealants Division; Hydro-Flex.

   e. JP Specialties, Inc.; Earthshield Type 20.

   f. Or approved equal.

C. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

1. Available Products:

   a. Deneef Construction Chemical; Swellseal.

   b. Greenstreak; Hydrotite.

   c. Mitsubishi International Corporation; Adeka Ultra Seal.

   d. Progress Unlimited, Inc.; Superstop.

   e. Or approved equal.

D. Split “Tee” Shaped Waterstop.

Provide split “Tee” shaped waterstops as manufactured by Paul Murphy Plastics Co., or approved equal. Where “Tee” waterstops are to be used, the following procedure shall be used:

1. Apply FX-752 All Purpose Bonding Agent as manufactured by Fox Industries, or approved equal, to the existing structure where the waterstop is to be installed.

2. Apply FX-263 Rapid Set Trowelable Mortar as manufactured by Fox Industries, or approved equal, to a depth of not less than 1/4” to the existing structure where the waterstop is to be installed.

3. Allow the trowelable mortar to set a minimum of 48 hours. Apply FX-523 Flex-E-Pox as manufactured by Fox Industries, or approved equal, to adhere the waterstop to the trowelled mortar surface. New concrete shall not be placed until the FX-523 Flex-E-Pox and waterstop have been in place for a minimum of one hour.

4. If a manufacturer other than Fox Industries is used, all components to install the split “Tee” waterstop shall be from the same approved manufacturer.

PART 3 - EXECUTION

3.01 FORMWORK

A. Design, construct, erect, brace, and maintain formwork according to ACI 301.

3.02 STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

3.03 JOINTS

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

B. Construction Joints: Locate and install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.

3.04 CONCRETE PLACEMENT

A. Comply with ACI 301 for measuring, batching, mixing, transporting, and placing concrete.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

C. Consolidate concrete with mechanical vibrating equipment.

3.05 FINISHING FORMED SURFACES

A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

B. Rubbed Finish: Apply the following rubbed finish, defined in ACI 301, to smooth-formed finished as-cast concrete:

1. Smooth-rubbed finish.

2. Grout-cleaned finish.

3. Cork-floated finish.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.06 FINISHING UNFORMED SURFACES

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

B. Screed surfaces with a straightedge and strike off.

1. Do not further disturb surfaces before starting finishing operations.

C. Trowel Finish: Apply a hard trowel finish.

3.07 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, but before finishing.

C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure formed and unformed concrete for at least seven days by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.

b. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by roller according to manufacturer's written instructions. Maintain continuity of coating and repair damage during curing period.

3.08 FIELD QUALITY CONTROL

A. Concrete Testing:

1. Perform compressive strength, slump, and air content tests for each 50 cubic yards of concrete placed, or any portion thereof, for each structure. Cast at least 5 cylindrical strength test specimens for each batch. Test 2

cylinders at 7 days; test 2 cylinders at 28 days. Hold the remaining cylinder for testing in the event that any of the other cylinders are damaged prior to testing.

2. Determine concrete strength from standard test specimens made and cured according to ASTM C31 and ASTM C172, and tested in accordance with ASTM C39. Perform core drilling and testing in accordance with ASTM C42. Compute and evaluate in accordance with ASTM C94.

3. Determine air content in accordance with ASTM C231 or ASTM C173, as applicable.

4. Determine slump in accordance with ASTM C143.

5. Keep a slump cone and an air-meter in close proximity to all concrete placements.

3.09 REPAIRS

A. Remove and replace concrete that does not comply with requirements in this Section.

END OF SECTION

SECTION 03600

GROUT

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work of this section includes grouting as indicated on the drawings or specified in other sections. Unless otherwise specified, all grouting shall be done with non-shrinking grout.

B. This section also covers epoxy grouting of anchor bolts and threaded rod anchors to be installed in hardened concrete.

1.02 REFERENCES

A. American Concrete Institute:

1. ACI 308, Recommended Practice for Curing Concrete.

B. American Society for Testing and Materials:

1. ASTM C33; Concrete Aggregates.

2. ASTM C109; Test Method for Compressive Strength of Hydraulic Cement Mortars (Using two inch or 50-mm Cube Specimens).

3. ASTM C150; Specification for Portland Cement.

4. ASTM C191; Test Method for Time of Setting of Hydraulic Cement by Vicat Needle.

5. ASTM C596; Test Method for Drying Shrinkage of Mortar Containing Portland Cement.

6. ASTM C827; Test Method for Early Volume Change of Cementitious Mixtures.

7. ASTM C1107; Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).

1.03 SUBMITTALS

A. Submit a statement of compliance, together with supporting data, from the materials suppliers attesting to the conformance of products and ingredients with these specifications.

B. Submit manufacturer's instructions for mixing, handling, surface preparation, and placing the epoxy type and the non-shrink, non-metallic type grouts.

1.04 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Grout manufacturer shall furnish copies of current independent laboratory test results showing the non-shrink, non-metallic grout as

non-shrink from time of placement according to the following:

1. The grout indicates no expansion after final set according to ASTM C827.

2. The grout indicates 4,000-psi strength developed with a trowelable mix within 24 hours according to ASTM C109.

3. The grout indicates placement time limitation based on initial set of not less than 60 minutes according to ASTM C191.

4. Test results, as supplied by the grout manufacturer, shall indicate that in projects of similar scope and size, the effective bearing area was between 95 and 100 percent.

1.05 DELIVERY, STORAGE AND HANDLING

A. Provide protection for the products to prevent moisture damage and contamination of the grout materials.

B. Store the grout in undamaged condition with seals and labels intact as packaged by the manufacturer.

1.06 PROJECT CONDITIONS

A. Protect freshly poured grout against high and low temperatures and unfavorable environmental conditions in accordance with ACI Standards 308.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Portland Cement: ASTM C150, Type II.

B. Water: Potable; containing no impurities, suspended particles, algae, organic substances, acids, alkalis, or dissolved natural salts in quantities that will cause:

1. Corrosion of steel,

2. Volume change that will increase shrinkage cracking,

3. Efflorescence, or

4. Excess air entraining.

C. Fine Aggregate:

1. Washed natural sand.

2. Gradation in accordance with ASTM C33 and represented by a smooth granulometric curve within the required limits.

3. Free from injurious amounts of organic impurities as determined by ASTM C40.

2.02 RAPID-CURING EPOXY GROUT

A. High strength, three-component epoxy grout formulated with thermosetting resins and inert fillers.

B. Grout shall be rapid curing, have high adhesion, and be resistant to ordinary chemicals, acids and alkalis.

C.

Physical Properties		Reference Spec.
Compressive Strength	12,000 psi (7-day)	ASTM C579
Tensile Strength	2,000 psi minimum	ASTM C307
Coefficient of Expansion	3×10^{-6} in/in/^{o}F	ASTM C531
Shrinkage	None	ASTM C827

2.03 NON-SHRINK, NON-METALLIC CEMENTITIOUS GROUT

A. Pre-mixed ready for use formulation requiring only the addition of water; non-shrink, non-corrosive, non-metallic, non-gas forming, no chlorides. No more water shall be used than is necessary to produce a flowable grout, and ASTM C1107.

B. Certified to maintain initial placement volume or expand after set and meet the following minimum properties when tested in accordance with Corps of Engineers Specification CRD-C621, for Type D non-shrink grout:

Setting Time:	Initial	2 hours (Approx.)
ASTM C191	Final	3 hours (Approx.)
Expansion:		0.4% Maximum

Compressive Strength:

Time	Consistency		
	Plastic (PSI)	Flowable (PSI)	Fluid (PSI)
1 Day	4,000	3,000	2,500
7 Day	7,000	6,000	5,000
28 Day	10,000	8,500	7,500

PART 3 - EXECUTION

2.04 SURFACE PREPARATION

A. Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until a sound, clean concrete surface is achieved. Perform additional surface preparation in accordance with non-shrink, non-metallic grout manufacturer's instructions.

B. Lightly roughen the concrete, but not enough to interfere with the proper placement of grout.

C. Remove foreign materials from metal surfaces in contact with grout.

D. Align, level and maintain final positioning of components to be grouted.

E. Take special precautions during periods of extreme weather conditions in accordance with the manufacturer's written instructions.

F. Saturate concrete surfaces with clean water; remove excess water, leave none standing.

2.05 FORMWORK

A. Construct leakproof forms anchored and shored to withstand grout pressures, so that no movement is possible.

B. Provide clearance between the formwork and the area to be grouted to permit proper placement of grout.

C. Forms shall be provided where structural components of baseplates or bedplates will not confine the grout.

D. Pre-treat wood forms with forming oils so that they do not absorb moisture.

E. Remove supports only after grout has hardened.

2.06 MIXING

A. Portland Cement Grout:

1. Prepare grout composed of Portland cement, sand and water; do not use ferrous aggregate or staining ingredients in grout mix.

2. Use proportions of 2 parts sand and 1 part cement, measured by volume.

3. Prepare grout with sufficient water to obtain consistency to permit placing and packing.

4. Mix water and grout in two steps; pre-mix using approximately 2/3 of the water; after partial mixing, add the remaining amount of water to bring mix to the desired placement consistency and continue mixing 2-3 minutes.

5. Mix only that quantity of grout that can be placed within 30 minutes after mixing.

6. After the grout has been mixed, do not add more water for any reason.

B. Epoxy Grout & Non-Shrink Cementitious Grout: Mix and prepare epoxy grout and non-shrink cementitious grout in strict accordance with the manufacturer's instructions.

C. Mix grout components as close to the work area as possible and transport the mixture quickly and in a manner, that does not permit segregation of materials.

2.07 PLACING

A. Unless otherwise specified or indicated on the drawings, the thickness of grout under baseplates shall be 1-1/2 inches. Grout shall be placed in strict accordance with the directions of the manufacturer so that all spaces and cavities below the top of baseplates and bedplates are completely filled, without voids.

B. Place grout material quickly and continuously.

C. Do not use pneumatic-pressure or dry-packing methods (Plastic Consistency).

D. Apply grout from one side only to avoid entrapping air. The final installation shall be thoroughly compacted and free of air pockets.

E. Do not vibrate the placed grout mixture or permit it to be placed if the area is being vibrated by nearby equipment.

F. In all locations where the edge of the grout will be exposed to view, the grout shall be finished smooth after it has reached its initial set. Except where shown to be finished on a slope, the edges of grout shall be cut off flush at the baseplate, bedplate, member, or piece of equipment.

G. Do not remove leveling shims for at least 48 hours after grout has been placed.

H. Unless otherwise noted in the drawings, anchor bolts and threaded rod anchors shall be epoxy grouted in holes drilled into hardened concrete. Diameters of holes shall be as follows:

Item	Diameter of Hole
Threaded Rod Anchors	1/8 inch larger than the bar or rod outside diameter
Anchor Bolts	Per manufacturer's instructions

I. The embedment depth for epoxy grouted anchor bolts and threaded rod anchors, shall be not less than 15 bolt or rod diameters, unless otherwise indicated on the drawings. Holes shall be prepared for grouting as recommended by the grout manufacturer.

J. Anchor bolts and threaded rod anchors shall be clean, dry, and free of grease and other foreign matter at time of installation. The bolts, rods, and bars shall be set and positioned, and the epoxy grout shall be placed and finished in accordance with the recommendations of the grout manufacturer. Particular care shall be taken to ensure that all space and cavities are filled with epoxy grout, without voids.

K. During assembly of all threaded stainless-steel components, anti-seize thread lubricant shall be liberally applied to the threaded portion not embedded in concrete.

2.08 CURING

A. After grout has attained its initial set, keep damp for a minimum of 3 days.

B. Prevent rapid loss of water from the grout during the first 48 hours by the use of an approved membrane-curing compound or with the use of the wet burlap method.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 03610

CONCRETE CRACK REPAIRS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This work shall consist of repairing cracks and defective joints in the sump pit as indicated in the contract documents by pressure injection of a hydrophobic polyurethane grout.

B. The Contractor shall furnish all labor, materials, tools and equipment, and perform all operations necessary for the repair of concrete cracks. The work shall include, but shall not be limited to the operation of drilling test and grout holes and the injection grouting of a hydrophobic polyurethane grout. The Contractor shall monitor and control the injection pressure so as not to damage the existing concrete structure.

C. Crack repairs shall be classified as follows:

1. Type I: hairline cracks up to 1/8” wide.

2. Type II: cracks 1/8" wide or greater.

3. Type III: High water flow areas.

1.02 SUBMITTALS

A. The Contractor shall submit all manufacturer’s product data, technical data sheets, MSDS sheets and recommended installation procedures to the Engineer for approval prior to the ordering of any materials.

1.03 QUALITY ASSURANCE

A. The work of this section shall be performed by a firm with a minimum of three (3) years experience installing this type of materials and be authorized by the manufacturer.

PART 2 - PRODUCTS

2.01 GENERAL

A. The repair product shall be capable of pressure injection for the repair of water leaking cracks and/or cracks under hydrostatic pressure.

B. All materials shall be delivered to the site in undamaged, unopened containers bearing the manufacturer's original labels. Grouting shall be performed in accordance with manufacturers' recommendations. Grouts shall be non-flammable and non-toxic.

C. The accelerator shall be based on tertiary amines, and be able to control the reaction time from one (1) minute to thirty (30) minutes depending on the amount of accelerator and the temperature of the grout.

2.02 TYPE I REPAIRS

A. The sealing materials shall be a polyurethane grout and accelerator system marketed under the name of Hydro-Active® Flex SLV with accelerator Hydro-ActiveFlex® Cat supplied by De Neef® Construction Chemicals, Inc. or approved equal.

B. The grouting compound shall be a hydrophobic polymer of the isocyanate type which is applied to a defective joint by use of a packer or injection port. When the grout is mixed with about 0.5% to 10% of accelerator, the mixture will react when it comes in contact with moisture, will expand up to 15 times its original volume and cure to a polyurethane foam.

2.03 TYPE II REPAIRS

A. The sealing materials shall be a polyurethane grout and accelerator system marketed under the name of Hydro-Active® Flex LV with accelerator Hydro-Active® Flex Cat supplied by De Neef® Construction Chemicals, Inc. or approved equal.

B. The grouting compound shall be a hydrophobic polymer of the isocyanate type which is applied to a defective joint by use of a packer or injection port. When the grout is mixed with about 0.5% to 10% of accelerator, the mixture will react when it comes in contact with moisture, will expand up to 10 times its original volume and cure to a polyurethane foam.

2.04 TYPE III REPAIRS

A. The sealing materials shall be a polyurethane grout and accelerator system marketed under the names of Hydro-Active® Cut with accelerator Hydro-Active® Cut Cat supplied by De Neef® Construction Chemicals, Inc. or approved equal.

B. The grouting compound shall be a hydrophobic polymer of the isocyanate type which is applied to a defective joint by use of a packer or injection port. When the grout is mixed with about 0.5% to 10% of accelerator, the mixture will react when it comes in contact with moisture, will expand up to 20 times its original volume and cure to a polyurethane foam.

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall have a manufacturer's technical representative present for the duration of the injection process. Also, the details, methods of repairs and the injection procedures shall be submitted for the Engineer's review.

B. All working personnel shall be familiar with the equipment, materials and procedures to be used during the grouting operation.

C. After repairs are completed, apply protective coating in accordance with manufacturer's requirement.

3.02 TYPE I REPAIRS

A. Contractor shall prepare cracks and adjacent surfaces for repair in accordance with the grout manufacturer's recommendations. Crack repair material shall be as specified in Section 2.02.

3.03 TYPE II REPAIRS

A. Contractor shall prepare cracks and adjacent surfaces for repair in accordance with the grout manufacturer's recommendations. Crack repair material shall be as specified in Section 2.03.

3.04 TYPE III REPAIRS

A. Contractor shall prepare cracks and adjacent surfaces for repair in accordance with the grout manufacturer's recommendations. Crack repair material shall be as specified in Section 2.04.

3.05 MATERIAL

A. Storage

Immediately upon receipt at the project site, all chemical grouting materials shall be stored in a secured, dry, weather-tight structure. All chemical grout shall be furnished in containers acceptable for use in the specified work. A sufficient quantity of chemical grout and other components shall be stored at or near the project site to ensure that grouting operations will not be delayed by material shortages.

B. Mixing and Handling

Mixing and handling of the chemical grout and the accelerator, shall be in strict accordance with the recommendations of the manufacturer and all applicable safety codes and shall be performed in such a manner as to minimize hazard to personnel. It is the responsibility of the Contractor to provide appropriate protective measures to ensure that chemicals or foam produced by said chemicals are under control of the Contractor at all times. Plastic or metal mixing tanks shall be used. Tanks of concrete or wood are not permitted.

3.06 EQUIPMENT

A. All equipment, including backup equipment, shall be at the project site before grout injection has begun. All equipment shall be in proper calibration and in good working order. The equipment shall be capable of providing a continuous and uninterrupted pressure head to continually force the injection of grout into the cracks.

3.07 INJECTION PREPARATION

A. The Contractor shall remove all loose, disintegrating, delaminating and porous concrete at cracks in the concrete sump pit.

B. Drill holes adjacent to and intersecting cracks. Insert 1/2-inch diameter manufacturer's recommended packer material with 1/8-inch diameter opening into the holes. Cover cracks with quick setting cement, letting any water drain out through installed packer. In the case water does not come through the packer of a leaking crack, drill an additional hole adjacent to the crack such that water drains through the packer of the new hole. All drilled holes shall be cleaned to remove any dust or debris left by the drilling operations.

3.08 INJECTION PROCEDURES

A. Hand operated, air driven or electrical positive displacement pumps are permitted for use. Grout shall be pumped at a delivery rate of one to five gallons per minute

or as recommended by manufacturer. A clear, legible and accurate pressure gauge shall be located in the grout supply line. Pumps must be flushed with manufacturer's recommended washing agent for at least two minutes before and after all grouting operation.

B. No grout injection or surface sealing shall be done when the concrete temperature or ambient temperature is, or is expected to fall below the product manufacturer's recommended minimum temperature during the 24 hours before or following the time of grout injection.

C. Before injecting, the automatic mixing and metering pump shall be activated and a small amount (about one pint) of grout shall be mixed and pumped into a disposable container. If the equipment is not working properly, it shall be immediately repaired to full working condition or replaced with backup equipment. If the backup equipment is used, additional and fully operable equipment shall be provided.

D. The grout shall be forced into the internal voids and cracks by means of pressure to fill all internal voids completely.

E. Inject chemical grout under sufficient pressure to fill the cracks and seal the leaks. For dry cracks, prior to chemical grout injection, first inject water through the packer then inject chemical grout as specified.

F. The feed line from the mixing equipment shall be securely held and properly attached to the port. The operator shall then initiate the grout injection. Pressure of injection shall be as recommended by the manufacturer.

G. In horizontal cracks, injection shall be started at either end. Injection shall continue at the first port until grout begins to flow out of the next port. The first port shall be plugged and injection started at the second port until grout flows from the next port. This sequence shall be followed until the entire crack is repaired.

H. In vertical cracks, injection shall be started at the lowest row of holes and at the hole nearest the centerline of structure. Injection shall continue at the first port until the grout begins to flow out of the port at the next highest elevation. The first port shall be plugged and injection started at the second port until the grout flows from the next port. This sequence shall be followed until the entire crack is repaired.

I. During the course of all operations, extreme care shall be given to observe for breaking out of grout material, and when such breaking out occurs, the injection line shall be moved to some other part of the structure. Injecting may be resumed in the original location after the elapse of 24 hours.

J. If the surface seal material does not have the adequate strength and adhesion to confine the injected grout until it has cured, the Contractor shall remove the surface seal material and furnish and place a new surface seal material, all at the sole cost and expense of the Contractor.

K. The injection procedure shall be monitored to assure the grout flow does not cease before the injection grout exudes from the adjacent port. When grout flows from the adjacent port, injection shall be stopped, the feed line removed from the port, and the port sealed. The feed line shall then be attached to the next port and the procedure repeated until the last port is sealed. If the grout

flow stops before grout appears at the adjacent port, the feed line shall be moved to the adjacent port and the port just used shall be sealed.

L. When the grout supply is about to be exhausted, it shall be replenished. Grout shall be thoroughly stirred before adding it to its respective storage tank in the injection equipment. No discontinuity of grout flow through the feed lines shall be allowed. In this manner, a continuous injection operation shall result.

M. After the injection process has been completed and the epoxy allowed to fully cure, the injection ports and surface seal shall be removed from all surfaces. Ports may be cut, or knocked off, while the surface seal and any spillage shall be ground off flush with the original surface, using a hand grinder. Any damage to the concrete during the clean-up procedure shall be repaired in a manner satisfactory to the Engineer at no additional cost to the County.

3.09 SAFETY PRECAUTIONS

To prevent any over-exposure to the hazardous chemicals used for chemical grout, the following precautions shall be observed in strict compliance.

A. Each employee who works with the products of the chemical grout must wear chemical goggles, face shield, NBR gloves (Edmont or equal), foul weather gear and boots.

B. A pressurized source of water, such as a garden type sprayer, must be provided at the work site, the use of which should be restricted only for first aid in the event the chemicals should contact an employees' skin.

C. A portable eye wash unit must also be provided near the work site for immediate use in an emergency.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 04200

MASONRY

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies masonry, including concrete masonry units (CMU), face brick, mortar, grout, reinforcing steel, joint reinforcement, ties and anchors, embedded flashing, and miscellaneous masonry accessories.

1.02 SUBMITTALS

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

B. Shop Drawings:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes including, but not limited to, openings for door frames, door frame anchors, openings for windows and louvers, equipment, pipe sleeves, electrical conduit and vent piping.

2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, “Details and Detailing of Concrete Reinforcement”, and ACI 530, “Building Code Requirements for Masonry Structures.”

3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

4. Concrete and Masonry Lintels: Show sizes, details and load capacity tables for concrete and masonry lintels.

C. Samples:

1. Exposed concrete masonry units.

2. Weep holes/vents.

D. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:

1. Masonry units. Include material test reports substantiating compliance with requirements. For bricks, include size-variation data verifying that actual range of sizes falls within specified tolerances and material test report for efflorescence according to ASTM C67. For concrete masonry units, include data and calculations establishing average net-area compressive strength of units.

2. Cementitious materials. Include brand, type and name of manufacturer.

3. Preblended dry mortar mixes. Include description of type and proportions of ingredients.

4. Reinforcing bars.

5. Joint Reinforcing.

6. Anchors, ties and metal accessories.

7. Concrete and masonry lintels.

E. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1.03 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of material of a uniform quality, texture and color, through one source from a single manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Deliver preblended, dry mortar mix in moisture-resistant containers. Store in delivery containers on elevated platforms, under cover, and in a dry location.

D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

PART 2 - PRODUCTS

2.01 CONCRETE MASONRY UNITS (CMU)

A. Provide CMU in accordance with ASTM C90 for Grade N, Type I, for exterior and load-bearing walls.

B. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions, as necessary to complete the work.

C. Nominal face dimensions of CMU installed with standard mortar joints shall be 8-inches by 16-inches, 12-inches by 16-inches, or as shown on the Contract Drawings.

2.02 CONCRETE AND MASONRY LINTELS

A. General: Provide either concrete or masonry lintels, at Contractor's option, where shown and above all masonry openings of 2-feet or more, complying with requirements below.

B. Concrete Lintels: Precast units made from concrete matching concrete masonry units in color, texture, and compressive strength and with reinforcing bars indicated. Cure precast lintels by same method used for concrete masonry units.

C. Masonry Lintels: Prefabricated or built-in-place from bond beam concrete masonry units with reinforcing bars placed as indicated or required to support loads and filled with course grout. Cure prefabricated lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.03 BRICK

A. General: Provide shapes as follows:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.

2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.

3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surface that cannot be produced by sawing.

4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Face Brick: ASTM C216, Grade SW, Type FBS

1. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute per ASTM C67.

2. Effloresence: Provide brick that is rated “not effloresced” according to ASTM C67.

3. Size: Nominal face dimensions shall be 8-inches long by 4-inches wide, with three courses being 8-inches high.

4. Color and Texture: As selected by the County or Engineer.

2.04 MORTAR AND GROUT

A. Portland Cement: ASTM C150, Type I, II or III. Provide natural color or white cement.

B. Masonry Cement: ASTM C91 and C1329 and meet the following criteria:

1. Prepackaged masonry cement shall contain Portland Cement, hydrated lime, and plasticizing admixtures or hydraulic hydrated lime. Masonry cements which contain other materials, including ground limestone, ground slag, or other cementitious and non-cementitious materials, are not acceptable.

C. Hydrated Lime: ASTM C207, Type S.

D. Mortar Pigments:

1. Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes meeting the requirements of ASTM C979. Use only pigments with a record of satisfactory performance in masonry mortar.

2. Pigment shall not exceed 10% of the weight of portland cement. Carbon black shall not exceed 2% of portland cement.

3. Color shall be selected by the Owner from the manufacturer's full range of colors.

E. Aggregate: ASTM C144, clean natural colored sand. For joints less than ¼-inch, an aggregate graded with 100% passing a No. 16 sieve shall be used.

F. Coarse and fine aggregate for grout: ASTM C404.

G. Water: Clean and potable.

H. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMU, containing integral water-repellent by same manufacturer; W. R. Grace Dry-Block Mortar Admixture, or approved equal.

I. Mortar shall comply with ASTM C270, Type S.

J. Mortar and grout shall not contain calcium chloride.

K. Masonry grout shall conform to the requirements of ASTM C476 and ACI 530.1.

2.05 REINFORCEMENT

A. Steel Reinforcing Bars: ASTM A615, Grade 60. Provide bar spacers in every fourth course of masonry where cells are to be grouted.

B. Masonry Joint Reinforcement: ASTM A951, hot-dip galvanized, carbon steel, 3/16-inch diameter, ladder or truss type with single pair of side rods, with spacing of cross rods, tabs and cross ties not more than 16-inches on centers. Provide in lengths of not less than 10-feet.

2.06 TIES AND ANCHORS

A. Corrugated Metal Ties: Metal strips not less than 7/8-inch wide with corrugations having a wavelength of 0.3 to 0.5-inch and an amplitude of 0.06 to 0.10-inch made from steel sheet, galvanized after fabrication not less than 0.067-inch thick.

B. Concrete Connectors: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.108-inch thick galvanized sheet. Dovetail slots in concrete shall be furnished with filler strips fabricated from 0.034-inch galvanized steel sheet; ASTM A653, Commercial Steel, G60 zinc coating.

C. Structural Steel Anchors: Crimped ¼-inch hot-dip galvanized steel wire, ASTM A82, with ASTM A153, Class B-2 coating.

D. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by ¼-inch thick by 24-inches long, with ends turned up 2-inches, hot-dip galvanized to comply with ASTM A153.

E. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge type inserts.

F. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A307, Grade A; with ASTM A563 hex nuts and flat washers; hot-dip galvanized to comply with ASTM A153, Class C.

2.07 EMBEDDED FLASHING

A. Rubberized-Asphalt Flashing: Composite flashing consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040-inch, W. R. Grace Perm-A-Barrier Wall Flashing, or approved equal.

B. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by the flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.08 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent.

B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D226, Type I (No. 15 asphalt felt).

C. Weep/Vent Products: Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8-inch OD by 4-inches long.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Build masonry walls to full thickness shown, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Use full-size units without cutting, if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying. Install cut units with cut surfaces and, where possible, cut edges concealed. Avoid using less-than-half-size units.

D. Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

E. Install masonry straight, flush, level and plumb, complying with construction tolerances in ACI 530.1/ASCE 6/TMS 602.

F. Lay masonry units with all units bonded by lapping. Bond and interlock each course at corners.

G. As construction progresses, build in items specified and fill in solidly with masonry around built-in items. Fill space between steel frames and masonry solidly with mortar. Where built in items are to be imbedded in cores of hollow masonry units, place a layer of metal lath or wire mesh in the joint below and rod mortar or grout the core.

H. Fill cores of hollow concrete masonry units with grout 24-inches under bearing plates, beams, lintels, posts, and similar items.

I. Install mortar and grout in accordance with ACI 530.1/ASCE 6.

3.02 MORTAR BEDDING AND JOINTING

A. Lay hollow brick and CMU as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.

2. With webs fully bedded in mortar in grouted masonry, including starting course on footings.

3. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness.

3.03 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8-inch on exterior side walls, ½-inch elsewhere. Lap reinforcement a minimum of 6-inches.

1. Space reinforcement not more than 16-inches on centers.

2. Space reinforcement not more than 8-inches on centers in foundation walls.

3. Provide reinforcement not more than 8-inches above and below wall openings and extending 12-inches beyond openings, in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints.

C. Provide continuity at corners by using prefabricated L-shaped units.

3.04 ANCHORING MASONRY TO STRUCTURAL MEMBERS

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

1. Provide and open space not less than ½-inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar and other rigid materials.

2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.

3. Space anchors as indicated, but not more than 24-inches on centers vertically and 36-inches on centers horizontally.

3.05 CONTROL AND EXPANSION JOINTS

A. Install control and expansion joint materials in unit masonry as masonry work progresses.

3.06 LINTELS

A. Provide concrete or masonry lintels where shown and where openings of more than 12-inches for brick-size units and 24-inches for block size units are shown without structural steel or other supporting lintels.

B. Provide a minimum bearing of 8-inches at each jamb, unless indicated otherwise.

3.07 FLASHING, WEEP HOLES, AND VENTS

A. Prepare masonry surfaces so they are smooth and free of projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

B. At lintels and shelf angles, extend flashing a minimum of 6-inches into masonry at each end. At heads and sills, extend flashing 6-inches at ends and turn up not less than 2-inches to form end dams.

C. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing ½-inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.

D. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

E. Install weep holes in head joints of first course of masonry immediately above embedded flashing. Space weep holes 24-inches on centers, unless indicated otherwise. Space weep holes formed from plastic tubing 16-inches on centers.

3.08 PARGING

A. Parge exterior faces of below-grade masonry walls in two (2) uniform coats to a total thickness of ¾-inch. Dampen wall before applying first coat and scarify first coat to ensure full bond of subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8-inch per foot. Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24-hours and protect parging until cured.

3.09 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction to provide a neat, uniform appearance.

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

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

1. Clean CMU by removing large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

2. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.

E. Excess masonry materials are the Contractor's property. At completion of unit masonry work, remove excess masonry materials, and other waste, and legally dispose of off of the County's property.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies structural steel, including fabrication, fasteners, coatings, and assembly.

1.02 SUBMITTALS

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

B. Shop Drawings: Show fabrication of structural steel components.

1. Include details of cuts, connections, splices, camber, holes and other pertinent data.

2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.

3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts.

C. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:

1. Structural steel including chemical and physical properties.

2. Bolts, nuts, and washers including mechanical properties and chemical analysis.

D. Welding certificates.

E. Qualification Data: For fabricator.

1.03 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, “Structural Welding Code—Steel”.

B. Comply with applicable provisions of the following specifications and documents:

1. AISC’s “Code of Standard Practice for Steel Buildings and Bridges”.

2. AISC’s “Manual of Steel Construction”.

3. RCSC’s “Specification for Structural Joints Using ASTM A325 or A490 Bolts”.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.

B. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or exhibit corrosion before use.

PART 2 - PRODUCTS

2.01 STRUCTURAL STEEL MATERIALS

A. W-Shapes: ASTM A992.

B. Channels, Angles, M-Shapes: ASTM A36.

C. Plate and Bar: ASTM A36.

D. Welding Electrodes: Comply with AWS requirements.

2.02 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts and Washers: ASTM A325, Type 1, heavy hex steel structural bolts; ASTM A563 heavy hex carbon steel nuts; and ASTM F436 hardened carbon steel washers; hot-dip zinc coating per ASTM A153.

B. Anchor and Threaded Rods: ASTM A307, Grade A with ASTM A563 hex carbon steel nuts; ASTM F436 hardened carbon steel washers; with ASTM A153 hot-dip zinc coating.

2.03 FABRICATION

A. Fabricate and assemble in shop to the greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges".

B. Cut, drill or punch standard bolt holes perpendicular to metal surfaces. Do not thermally cut bolt holes or enlarge holes by burning.

2.04 SHOP CONNECTIONS

A. Shop install high-strength bolts according to RCSC's "Specifications for Structural Joints Using ASTM A325 or A490 Bolts" for type of bolt and type of joint required.

B. Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

2.05 GALVANIZING

A. Apply zinc coating by the hot-dip process to structural steel according to ASTM A123. Fill vent holes and grind smooth after galvanizing.

PART 3 - EXECUTION

3.01 PREPARATION

A. Provide temporary shores, guys, braces and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections and braces are in place.

3.02 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges".

B. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges".

D. Align and adjust various members forming part of complete frame or structure before permanent fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of the structure.

2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

3. Splice members only when shown, accepted and approved on shop drawings.

E. Remove erection bolts on welded structural steel, fill holes with plug welds, and grind smooth at exposed surfaces.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.03 FIELD CONNECTIONS

A. Shop install high-strength bolts according to RCSC's "Specifications for Structural Joints Using ASTM A325 or A490 Bolts" for type of bolt and type of joint required.

B. Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

3.04 QUALITY CONTROL

A. Engage a qualified independent testing and inspection agency to inspect field welds and high-strength bolted connections.

B. Shop-bolted connections shall be inspected according to RCSC's "Specifications for Structural Joints Using ASTM A325 or A490 Bolts".

C. Field welds shall be visually inspected according to AWS D1.1.

3.05 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.

B. Clean, prepare surfaces and paint in accordance with Section 09900.

END OF SECTION

SECTION 05500

MISCELLANEOUS METALS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope

1. Furnish labor, materials, tools, equipment, services, supervision required to complete miscellaneous metalwork including all incidental and complementary work shown, specified, or necessary to complete work as indicated.

2. No attempt is made to enumerate each item required, but to indicate parts and describe general construction and certain special items; perform work in strict conformity with the Contract Documents, approved Shop Drawings, and the Specifications; obtain field measurements of adjoining work required to locate and fit work.

B. Related work specified elsewhere

1. Section 03300 - Concrete

2. Section 03600 - Grout

3. Section 09910 - Painting

4. Section 15060 - Pipe & Pipe Fittings

1.02 QUALITY ASSURANCE

A. Standards

1. Aluminum Association (AA)

2. American Society for Testing and Materials (ASTM)

3. American Institute of Steel Construction (AISC)

4. American Welding Society (AWS)

5. OSHA Standards

6. Steel Structures Painting Council (SSPC)

B. Welder, Welding Operator and Tracker Qualifications: Each welder, welding operator and tacker shall be qualified in accordance with the applicable requirements of AWS D1.1

1.03 SUBMITTALS

Shop Drawings: Submit complete, detailed shop and erection drawings, in accordance with Section 01300, of all work for approval before starting fabrication and installation of materials. Show details of construction and placement including hardware, fittings and fastenings, anchorages, types and gauges of metals being used.

1.04 JOB CONDITIONS

A. Field paint exposed steel in addition to shop coats and mill finishes.

B. Protect aluminum and galvanized steel in contact with masonry or concrete with coating of bituminous paint, asphalt emulsion, zinc chromate primer, or equal.

1.05 PRODUCT DELIVERY, HANDLING AND STORAGE

Deliver all materials in good condition. Store in dry place, off ground; keep dry at all times. Handle materials to prevent damage to product or structure.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General: Metals free from defects impairing strength, durability and appearance; best commercial quality for purposes specified, structural properties to safely withstand strains and stresses to which subjected.

B. Steel Materials

1. Structural Steel: W-Shapes shall meet ASTM A992, Grade 50. HP-Shapes shall meet ASTM A572, Grade 50. All other shapes shall meet ASTM A36.

2. Cold Finished Steel: Mild steel, rolled, drawn, ASTM A366 and A568.

3. Steel Pipe: Galvanized, Schedule 40, ASTM A53, Grade B.

4. Steel Bolts, Nuts, Washers: ASTM A307, Grade A, general use, or Grade B, flanges; galvanized in accordance with ASTM A153.

5. High Strength Bolts: ASTM A325, galvanized (Type 3 for corrosive locations).

6. Galvanized Guard Chain: Carbon steel proof coil chain, 3/8" trade size, electric welded, minimum 1700 pound work load limit, ASTM A413; hot dipped galvanized in accordance with ASTM A153.

7. Anchor Bolts: Stainless steel, ASTM F593.

8. Galvanized steel: Steel as listed above, galvanizing per ASTM A123, A153, A385 as applicable.

C. Stainless Steel Materials

1. Stainless and heat resisting steel bars and shapes: ASTM A276, Class A, Type 304.

2. Stainless and heat resisting steel plate, sheet, strip: ASTM F593.

3. Bolts shall be ASTM A 193, Grade B8, Type 2. Nuts and thru-bolts shall be ASTM A 194, Grade 8. Washers shall be ASTM 290, Type 304.

D. Gratings

1. Metal bar grating manual for steel and aluminum gratings: ANSI/NAAMM MGB532.

2. Grating, metal, bar type: Federal Specification RR-G-661C.

3. Grating, metal, other than bar type: Federal Specification RR-G-1602.

E. Aluminum-Alloy Materials

1. Uniform quality, free from injurious defects, and meet properties and standards of the Aluminum Association (AA).

a. Aluminum and Aluminum-Alloy Sheet and Plate: ASTM B209, Alloy 6061.

b. Aluminum and Aluminum-Alloy Extruded Bars, Rods, Shapes and Tubes: ASTM B221, Alloy 6061.

c. Aluminum-Alloy Extruded Structural Pipe and Tube: ASTM B429, Alloy 6061.

d. Aluminum-Alloy Sand Castings: ASTM B26, Alloy 356.0.

e. Aluminum-Alloy Bolts, Nuts and Screws: Ally 6061 produced from material conforming to ASTM B211.

f. Aluminum-Alloy Washers: ASTM B209, Alloy Alclad 2024.

F. Stainless Steel Guard Chain: Type 316 Stainless Steel proof coil chain, 1/4" trade size, electric welded, min. 1700 lb. work load limit. Bolt and snap hook.

2.02 STEEL SHOP PRIMER

A. Preparation: SSPC SP-2 and SP-1.

B. Acceptable Primers: Comply with F.S. TT-P-86, Type I or II, TT-P-636C; or SSPC Painting System Guide No. 7.00.

C. Application: Apply with spray only for metal fabrications exposed to public view. Apply primer free of runs and other irregularities that may require modification to achieve the specified finish appearance. Provide a minimum dry film thickness of 2 mils per coat.

2.03 FABRICATION

A. General

1. Form and finish metalwork to shape and size with sharp angles and lines.

2. Metalwork that becomes bent by shearing or punching may be straightened and used if approved by the Engineer.

3. Grind exposed edges of work smooth; construct joints exposed to weather to exclude water.

B. Hardware

1. Countersink metalwork to receive the required hardware and to provide the proper bevels and clearances.

2. Provide welded back-up plates for mounting hardware; drill or punch holes for bolts and screws; conceal fastenings wherever practicable.

3. Provide brackets, lugs, and similar accessories required for installation as part of the metal item.

C. Shop and Field Welding

1. In accordance with recommendations of American Welding Society (AWS) Standard D1.1.

2. Welds solid and homogeneously a part of metals joined for full area indicated or necessary to develop required strength of joint.

3. Welds free from pits or incorporated slag or scale; surfaces of welds smooth and regular.

D. Workmanship Class 1

1. Exposed Surfaces: Sandblast surfaces smooth with pits, mill marks, nicks and scratches filled or ground off. Defects shall not show when painted.

2. Welds: Conceal welds where possible. Where exposed, grind welds to small radius with uniform sized cove. When painted, welds shall be undetectable.

3. Bolts: Use only flat head countersunk bolts in exposed locations.

4. Straightness: Distortions visible to the eye will be rejected.

5. Joints: Fit joints to hairline finish.

E. Workmanship Class 2

1. Exposed Surfaces: Moderate irregularities not visible at 30' may remain. Mill marks may remain.

2. Welds: Grind welds to small radius with uniform sized cove.

3. Bolts: Use only flat or oval head countersunk bolts where exposed to view.

4. Straightness: Minor distortions will be permitted.

5. Joints: Provide maximum gap of 1/16".

F. Workmanship Class 3

1. Exposed Surfaces: No improvement from mill finish required except preparation for galvanizing or priming.

2. Welds: Grinding not required.

3. Bolts: Exposed bolts permitted.

2.04 GRATINGS

NOT USED

2.05 HANDRAILINGS

NOT USED

2.06 METAL STAIRS

NOT USED

2.07 TOE BOARDS

NOT USED

2.08 VERTICAL LADDERS

NOT USED

2.09 ACCESS HATCHES

A. Access hatch shall be manufactured by Halliday or approved equal and must meet the dimensional requirements and specifications as called out on the project plans.

B. Door panels shall be ¼" aluminum diamond plate, reinforced to withstand a live load of 300 lbs. psf.

C. Uniform live load with maximum allowable deflection of 1/150 of the span.

D. Doors shall open 90° and automatically lock with T-316 stainless steel hold open arms with aluminum release handles. Doors shall close flush with frame and have a 316 stainless steel slam lock with removable key and non-corrosive locking bar used in conjunction with an owner supplied padlock.

E. Hinges and all fastening hardware shall be T-316 stainless steel.

F. Units shall carry a lifetime guarantee against defects in material and/or workmanship.

G. Finish: Standard mill finish.

H. Shop coat portions of the frame which may contact or be embedded in concrete with a heavy coat of bituminous paint.

I. Rectangular Hatches

1. Aluminum, flush, channel frame type; single or double leaf as indicated on the drawings.

2. Cover shall be equipped with stainless steel spring assist.

3. Unit shall have a neoprene cushion/gasket unless indicated otherwise on the project drawings.

4. Provide 1/4" extruded aluminum channel frame with anchoring flange, alloy 6063-T6. 1-1/2" channel drain.

J. Circular Hatches

1. Hatch shall be bolt down cover and constructed of ¼" thick aluminum diamond plate.

2.10 PIPE BOLLARDS

A. Provide Schedule 40 aluminum pipe of size and height indicated as detailed on the drawings.

B. Permanent Setting: Anchor posts to concrete floor using appropriate concrete expansion (wedge) anchors. Fill posts completely with concrete and dome on top.

C. Finish: Standard mill finish.

2.11 VAULT VENTILATORS

NOT USED

2.12 MISCELLANEOUS STEEL FABRICATIONS

A. Lintels

1. Provide steel lintels for masonry openings 18" or wider.

2. Provide shop primed angles for lintels unless otherwise indicated.

3. For brick veneer with steel stud back-up, galvanized or stainless steel lintel and shelf angles.

B. Sill Angle

1. Provide 2" x 1-1/4" x 1/4" galvanized steel angle from jamb to jamb at the sill of overhead doors.

2. Provide 1/4" thick strap anchors, 24" on center.

C. Door Guards

1. Provide 2" x 2" x 1/4" galvanized steel angle guards on exterior jambs, where shown on the drawings.

2. Anchor door guard 12" on center with cinch type anchors.

D. Channel Door Frames

1. Provide channel door frames where shown on drawings.

2. Anchor to masonry with strap anchors 24" on center.

E. Steel angle Nosing and Floor Plates

1. Provide steel angle nosings or frames around equipment pits, sumps and trenches unless otherwise indicated on the Drawings.

2. Provide angle sizes indicated with 1/4" anchor rods 24" on center maximum.

3. Steel or aluminum floor plates where required shall be checkered, 4-way safety plate, medium pattern.

2.13 ANCHOR BOLTS

A. Unless otherwise noted on the drawings, furnish stainless steel anchor bolts and associated fasteners for interior and exterior applications. Anchor bolt sizing to be as shown on drawings. anchor bolt sizes not shown on drawings shall be as recommended by manufacturer of equipment being anchored. Minimum anchor bolt length 3" with minimum 6" embedment. Provide a minimum of ½" bolt projection beyond anchor bolt nut. Furnish flat washer with each anchor bolt. Unless otherwise indicated, all anchor bolts to be embedded type. Set prior to concrete placement.

B. Expansion type anchor bolts may be utilized where indicated on the drawings. Expansion bolts shall be stainless steel and meet the requirements of 2.15(A) except bolts shall have a 4" minimum embedment and conform to Federal Specification FF-S-325, Group II, Type 4, Class I for concrete expansion anchors.

2.14 ALUMINUM PLATE

Shall be aluminum checkered plate with diamond pattern, 6061-T6.

2.15 PLATFORM STRUCTURES

These structures shall be fabricated with hot dipped galvanized steel. NO field applied galvanizing will be allowed. No field cuts or holes will be tolerated.

PART 3 - EXECUTION

3.01 PREPARATION

A. Clean dirt, debris, oil, grease and other foreign substances from surfaces to receive metal items.

B. Where aluminum components contact concrete or lime mortar, paint surfaces with alkaline-resistant coatings such as heavy-bodied bituminous paint.

C. Dissimilar Materials: Isolate dissimilar materials to prevent electrolytic actions by neoprene gaskets, asphaltum paint or other materials.

3.02 WORKMANSHIP

A. General: Refer to the drawings for items required. Items require the following workmanship classes and finishes:

1. Concealed Items: Class 3.

2. Exposed Items in Utility Areas: Class 2.

3. Exposed Items in Finished Areas: Class 1.

4. Steel Items Subject to Contact with Moisture: Galvanized finish.

5. Steel Items Not Subject to Contact with Moisture: Primed finish.

B. Details and connections shall be carefully made and fitted, with special care exercised to produce a thoroughly neat appearance; make pieces in accordance with detail shop drawings; members shall be true to length so assembling may be done without fillers, except where required by details; allow no projecting edges or corners where different members are assembled; do mitering and blocking precisely.

C. Set build-up parts true to line and without sharp bends, twists or kinks.

D. Provide caulking as required to set, seal and secure metal items; refer to Section 13121 - Building Construction/Operations Building.

3.03 BURNING AND WELDING

A. Burning: Burning of holes in field shall not be permitted without written approval by the Engineer; if approval is given, burned members shall be finished to an appearance equal to sheared finish; burning shapes to length with standard flame-cutting machine will be permitted.

B. Perform both shop and field welding in accordance with recommendations of American Welding Society. Welds shall be solid and homogeneously a part of metals joined, free from pits or incorporated slag or scale; surfaces of welds shall be smooth and regular, of full area indicated or necessary to develop required strength of joint.

3.04 INSTALLATION

A. Erect work to lines and levels, plumb and true, in correct relation to adjoining work; secure parts in rigid, durable manner. Provide concealed connections wherever possible.

B. Provide anchors and inserts in sufficient number for proper fastening of metal items; embed anchors in concrete so as to accurately align metalwork at proper level.

C. Built-in Anchors: Provide strap iron anchors welded to steel or iron frames or miscellaneous member for attaching to concrete or masonry.

1. Minimum Anchor Size: 1-1/2" wide by length required to embed 2" into substrate.

2. Minimum Anchor Thickness

a. Concrete Substrates: 1/4"

b. Masonry Substrates: 1/8".

3. Maximum Anchor Spacing

a. Concrete Substrates: 32" on center, unless noted otherwise.

b. Masonry Substrates: 32" on center; match joint locations.

D. Anchors Not Built-in: Provide cinch type anchors with machine bolts or screws, where built-in anchors cannot be used.

E. Where necessary to secure miscellaneous metalwork to structure by means of expansion bolts, cinch anchors and similar connections, do work of layout, installing such connections, installing miscellaneous work, and bolting up.

F. Throughout work, provide anchors, inserts wherever possible for building adjoining work; where lugs are shown or specified for building into adjoining masonry, erect parts having lugs before masonry is built; elsewhere, bring work to building in as large pieces as practicable, attach to anchors or inserts during erection.

G. Connections made to sleeve inserts, except where noted removable, install members into sleeves, wedged tight with metal wedges; pour surrounding space full of grout; finish flush with adjoining surface.

3.05 RAILING AND WALL BRACKETS

NOT USED

3.06 ALUMINUM STAIRS

NOT USED

3.07 CONNECTIONS

A. Unless otherwise specified, all shop connections shall be welded or bolted; framing connections made in field shall be made with high strength stainless steel bolts; other connections may be made by any of the above methods (using stainless steel) or with standard strength stainless steel bolts.

B. All connections shall develop strength required for members involved; in no case less than AISC standard.

C. Provide lugs, clips, connections, rivets, bolts, necessary for complete fabrication, erection; bolts remaining in finished, exposed work shall be hexagon head bolts with hexagon nuts; bolts shall be of proper length to permit full thread in nut, but not project more than 1/4" beyond face of nut. Rivets, both shop and field, power driven; shall provide 100 lbs. per sq. in. at hammer minimum.

D. High Strength Stainless Steel Bolts: Furnish and install in accordance with Research Council or “Riveted and Bolted Structural Joints Using High Tensile Stainless Steel Bolts”, latest edition.

3.08 FIELD PAINTING

A. Where shop coat is abraded or burned by welding, clean and touch-up.

B. Repair surfaces of zinc coating that have been damaged during delivery, storage or installation by thoroughly wire brushing the damaged areas and removing all loose and cracked zinc coating, then paint the cleaned areas with 2 coats of zinc-dust, zinc-oxide primer; touch-up zinc-dust coated surfaces with the same material as the coating.

C. Field paint in accordance with the requirements of Section 09910.

3.09 CLEAN UP

All work shall be left in clean condition, and all debris and rubbish cleaned up and removed from site by Contractor.

END OF SECTION

SECTION 06100

ROUGH CARPENTRY

PART 1 - GENERAL

1.01 DESCRIPTION

Installation of all wood framing indicated on the Drawings is required for a complete and operable facility.

1.02 QUALITY ASSURANCE

A. Provide sufficient skilled workmen and supervisors who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of the construction involved and the materials and techniques specified.

B. In the acceptance or rejection of rough carpentry, no allowance will be made for lack of skill on the part of workmen.

1.03 PRODUCT HANDLING

A. Store all materials in such a manner as to ensure proper ventilation and drainage and to protect against damage and the weather.

Keep all material clearly identified with all grade marks legible; Keep all damaged material clearly identified as damaged, and separately store to prevent its inadvertent use.

Do not allow installation of damaged or otherwise non-complying material.

Use all means necessary to protect the installed work and materials of all other trades.

B. In the event of damage, immediately make all repairs and replacement necessary to the approval of the Engineer and at no additional cost to the Owner.

PART 2 - PRODUCTS

(No products are required in this Section)

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence. Verify that rough carpentry may be performed in strict accordance with the original design and all pertinent codes and regulations.

B. In the event of discrepancy, immediately notify the Engineer. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 WORKMANSHIP

A. All rough carpentry shall produce joints true, tight, and well nailed with all members assembled in accordance with the Drawings and with all pertinent codes and regulations.

B. Carefully select all members; select individual pieces so that knots are obvious; defects will not interfere with placing bolts or proper nailing or making proper connections.

Cut out and discard all defects which will render a piece unable to serve its intended function; lumber may be rejected by the Engineer, whether or not it has been installed, for excessive warp, twist, bow, crook, mildew, fungus, or mold, as well as for improper cutting and fitting.

C. Do not shim sills, joists, short studs, trimmers, headers, lintels, or other framing components.

3.03 GENERAL FRAMING

A. In addition to all framing operations normal to the fabrication and erection indicated on the Drawings, install all backing required for the work of other trades.

Set all horizontal or sloped members with crown up.

Do not notch, bore, or cut members for pipes, ducts, conduits, or other reasons except as shown on the Drawings or as specifically approved in advance by the Engineer.

B. Make all bearings full unless otherwise indicated on the Drawings.

3.04 STUD WALL AND PARTITIONS

A. Make all studs single length, unspliced, and platform framed

B. Unless otherwise indicated on the Drawings, frame all corners and intersections with three or more studs and all required bearing for wall finish. Top plate shall overlap intersecting walls on partitions.

3.05 FRAMING

On all framing members to receive a finished wall or ceiling, align the finish subsurface to vary not more than 1/8 inch from the plane of surfaces of adjacent framing and furring members.

3.06 INSTALLATION OF PLYWOOD SHEATHING

Install panels per APA recommendations and continuously over at least three supports, except where otherwise specifically shown on the Drawings. Spacer type clips will be centered between roof trusses for roof sheathing. Center joints accurately over supports; unless otherwise specifically shown on the Drawings, stagger the end joints of plywood panels to achieve a minimum of continuity of joints.

3.07 FASTENING

A. Use only common wire nails or spikes of the dimension shown on the Nailing Schedule, except where otherwise specifically noted in the Drawings

For conditions not covered in the Nailing Schedule provide penetration into the piece receiving the point of not less than ½ the length of the nail or spike provided, however, that 16d nails may be used to connect two pieces of two inch nominal thickness.

B. Drill holes 1/16 inch larger in diameter than the bolts being used; drill straight and true from one side only. Bolt threads must not bear on wood; use washers under all nails.

C. For lag-screws and wood-screws, pre-bore holes same diameter as root of thread; enlarge holes to shank diameter for length of shank. Screw, do not drive, all lag screws and wood screws.

3.08 NAILS SCHEDULE

Unless otherwise indicated on the Drawings or required by pertinent codes and regulations, provide at least the following nailing:

- Blocking to joist bearing: 2-10d toe nailed each side
- Block to joist or stud: 2-10d toe nailed each side
- One inch brace to stud: 2-8d face nailed
- Two inch brace to stud: 2-16d face nailed
- Bridging to joist: 2-8d toe nailed
- Built-up beams eight inches or less in depth: 16d twelve inches on centers
- Joists and rafters to support: 2-10d toe nailed each side
- At laps (twelve inches minimum) 4-16d face nailed
- Multiple joists: 16d twelve inches on centers staggered
- Joists to still or girder: 2-16d toe nailed
- One inch furring to under-side of joists: 2-8d (one straight; one slant)
- Two inch furring to under-side of joists: 2-16d
- (one straight; one slant)
- Studs toe nailed to plate: 2-10d each side
- Studs end nailed to plate: 2-20d
- Studs nailed together: 16d twelve inches on centers, staggered

- Plates, upper to lower: 16d twelve inches on centers, staggered
- At splices: 2-16d face nailed
- Plate lap at corners: 2-16d face nailed
- Bottom interior plates anchored with power driven nails 24" O.C.

3.08 WORK SITE

Keep the premises in a neat, safe, and orderly condition at all times during execution of this portion of the work, free from accumulation of sawdust, cut-ends, and debris. As necessary thoroughly sweep all surfaces where refuse from this portion of the work has settled.

END OF SECTION

SECTION 06200

FINISH CARPENTRY

PART 1 - GENERAL

1.01 DESCRIPTION

Installation of all wood trim and other items not specifically described as being installed under other Sections of these Specifications.

1.02 QUALITY ASSURANCE

For actual cutting and fitting of trim and finish material, use only journeymen finish carpenters who are thoroughly trained and experienced in the skills required, who are completely familiar with the material involved and the manufacturers' recommended methods of installation, and who are thoroughly familiar with the requirements of this work. In the acceptance or rejection of finish carpentry no allowances will be made for lack of skill on the part of the workmen.

1.03 PRODUCT HANDLING

A. Use all means necessary to protect the materials of this Section before, during, and after installation and to protect the installed work and materials of all other trades.

B. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer and at no cost to the Owner.

PART 2 - PRODUCTS

2.01 TRIM AND BASE

Trim and base used should be standard size and shape for the intended purpose as set forth in the Engineer's Standards unless otherwise specified.

PART 3 - EXECUTION

3.01 SURFACE HANDLING

A. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

Verify that finish carpentry may be completed in strict accordance with the original design and all pertinent codes and regulations.

B. In the event of discrepancy, immediately notify the Engineer. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 WORKMANSHIP

A. All finish carpentry shall produce joints true, tight, and well nailed with all members assembled in accordance with the Drawings.

B. Make all joints to conceal shrinkage; miter all exterior corners; cope all interior corners, miter or scarf all end-to-end joints. Install all trim in pieces as long as possible, jointing only where solid support is obtained.

C. Install all items straight, true, level, plumb, and firm anchored in place where blocking or backing is required; coordinate as necessary with other trades to ensure placement of all required backing and blocking in a timely manner. Nail trim with finish nails of proper dimension to hold the member firmly in place without splitting the wood. On exposed finish work, set all nails for putty. Screw, do not drive, all wood screws may be started by driving and then screwing home.

3.03 CLEANUP

Keep the premises in a neat, safe, and orderly condition at all times during execution of this portion of the work, free from accumulation of sawdust, cut-ends, and debris. As necessary, thoroughly sweep all surfaces where refuse from this portion of the work has settled.

END OF SECTION

SECTION 06500

FIBERGLASS PRODUCTS

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall design, fabricate, furnish, and install all fiberglass reinforced plastic (FRP) products, including grating, stair treads, structural shapes, guardrail, handrail, ladders, stair systems and all appurtenances, accessories and incidentals necessary to produce a complete, operable and serviceable installation as shown on the Contract Drawings and as specified herein.

1.02 REFERENCES

A. American Society for Testing and Materials Test Methods:

1. ASTM D638 Tensile Properties of Plastics

2. ASTM D790 Flexural Properties of Unreinforced and Reinforced Plastics

3. ASTM D2344 Apparent Interlaminar Shear Strength of Parallel Fiber Composites by Short Beam Method

4. ASTM D696 Coefficient of Linear Thermal Expansion for Plastics

5. ASTM D635 Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

6. ASTM E84 Surface Burning Characteristics of Building Materials

1.03 SUBMITTALS

A. All products furnished shall include structural design data and calculations, structural properties data, grating load/deflection tables, corrosion resistance tables, certificates of compliance, test reports, as applicable; and concrete anchor systems and their allowable load tables.

B. Shop Drawings: Show fabrication and installation details, including plans, elevations, sections, and details of FRP fabrications and their connections. Show material sizes, types, styles, part or catalog numbers, complete details for fabrication and erection of components including, but not limited to, location, lengths, type and sizes of fasteners, clip angles, member sizes, and connection details. Show anchorage and accessory items. Provide templates for anchors and bolts.

C. All FRP products, anchor systems, fasteners, and accessory items shall comply with manufacturers published product data. All structural analysis data and design calculations for installed products shall meet or exceed the performance requirements specified herein, and must be signed and sealed by a Professional Engineer licensed in the State of Maryland, who shall be responsible for their preparation.

1.04 PERFORMANCE REQUIREMENTS

A. FRP products shall be capable of withstanding the following applied loads and stresses within the limits, and under the conditions, indicated:

1. Grating:

a.	Uniform Load:	200 psf
b.	Concentrated Point Load:	1,000 lbs
c.	Maximum Deflection:	L/120 or 0.375-inch, (whichever is less)

2. Stair Tread: **(NOT USED)**

a. Stair treads shall meet manufacturer's published recommended loading, and shall be capable of supporting a concentrated point load of 500 lbs, placed at the centerline of a 36-inch tread span with a maximum deflection not to exceed 0.32-inch.

3. Structural Shapes:

a.	Allowable Bending Stress:	10,000 psi (FS = 3)
b.	Allowable Shear Stress:	1,500 psi (FS = 3)
c.	Allowable Bearing Stress:	10,000 psi (FS = 3)
d.	Maximum Deflection:	L/180
e.	Flange Width-to-Flange Thickness Ratio:	$b/t \leq 12$

4. Guardrail:

a. The completed guardrail system shall be designed to meet the loading requirements set forth in OSHA 1910.29. The guardrail shall also be capable of supporting a concentrated load of 200 lbs or a uniform load of 50 lb/lf, whichever is greater, applied in any direction at the top of the rail, while maintaining a minimum safety factor of 2.0. Similarly, mid rails and intermediate vertical members shall be capable of supporting a concentrated load of 150 lbs applied in any direction at any point along the member, while maintaining a minimum safety factor of 2.0.

b. FRP gates for access through guardrail shall be constructed to match adjacent guardrail, with each gate mounted to the adjacent guardrail with 316 stainless steel hinges and a 316 stainless gravity latch and plate. Surface mount hinges and latch assembly shall be Models 15095A44 and 1771A12 as be McMaster-CARR or approved equal.

5. Stair Rail:

NOT USED

6. Handrail:

a. Handrail shall be designed to meet the loading requirements set forth in OSHA 1910.29. Handrails shall be not less than 30 inches and not more than 38 inches as measured from the leading edge of the stair tread to the top surface of the handrail.

7. Ladder:

a. The completed ladder and cage system installation shall meet the load requirements set forth in OSHA 1910.23, 1910.28, and 1910.29. The ladder shall also be capable of supporting a concentrated vertical load of 1,200 pounds applied at the mid-span of the rung. Manufacturer shall be required to provide supporting test data for rung capacity.

8. Stair Systems:

NOT USED

1.05 PRODUCT DELIVERY AND STORAGE

A. Manufactured materials shall be delivered in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturer. Adhesives, resins and their catalysts and hardeners shall be crated or boxed separately and noted as such to facilitate their movement to a dry indoor storage facility.

B. All materials shall be carefully handled to prevent them from abrasion, cracking, chipping, twisting, other deformations, and other types of damage. Adhesives, resins and their catalysts are to be stored in dry indoor storage facilities between 70 and 85 degrees Fahrenheit until they are required.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Subject to compliance with requirements, FRP products shall be manufactured by Fibergrate Composite Structures, Inc., GEF, Inc. or approved equal.

2.02 GENERAL

A. All FRP items furnished under this section shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as shown and specified in the Contract Documents.

B. Fiberglass reinforcement shall be continuous roving in sufficient quantities as needed by the application and/or physical properties required.

C. Unless specified otherwise, all resin shall be polyester with chemical formulations, as necessary, to provide the corrosion resistance, strength and other physical properties required.

D. All finished surfaces of FRP products shall be smooth, resin-rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.

E. All molded FRP products shall have no dry glass fibers visible after molding on any surface of bearing bars or cross bars. All bars shall be smooth and uniform with no evidence of fiber orientation irregularities, interlaminar voids, porosity, resin rich or resin starved areas.

F. The manufacturer shall certify that the stiffness of all molded FRP panels manufactured is never more than 2.5% below the published load-deflection values.

G. All FRP products shall have a tested flame spread rating of 25 or less per ASTM E84 Tunnel Test. Fire retardant gratings shall also have a tested burn time of less than 30 seconds and an extent of burn rate of less than or equal to 10 millimeters per ASTM D635.

H. All FRP products shall be integrally pigmented yellow. All wall, floor pedestals and floor mounting brackets shall be gray.

I. All mechanical clips, fasteners and hardware shall be Type 316 stainless steel. Rivets shall be 18-8 stainless steel.

2.03 FRP PRODUCTS

A. Molded Grating

1. Grating shall be of one piece molded construction with tops and bottoms of bearing bars and cross bars in the same plane. Grating shall have a square mesh pattern providing bidirectional strength. Grating shall be reinforced with continuous rovings of equal number of layers in each direction. The top layer of reinforcement shall be no more than 1/8-inch below the top surface of the grating so as to provide maximum stiffness and prevent resin chipping of unreinforced surfaces. Percentage of glass shall not exceed 35% by weight so as to achieve maximum corrosion resistance, and as required to maintain the structural requirements of the contract.

2. Grating shall be manufactured with a concave, meniscus profile on the top of each bar.

3. Grating bar intersections are to be filleted to a minimum radius of 1/16” to eliminate local stress concentrations and the possibility of resin cracking at these locations.

4. The resin system used in the manufacture of the grating shall be Corvex. Manufacturer shall be required to submit corrosion data from tests performed on actual grating products in standard chemical environments.

5. Depth of grating shall be 2-inches minimum with a tolerance of plus or minus 1/16".

6. Mesh Configuration shall be 2-inch by 2-inch maximum with a tolerance of plus or minus 1/16" mesh centerline to centerline.

7. Grating spans shall be determined based on manufacturer's published load/deflection tables, not to exceed the allowable deflection at the design loads.

8. Grating may be cantilevered, as required, to a maximum of 6-inches, or as permitted by the manufacturer's design. Cantilevered grating must be fastened to a minimum of two supports, with adequate fasteners to prevent overturning or failure of the grating.

9. Abutting edges of molded grating panels shall be supported by structural members or fastened together to prevent differential deflection. Spacing of fasteners shall be a maximum of 24 inches, or as recommended by the manufacturer.

10. In locations where grating is shown without guardrails, the Contractor shall provide an FRP kick plate. Kick plate shall be 1/4-inch deep x 4-inches wide, and fastened to the grating in accordance with the manufacturer's recommendations.

11. Hold-down clips shall be provided and spaced at a maximum of four feet apart with a minimum of four per piece of grating, or as recommended by the manufacturer.

B. Stair Treads

NOT USED

C. Structural Shapes

1. All structural shapes are to be manufactured by the pultrusion process with a glass content minimum of 45%, maximum of 70% by weight. The structural shapes shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as shown and specified in the Contract Documents.

2. Fiberglass reinforcement shall be a combination of continuous roving, continuous strand mat, bi-directional roving mat and surfacing veil in sufficient quantities as needed by the application and/or for the physical properties required.

3. Resins shall be fire retardant isophthalic polyester with chemical formulation necessary to provide the corrosion resistance, strength and other physical properties required.

4. All pultruded structural shapes shall be further protected from ultraviolet (UV) attack with:

   a. An integral UV inhibitor in the resin.

b. A synthetic surfacing veil to produce a resin rich surface.

c. An appropriate UV resistant coating for outdoor exposures.

5. Pultruded structural shapes are to have the minimum longitudinal mechanical properties listed below:

6.

Property	ASTM Method	Value	Units
Tensile Strength	D638	30,000	psi
Tensile Modulus	D638	2.5×10^6	psi
Flexural Strength	D790	30,000	psi
Flexural Modulus	D790	1.8×10^6	psi
Flexural Modulus (Full Section)	N/A	2.8×10^6	psi
Short Beam Shear (Transverse)	D2344	4,500	psi
Shear Modulus (Transverse)	N/A	4.5×10^5	psi
Coefficient of Thermal Expansion	D696	4.4×10^{-6}	in/in/°F
Flame Spread	E84	25 or less	N/A

D. Guardrail

1. All posts and rails are to be FRP structural shapes manufactured by the pultrusion process. Pultruded structural shapes shall meet the requirements specified herein.

2. The height of the top rail is to be 42 inches above the walking surface, with the midrail at a height midway between the top edge of the guardrail system and the walking surface. Intermediate vertical members shall be installed so that openings are not more than 19 inches wide. Top and bottom rails are to be 1¾-inch by 1/8-inch wall square tube; the posts are to be 2 1/8-inch by 3/16-inch wall square tube.

3. FRP toe plates shall be installed on all guardrails. Toe plates shall be 1/2-inch deep x 4-inches wide with two reinforcing ribs.

4. Post spacing shall not exceed 6 feet, with a minimum of two posts per section.

5. Interior and exterior corners shall be provided with two posts placed 12 inches off of the corner, on both sides.

E. Stair Rail

NOT USED

F. Handrail

1. All posts and rails are to be FRP structural shapes manufactured by the pultrusion process. Pultruded structural shapes shall meet the requirements specified herein.

2. Handrail shall be 1½-inch by ¼-inch round tube. Spacing of posts for handrail supports shall not exceed 3'-6". The minimum clearance from between the handrails and any other object is 2.25 inches.

3. Inline splices for handrail shall be FRP solid round rods measuring 5 inches in length and 1-inch in diameter.

G. Ladder

1. All ladder side rails, rungs, ladder mounting brackets and cage straps are to be FRP structural shapes manufactured by the pultrusion process. Pultruded structural shapes shall meet the requirements specified herein. Cage hoops and brackets shall be produced by the open molded hand lay-up method.

2. The ladder side rail shall be 1¾-inch square tube with a wall thickness of 1/4-inch or greater. The rungs shall be 1¼-inch diameter pultruded structural shapes, continuously fluted to provide a non-slip surface. Ladder wall and floor mounts shall be fabricated from pultruded angles, 3/8-inch minimum thickness.

3. All rungs shall be both mechanically attached to the ladder with stainless steel rivets and chemically bonded with epoxy.

4. Ladders shall be provided with both wall and floor mounts. Wall mount brackets shall be spaced at intervals not to exceed 6 feet.

5. Ladders with a length of more than 24 feet shall be provided with a ladder safety system. Ladder safety systems shall be type 316 stainless steel rails, clamps, extensions, dismounts, shuttle, harness and accessories to provide a fully functional system. Ladder safety system shall be Miller Saf-T-Climb® as manufactured by Honeywell, or approved equal. Ladders extending between floors and/or rest platforms that are vertically separated by more than 20 feet shall include cages. Cages shall start at a minimum of 7 feet and a maximum of 8 feet above the walking surface. They shall extend 42 inches above the top of the landing, and to the top of the ladder except where a cage cannot extend 42 inches above the ladder as a result of the ladder being installed under a floor slab with access hatch.

6. The ladder cage vertical bars shall be 1½-inch wide by 5/8-inch pultruded I-beam shapes to offer protection to workers from exposed hardware. Cage hoops and cage brackets shall be manufactured by the open mold hand lay-up process. All cage hoops shall be 3-inch wide by 1/4-inch thick minimum.

7. Type 316 stainless steel fasteners shall be provided for attaching ladder cage vertical bars to hoops, ladder hoops to brackets, ladder cage brackets to the ladder, wall brackets to the ladder, and the wall brackets to the wall.

H. Grating Pedestal Support System

1. Pedestals shall be adjustable. Pedestal shall consist of molded bases and tops, with pedestals joining the bases and tops and 316 stainless steel threaded rods for adjustability.

2. Bases and tops shall be injection molded, glass reinforced, thermoplastic polyester for maximum corrosion resistance. Tops shall be provided in a single head configuration for use in the interior of the grating panels and in a quad head configuration for use at the corners and edges of the grating panels. Pedestal tops are to be manufactured such that there is free drainage of fluids.

3. Pedestals shall be 2-1/8-inch square tube with a wall thickness of 3/16-inch or greater, and shall be manufactured by the pultrusion process. Adjustability shall be achieved with a 316 stainless steel all-thread component that threads into the molded fittings.

4. Where required, stainless steel clips for holding single head pedestals to the underside of the grating are to be provided. Clips are to be constructed of 316 stainless steel and configured to allow height adjustment of the pedestal from the walking surface of the grating.

5. Perimeter embedded support angles shall be 3-inch by 3-inch by ¼-inch minimum. This ledge angle is to be anchored at a maximum of 24 inches on center with 3/8-inch diameter 316 stainless steel Hilti Kwik Bolt 3 anchors, or approved equal.

2.04 STAIR SYSTEMS

NOT USED

PART 3 - EXECUTION

3.01 FRP FABRICATION

A. General

1. All shop fabricated cuts, machined edges, holes, and notches shall be sealed with vinyl ester resin to provide maximum corrosion resistance. All field fabricated cuts shall be coated similarly by the Contractor in accordance with the manufacturer's instructions.

B. Molded Grating

1. Grating shall meet the dimensional requirements and tolerances as shown and specified. The Contractor shall provide and verify measurements in field for work fabricated to fit field conditions as required by grating manufacturer to complete the work. Contractor shall determine correct size and locations of required holes or cutouts from

field dimensions before fabrication.

2. Each grating section shall be readily removable, except where indicated on drawings. Manufacturer to provide openings and holes where located on the contract drawings. Grating openings which fit around protrusions (pipes, cables, machinery, etc.) shall be discontinuous at approximately the centerline of opening so each section of grating is readily removable.

C. Stair Tread Fabrication

NOT USED

D. Structural Shape Fabrication

1. Structural Shapes supplied shall meet the intended application as shown on the contract drawings and specified herein. The Contractor shall provide and verify measurements in field for work fabricated to fit field conditions as required by manufacturer to complete the work. Determine correct size and locations of required holes or coping from field dimensions before structural shape fabrication.

2. Hardware: Type 316 stainless steel bolts and anchors shall be provided.

E. Guardrail

1. Guardrail post/rail connection is to be fabricated such that the rails are unbroken and continuous through the post without the use of packs or splices. The bottom rail shall be installed through the post at a prepared hole made to fit the outside dimensions of the rail. The top rail shall fit into a machined, u-shaped pocket formed into top of the post such that the rail is located at the center of the post. All exposed post corners are to be radiused to eliminate sharp edges. The rails are to be joined to the post through a combination of bonding and riveting. No sharp, protruding edges are to remain after assembly of the guardrail. Spacing of the posts shall not exceed 6'-0".

2. The bases of the posts are to be attached according to the contract drawings. The bases of the posts are to be reinforced to a height of 10 inches.

3. When required, rails are to be spliced using a 10-inch length of 1.5-inch by 1/8-inch FRP square tube bonded and riveted into place using epoxy adhesive and 18-8 stainless steel rivets.

4. PVC or CPVC connectors shall not be used as a load carrying component of the guardrail system.

F. Stair Rail

NOT USED

G. Handrail

1. Handrail shall be installed at a height between 3’-0” to 3’-2” above the walking surface and/or stair nosings and extend beyond the upper and lower treads as required to comply with governing building codes. The

ends of the offset handrail are to terminate via a smooth, molded transition into the guardrail or wall. The handrails are to be attached to guards or walls with brackets fabricated from 316 stainless steel and/or FRP components. The configuration of the handrail brackets shall comply with governing building codes graspability requirements.

2. Handrail at 90-degree bends shall be spliced using a specially molded component which smoothly transitions between the spliced tubes with a constant radius. The spliced tubes are to be bonded and riveted to this molded 90-degree splice. Handrail at non-90-degree bends shall be connected using a molded adjustable splice which can be adjusted to an included angle of 180 to 39 degrees. The ends of the spliced tube are to be mitered to achieve a minimum-gap butt joint. The spliced tubes are to be bonded and riveted to the molded splice.

H. Ladder Fabrication

1. All ladders and cages shall be designed and laid out in strict accordance with OSHA 1910.23, 1910.28, and 1910.29.

2. All rungs shall penetrate the wall of the tube side rails and shall be connected to the rails with both epoxy and rivets to provide both a chemical and mechanical lock.

3. Ladders shall be fully shop assembled. Ladder cages shall be test assembled and drilled to ensure a proper fit in the field. Ladder cage brackets shall remain attached to the ladder for shipping, and the ladder cage components shall be disassembled, packaged, and shipped separately to prevent damage in transit. Cage components shall be bundled with each respective ladder.

4. The hoop brackets shall be shop attached to the ladder with bolts. The hoops shall be field attached to the hoop brackets.

3.02 INSPECTION

A. The County reserves the right to conduct a shop inspection at the County's expense. The Contractor shall give the County two (2) weeks notice prior to the beginning of any fabrication work so that the inspection can be arranged, at the County’s discretion.

B. The grating shall be free from visual defects such as foreign inclusions, delamination, blisters, resin burns, air bubbles and pits. The surface shall have a smooth finish (except for grit top surfaces).

3.03 INSTALLATION

A. Contractor shall install FRP products in accordance with manufacturer’s assembly drawings. Fasten FRP products securely in place with fasteners as specified herein. Field cut and drill FRP products with carbide or diamond tipped bits and blades. Seal cut or drilled surfaces in accordance with manufacturer's instructions.

END OF SECTION

SECTION 06600

PLASTIC FABRICATIONS

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work of this section includes, but is not limited to:

1. Weir Plates
2. Fiberglass Grating
3. Structural Shapes
4. Baffles

B. Related work specified elsewhere:

1. Section 03300 - Cast-in-Place Concrete
2. Section 05500 - Miscellaneous Metals
3. Section 15060 - Pipe and Pipe Fittings

1.02 QUALITY ASSURANCE

A. Reference Standards

1. American Society for Testing and Materials (ASTM)

a. D635 Test Method for Rate of Burning and/or Extent and Time of Burning Self-Supporting Plastics in a Horizontal Position.

b. E84 Test Method for Surface Burning Characteristics of Building Materials.

2. Occupational Safety and Health Administration (OSHA).

1.03 SUBMITTALS

A. Shop Drawings and Product Data: Submit manufacturer's product data and shop drawings for all products specified herein.

B. Drawings and calculations submitted for products listed under paragraph 1.04 shall be sealed by a professional engineer registered in the state in which the project is located.

C. Certificates: Submit certification from each product manufacturer attesting that the product meets or exceeds specification requirements.

1.04 DESIGN CONDITIONS

A. Ladders shall be designed to withstand 1200 pound vertical concentrated load at mid-span of a rung as per OSHA paragraph 1910.17, “Fixed Ladders”.

B. Grating (Molded)

1. Design for 50 psf live load.

2. Maximum deflection 1/360 of span.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Fiberglass reinforced polyester contact molded to produce uniform, smooth surfaces free of voids and porosity, free of dry spots, crazes, or unreinforced areas; corrosion, weathering and UV resistant, surfaces shall have gelcoat finish, gelcoat to contain UV inhibitors and all cut edges shall be sealed with polyester resin.

B. Resin seal all plastic material edges that are machined or cut during the manufacturing of the product.

C. Provide plastic fabrications with stainless steel hardware.

D. Materials/products shall be as manufactured by NEFCO, Jay R. Smith, MFG, or Equal.

2.02 WEIR PLATES

NOT USED

2.03 BAFFLES

NOT USED

2.04 LADDER

A. Structural fiberglass shape with a minimum glass content of 60 percent comprising both longitudinal strands and continuous strand mat so aligned to prevent laminar share splitting.

B. Material shall have the minimum following properties:

1.	Ultimate Tensile Strength:	30,000 psi
2.	Ultimate Compressive Strength:	30,000 psi
3.	Modulus of Elasticity:	3.0 x 10 psi
4.	Barcol Hardness:	50

C. Structural fiberglass shapes shall have a synthetic surfacing veil for chemical and ultra-violet resistance.

D. Class 1 fire retardance with an ASTM E84 flame spread rating of 25 maximum.

E. Color - safety yellow.

2.05 STRUCTURAL SHAPES

A. Composite of a glass fiber reinforced polyester resin matrix of which 50 percent shall be glass fiber.

B. Resin matrix shall be halogenated fire retardant isophtalic polyester with antimony trioxide having a U.L. classification of 94, Class 1 flame spread and flammability rating of 25 maximum in accordance with ASTM E84, D635.

C. The following properties shall apply:

1.	Flexural Strength:	20,000 psi
2.	Ultimate Tensile Strength:	30,000 psi
3.	Ultimate Flexural Strength:	30,000 psi
4.	Modulus of Elasticity:	2.5 x 10 psi
5.	Barcol Hardness:	50

2.06 GRATING (MOLDED)

A. One piece molded construction using thermosetting resin, fire retardant polyester, Class 1 and continuous glass fiber reinforcement with glass content not to exceed 35 percent of the composite.

B. Thermosetting resin shall be extra corrosion resistant vinyl ester resin system.

C. Grating shall meet or exceed ASTM E84, 25 maximum, and be self-extinguishing in accordance with ASTM D635.

2.07 STOP LOGS

NOT USED

PART 3 - EXECUTION

3.01 CONSTRUCTION

A. Ladders

1. Ladders shall have channel side rails and 1-3/8" minimum diameter round rungs.

2. Rung to side rail connections shall have a keyed, pinned and bonded joint for positive prevention of rung rotation and pull out.

3. Rungs shall have a factory applied epoxy-glass bead non-skid coating for maximum safety.

4. Ladder shall be entirely non-metallic with the exception of spliced and mounting fasteners; provide standoff clips every 6 feet, or increment, of ladder height.

5. Ladders and cages shall be supplied completely assembled, ready for installation.

6. Seal all cut edges and holes with a compatible resin system.

B. Grating (Molded)

1. Maximum bar center to center spacing shall be 1-3/4".

2. Grating shall be 1-1/2" x 1-1/2" nominal square mesh pattern.

3.02 INSTALLATION

A. Ladders and cages shall be supplied completely assembled, ready for installation.

B. Each piece, part or unit shall be tagged with the manufacturer's drawing and part numbers for each of field installation.

3.03 GENERAL

A. All components shall be shipped from the manufacturer's plant in fully enclosed crates to prevent damage in shipment.

B. All field joints, unless otherwise shown, shall be bolted.

C. Weir Plates

1. Mount weir plates with stainless steel anchor bolts approximately 24" o.c. and 5" diameter fiberglass reinforced plastic washers.

2. Secure ends of weir plates (joints) with 6"x9" butt plates arranged to allow for horizontal expansion.

3.04 ADJUSTMENT

Level weir plates to provide equal distribution of flow along the weir length.

END OF SECTION

SECTION 07100

WATERPROOFING AND DAMPPROOFING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included: Provide materials, labor and equipment required to perform all waterproofing and dampproofing Work indicated on the drawings, as specified herein, and as needed for a complete and proper installation.

B. Related work: Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Waterproofing membrane shall be compatible with waterproofing material and installed by methods approved by the membrane manufacturer.

1.03 PRODUCT HANDLING

A. Deliver the materials to the job site and store, in a safe are, out of the way of traffic and shored up off the ground surface, complying in all respects with product manufacturers recommendations.

B. Pallets of material shall be stored at job site on a level surface and protected from the weather. Membrane shall be left on pallets as received and not stacked more than one pallet high.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 21 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:

1. Materials list of items proposed to be provided for all work under this Section;

2. Manufacturers' specifications and other data needed to prove compliance with the manufacturer’s recommended installation procedures which, when approved by the Engineer, will become the basis for accepting or rejecting actual installation procedures used on the Work.

1.05 CAUTIONS AND WARNINGS

A. Primers and mastics are solvent-based liquids. Prior to the use of any product, consult the manufacturer's product label for handling, use and storage instructions.

B. Adhere strictly to all manufacturer's cautions, warnings and product safety and handling instructions.

PART 2 - PRODUCTS

2.01 MEMBRANE WATERPROOFING

At foundation walls below grade, use Premoulded Membrane with Plasmatic Core as manufactured by W. R. Meadows, Inc., 2100 Monroe Street, York, PA 17405. Phone: (717) 792-2627, Fax: (717) 792-0151, or acceptable equivalent. Provide joint sealing strips, bonding agents and other materials required for a complete system as recommended by manufacturer.

2.02 COATING FOR MEMBRANE WATERPROOFING

The coating for membrane waterproofing shall consist of a prime coat, three mop coats, and two layers of fabric. Membrane waterproofing shall be applied to the face of construction joints as shown on the Contract Drawings for a width of 16-inches minimum centered on the joint.

2.03 WATERPROOFING MEMBRANE

The adhesive side of the membrane shall be protected with a special release paper that can be easily removed for installation. The membrane shall conform to the following requirements:

Test Property	Test Method	Specification Limit
Grab Tensile Strength	ASTM D 5034	70
Pliability, 180-degree bend	ASTM D 146	Unaffected
Resistance to Puncture	ASTM E 154	40
Permeance, Permeabiltiy	ASTM E 96 –B	0.1
Weight, oz/SY, Min.	ASTM D 3776	40

2.04 DAMPPROOFING

Dampproofing material shall be asphaltic coatings and shall consist of two prime coats and one seal coat. Dampproofing shall be applied to concrete surfaces that will be below ground. Dampproofing asphalt shall be hot applied and shall conform to ASTM D449. The primer shall conform to ASTM D41.

2.05 OTHER MATERIALS

Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the acceptance of the Engineer.

PART 3 - EXECUTION

3.01 DELIVERIES

Stockpile materials sufficiently in advance of need to assure their availability in a timely manner for this Work. Make as many trips to the job site as are needed to deliver materials of this Section in a timely manner to ensure orderly progress of the work.

3.02 COMPLIANCE

Do not permit materials not complying with the provisions of this Section to be brought onto or to be stored at the job site. Promptly remove non-complying materials from the job site and replace with materials meeting the requirements of this Section.

3.03 SURFACE CONDITIONS

Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.04 INSTALLATION

A. Install entire waterproofing system in strict accordance with system manufacturer's written instructions.

1. The concrete surface to receive membrane must be smooth and free from all sharp projections, dirt, dust and loose materials. Repair all voids and holes.

2. At foundation walls, continue application over the footings and under perimeter drains.

a) Backfilling may be done as soon as installation is completed and should be done within 4 hour after material is applied to the wall. Backfilling can be done as installation progresses. Care shall be taken to ensure that backfilling does not disrupt the bond of the membrane to the walls.

3. At deck, install sheets in continuous bed of hot asphalt.

B. Materials shall be applied at a temperature above 40 degrees F., unless specifically listed for application below .40 degrees F. Do not apply materials when there is ice, frost or dampness visible on the surface to be waterproofed or damp proofed.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 07200

THERMAL INSULATION

PART 1 - GENERAL

1.01 Description

A. Work Included:

1. Ceiling insulation

2. Exterior wall insulation

1.02 Quality Assurance

A. For actual installation of thermal insulation. All insulation shall be done by skilled journeymen who are completely familiar with the recommended methods of installation and the requirements of this work.

B. All installation of insulation shall comply with all pertinent codes and regulations, and shall comply with the thermal standards established by IBC Energy Code. Upon completion of this work, the installer shall issue a Certificate of Assurance that the installation was installed in accordance with the recommendations.

PART 2 - PRODUCTS

2.01 Insulation

A. Ceiling Insulation:

Batt insulation will be installed with resistance value of R-38. Insulation shall be noncombustible, ASTM E136.

B. Exterior Walls:

1. Exterior walls shall be insulated with Korfil block insulation inserts for concrete masonry units.

2. Exterior walls shall be insulated with resistance value of R-16. Insulation shall be noncombustible, ASTM E136.

PART 3 -EXECUTION

3.01 Install batt or blanket type insulation with tightly butted joints. Fasten all insulation in a manner to preclude any displacement. Install dry and keep dry. Vapor barrier to face heated area. All insulation must be installed, and certified that the installation procedures and insulation meets all the requirements of the Minimum Property Standards, as established. A 6 mil vapor barrier and unfaced insulation may be substituted for craft faced insulation. Tightly stuff insulation in all cracks around windows and the doors. Where flanged batts are used the flanges of the batts shall be stapled flat on the 1 1/2 inch edge of wood framing.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 07920

JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:

1. Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

2. Interior joints in vertical surfaces and horizontal nontraffic surfaces.

3. Interior joints in horizontal traffic surfaces.

1.02 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.03 SUBMITTALS

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

1.04 QUALITY ASSURANCE

A. Preconstruction Compatibility and Adhesion Testing: Submit samples of materials that will contact or affect joint sealants to joint-sealant manufacturers for testing according to ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

B. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates according to the method in ASTM C 1193 that is appropriate for the types of Project joints.

C. Mockups: Build mockups incorporating sealant joints, as follows, to verify selections made under ample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1.05 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

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

B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

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

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Engineer from manufacturer's full range.

2.02 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Single-Component Pourable Neutral-Curing Silicone Sealant:

1. Type and Grade: S (single component) and P (pourable)

2. Class: 100/50.

3. Uses Related to Exposure: NT and T (traffic)

4. Uses related to Joint Substrates: M A and O, as applicable to joint substrates indicated.

D. Single-Compound Neutral-Curing Silicone Sealant:

1. Type and Grade: S (single component) and NS (nonsag).

2. Class: 25.

3. Uses Related to Exposure: NT (nontraffic)

4. Uses Related to Joint Substrates: M, G, A, and as applicable to joint substrates indicated, O.

E. Single-Compound Acid-Curing Silicone Sealant:

1. Type and Grade: S (single component) and NS (nonsag)

2. Class: 25.

3. Uses Related to Exposure: NT (nontraffic).

4. Uses Related to Joint Substrates: G, A, and as applicable to joint substrates indicated, O.

F. Single-Compound Mildew-Resistant Neutral-Curing Silicone Sealant:

1. Type and Grade: S (single component) and NS (nonsag).

2. Class: 25.

3. Use Related to Exposure: NT (nontraffic).

4. Uses Related to Joint Substrates: M, G, A, and as applicable to joint substrates indicated, O.

2.03 LATEX JOINT SEALANTS

A. Latex Sealant: Comply with ASTM C 834, Type O P, Grade NF.

2.04 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) O (open-cell material) B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.

D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.05 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.

a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.

2. Remove laitance and form-release agents from concrete.

a. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.02 INSTALLATION

A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

B. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.

2. Do not stretch, twist, puncture, or tear sealant backings.

3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.

2. Completely fill recesses in each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

F. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.03 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior vertical and horizontal nontraffic construction joints in cast-in-place concrete.

1. Joint Sealant: Single-component neutral-curing silicone sealant.

2. Joint Sealant Color: Match Adjacent Surfaces.

B. Joint-Sealant Application: Exterior vertical control and expansion joints in unit masonry.

1. Joint Sealant: Single-component neutral-curing silicone sealant.

2. Joint-Sealant Color: Match mortar color.

C. Joint-Sealant Application: Exterior perimeter joints between masonry, concrete and frames of doors, windows and louvers.

1. Joint Sealant: Single-component neutral-curing silicone sealant.
2. Joint-Sealant Color: As selected by the Engineer from the manufacturer's available full range of colors.

D. Joint-Sealant Application: Exterior control and expansion joints in ceiling and other overhead surfaces.

1. Joint-Sealant: Single-component neutral-curing silicone sealant.
2. Joint-Sealant Color: As selected by the Engineer form the manufacturer's available full range of colors.

E. Joint-Sealant Application: Insert other exterior joints in vertical and horizontal nontraffic surfaces.

1. Joint Sealant: Single-component neutral-curing silicone sealant.
2. Joint-Sealant Color: As selected by the Engineer from the manufacturer's available full range of colors.

F. Joint-Sealant Application: Vertical control and expansion joints on exposed interior surfaces of exterior walls.

1. Joint Sealant: Single-component neutral-curing silicone sealant.
2. Joint-Sealant Color: As selected by the Engineer from the manufacturer's available full range of colors.

G. Joint-Sealant Application: Interior perimeter joints of exterior openings.

1. Joint Sealant: Single-component neutral-curing silicone sealant
2. Joint-Sealant Color: As selected by the Engineer from the manufacturer's available full range of colors.

H. Joint-Sealant Application: Interior joints between plumbing fixtures and adjoining walls, floors, and counters.

1. Joint Sealant: Single-component mildew-resistant neutral -curing silicone sealant.
2. Joint-Sealant Color: As selected by the Engineer from the manufacturer's available full range of colors.

I. Joint-Sealant Application: Vertical painted joints on exposed surfaces of interior partitions and perimeter of door, windows and other openings.

J. Joint-Sealant Application: Perimeter joints between interior wall surfaces and frames of interior doors and windows.

1. Joint Sealant: Latex sealant.
2. Joint-Sealant Color: As selected by the Engineer from the manufacturer's available full range of colors.

K. Joint-Sealant Application: Interior control, expansion, and isolation joints in horizontal traffic surfaces.

1. Joint Sealant: Single-component pourable neutral curing silicon sealant.

2. Joint-Sealant Color: As selected by the Engineer from the manufacturer's available full range of colors.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 08220

FIBERGLASS REINFORCED PLASTIC (FRP) DOORS AND FIBERGLASS RESIN TRANSFER MOLDED DOOR FRAMES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section Includes The Following:

1. Fiberglass Reinforced Plastic (FRP) Doors

2. Fiberglass Resin Transfer Molded Door Frames

1.02 RELATED SECTIONS

A. Related Sections Include The Following:

1. Division 0 - Bidding and Contract Requirements

2. Division 1 - General Requirements

3. Division 8 - Finish Hardware

1.03 QUALITY ASSURANCE

Test certification by independent and accredited laboratories.

A. Referenced Standards

1. Door Properties

a) Standard test method for steady state thermal transmission properties by means of the heat flow meter apparatus.

b) Successfully completed 1,000,000 cycles test in accordance with:

- AAMA 920-03 – specification for Operating Cycle Performance of Side-Hinged Exterior Door Systems
- ANSI A250.4-2001 – Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcing's
- NWWDA TM-7 – Test Method to Determine the Physical Endurance of Wood Doors and Associated Hardware under Accelerated Operating Conditions.

c) Florida Building Code

- SFBC PA 201 – Impact Procedures for Large Missile Impact
- SFBC PA 202 – Uniform Static Load on Building Components
- SFBC PA 203 – Products Subjected to Cyclic Wind Pressure
- SFBC 3603.2 – Forced Entry Test
- ASTM E 330 – Uniform Static Load +/- 70 psf
- ASTM E 1886 – Impact and Cycling, Large Missile Impact
- ASTM E 1996 – Specifications for Performance of Exterior Doors
- ASTM C 518 – Heat Transfer
- ASTM D 1761 – Mechanical Fasteners 1530 lb

2. Laminate Properties

Door face plate is a minimum of 0.125 inch thick fiberglass reinforced plastic molded into one continuous sheet starting with 25 mil resin-rich gelcoat layer integrally molded with at least 3 layers of 1.5 oz. per sq. ft fiberglass mat and one layer of 18 oz per square yard fiberglass woven roving saturated with special resins. Door plate weight not less than 0.97 lbs per square foot at a ratio of 30/70 glass to resin.

Laminated plate by itself evaluated in accordance with Florida Building Code TAS 201 Large Missile Impact Test as per ASTM-1996-05b, Standard Specification for Performance of Exterior Windows, Curtain Wall, Doors and Storm Shutters Impacted by Windborne Debris in Hurricanes. The missile (a 2 x 4 with a weight of 9 lbs shot from a cannon at a velocity of 50 ft/sec) did not penetrate the door face plate.

b) ASTM D 882 – Tensile Strength 12,000 psi
c) ASTM D 790 – Flexural Strength 39,000 psi
d) ASTM D 2583 – Barcol Hardness 53
e) ASTM D 256 – Impact Resistance
f) ASTM D 792 – Density/Specific Gravity Of Laminate
g) ASTM D 1761 – Mechanical Fasteners 1530 lb
h) ASTM E 84 – Surface Burning Characteristics
i) ASTM G 155 – Gelcoat Xenon Arc light exposure test
j) ASTM D 635 – Rate of Burning Time of Burning
k) ASTM D 2843 – Smoke Density
l) ASTM D 1929 – Self Ignition Temperature

3. Core Properties

a) ASTM C 177 – Thermal Properties

b) ASTM D 1622 – Density/Specific Gravity

c) ASTM E 84 – Surface Burning Characteristics

d) WDMA TM-10 and TM-5 – Firestop ASTM E 152 U.L. 10(b)

e) ASTM E90-04 – Sound Transmission Loss

f) ASTM E413-04 – Classification for Rating Sound Insulation

g) ASTM E1332-90 – Standard Classification for Determination of Outdoor-Indoor Transmission Class

h) ASTM E2235-04 – Standard Test Method for Determination of Decay Rates for Use in Sound Insulation Methods

B. Qualifications

1. Manufacturer Qualifications: A company specialized in the manufacture of fiberglass reinforced plastic (FRP) doors and frames as specified herein with a minimum of 30 years documented experience and with a record of successful in-service performance for the applications as required for this project.

2. Installer Qualifications: An experienced installer who has completed fiberglass door and frame installations similar in material, design, and extent to those indicated and whose work has resulted in construction with a record of successful in-service performance.

3. Source Limitations: Obtain fiberglass reinforced plastic doors and resin transfer molded fiberglass frames through one source fabricated from a single manufacturer, including fire rated fiberglass frames. This ensures complete uniformity of physical properties and consistency in the resin chemistry tailored for this application.

4. Source Limitations: Hardware and accessories for all FRP doors as specified in Section 08710 shall be provided and installed by the fiberglass door and frame manufacturer.

5. Source Limitations: Glass for windows in doors shall be furnished and installed by door and frame manufacturer.

1.04 SUBMITTALS

A. Product Technical Data Including:

1. Acknowledgment that the products submitted meet the requirements of the standards referenced and Section 1300.

2. Manufacturer shall provide certificate of compliance with current local and federal regulations as it applies to the manufacturing process.

3. Manufacturer's installation instructions.

4. Schedule of doors and frames indicating the specific reference numbers used on the owner's project documents, noting door type, frame type, size, handing and applicable hardware.

5. Details of core and edge construction. Include factory construction specifications.

6. Certification of manufacturer's qualifications.

B. Submittal Drawings: shall be submitted prior to manufacture and will include the following information and formatting:

1. Summary door schedule indicating the specific reference numbers as used on owner's drawings, with columns noting door type, frame type, size, handing, accessories and hardware.

2. A drawing depicting front and rear door elevations showing hardware with bill of material for each door.

3. Drawing showing dimensional location of each hardware item and size of each door.

4. Individual part drawing and specifications for each hardware item and FRP part or product.

5. Construction and mounting detail for each frame type

C. Samples:

Provide one complete manufactured door sample which represents all aspects of the typical manufacturing process, including molded in gelcoat color and face plate construction. One edge should expose the interior of the door depicting the unique U-shaped continuous piece stile and rail, hardware reinforcement and core material

D. Operation and Maintenance Manual

1. Include recommended methods and frequency for maintaining optimum condition of fiberglass doors and frames under anticipated traffic and use conditions.

2. Include one set of final as built drawings with the same requirements as mentioned in Section 1.04.B above.

3. Include certificate of warranty for door and frame listing specific door registration numbers.

4. Include hardware data sheets and hardware manufacturer's warranties.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Each door and frame shall be delivered individually crated for protection from damage in cardboard containers, clearly marked with project information, door location, specific reference number as shown on drawings, and shipping information. Each crate shall contain all fasteners necessary for installation as well as complete installation instructions.

B. Doors shall be stored in the original container on edge, out of inclement weather for protection against the elements.

C. Handle doors pursuant to the manufacturer's recommendations as posted on outside of crate.

1.06 WARRANTY

A. Warrant all fiberglass doors and frames for a period of 25 years against failure due to corrosion. Additionally, warrant all fiberglass doors and frames on materials and workmanship for a period of 10 years, including warp, separation or delamination, and expansion of the core.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

A. Chem-Pruf Door Co., Ltd., P.O. Box 4560, Brownsville, Texas 78523 Phone: 1-800-444-6924, Fax: 956-544-7943, Website: www.chem-pruf.com.

B. Substitutions may be considered, provided manufacturer can comply with the specifications as written herein and said products are manufactured in the United States of America. Requests for substitution must be submitted in writing no less than 10 days prior to bid date. Substitution request to include a physical sample and written documentation that product will meet the specific manufacturing methods as highlighted below.

2.02 FRP DOORS

A. Doors shall be made of fiberglass reinforced plastic (FRP) using chemically proven resins resistant to contaminants typically found in the environment for which these specifications are written. Doors shall be 1 3/4 inch thick and of flush construction, having no seams or cracks. All doors up to 4'0 x 8'0 shall have equal diagonal measurements. For consistency in the resin chemistry tailored for this application and to maintain the same physical properties throughout the structure, all fiberglass components including face plates, stiles and rails and frames must be fabricated by the same manufacturer. Components obtained through various outside sources for plant assembly will not be accepted.

B. Door Plates shall be 0.125 inch thick, molded in one continuous piece, starting with 25 mil gelcoat of the color specified, integrally molded with three layers of 1.5 ounce per square foot fiberglass mat and one layer of 18 ounce per square yard fiberglass woven roving. Door plate weight shall not be less than 0.97 lbs per square foot at a ratio of 30/70 glass to resin.

C. Stiles and Rails shall be constructed starting from the outside toward the inside, with a matrix of at least three layers of 1.5 ounce per square foot of fiberglass mat. The stile and rail shall be molded in one continuous piece to a U-shaped configuration and to the exact dimensions of the door. In this manner there will be no miter joints or disparate materials used to form the one-piece stile and rail.

D. Core material options to be:

- Polypropylene plastic honeycomb core with a non woven polyester veil for unparalleled plate bonding, 180 PSI typical compression range.
- 2 PSF expanded polyurethane foam core, which completely fills all voids between the door plates. Foam properties ASTM E-84 comply with IBC Code.

E. Internal Reinforcement shall be #2 SPF of sufficient amount to adequately support required hardware and function of same.

F. Finish of door and frame shall be identical with 25 mil resin-rich gelcoat of the specified color integrally molded in at time of manufacture. To achieve optimum surface characteristics, the gelcoat shall be cured within a temperature range of 120°F to 170°F creating an impermeable outer surface, uniform color throughout, and a permanent homogeneous bond with the resin/fiberglass substrate beneath. Only the highest quality gelcoat will be used to ensure enduring color and physical properties. Paint and/or post application of gelcoat result in poor mechanical fusion and will be deemed unacceptable for this application. The finish of the door and frame must be field repairable without compromising the integrity of the original uniform composite structure, function or physical strength.

G. Window openings shall be provided for at time of manufacture and shall be completely sealed so that the interior of the door is not exposed to the environment. Fiberglass retainers, which hold the glazing in place, shall be resin transfer molded with a profile that drains away from glazing. Mechanical fasteners shall not be used to attach retainers. The retainers must match the color finish of the door plates. Glass shall be furnished and installed by door and frame manufacturer. At time of manufacture, 25 mil of resin-rich gelcoat must be integrally molded into the window and window retainer. In order to maintain uniform appearance, product longevity and the corrosion resistance this application requires, window retainers fabricated from Metal, PVC or Vinyl will not be accepted

H. Louver openings shall be completely sealed so that the interior of the door is not exposed to the environment. Louvers are to be solid fiberglass “V” vanes and shall match the color of the door plates. At time of manufacture, 25 mil of resin-rich gelcoat must be integrally molded into louver and louver retainer.

I. Transoms shall be identical to the doors in finish, construction, materials, thickness and reinforcement.

2.03 FRAMES

A. Frames (rated and non-rated) shall be fiberglass and manufactured using the resin transfer method creating one solid piece with complete uniformity in color and size. Beginning with a minimum 25 mil gelcoat layer molded in and a minimum of two layers of continuous strand fiberglass mat saturated with resin, the frame will be of one-piece construction with molded stop. All frame profiles shall have a core material of 2 psf polyurethane foam. Metal frames or pultruded fiberglass frames will not be accepted.

B. Finish of frame shall be identical to the door with 25 mil resin-rich gelcoat of the specified color integrally molded in at time of manufacture. To achieve optimum surface characteristics, the gelcoat shall be cured within a temperature range of 120 F to 170F creating an impermeable outer surface, uniform color throughout, and a permanent homogeneous bond with the resin/fiberglass substrate beneath. Only the highest quality gelcoat will be used to ensure enduring color and physical properties. Paint and/or post application of gelcoat result in poor mechanical fusion and will be deemed unacceptable for this application. The finish of the door and frame must be field repairable without compromising the integrity of the original uniform composite structure, function or physical strength.

C. Jamb/Header connection shall be mitered for tight fit.

D. Internal Reinforcement shall be continuous within the structure to allow for mounting of specified hardware. Reinforcing material shall be a dense matrix of cloth glass fibers and premium resin with a minimum hinge screw holding value of 1000 lbs per screw. All reinforcing materials shall be completely encapsulated. Documented strength of frame screw holding value after third insert must be submitted. Dissimilar materials, such as steel, will be deemed unacceptable as reinforcement for hardware attachment.

E. Mortises for hardware shall be accurately machined by CNC to hold dimensions to +/- 0.010 inch in all three axis.

F. Hinge pockets shall be accurately machined by CNC to facilitate heavy duty hinges at all hinge locations, using plastic shims when standard weight hinges are used.

2.04 HARDWARE

A. See Section 08710

B. The special nature of this material requires that all related hardware as specified must be furnished and installed by the door and frame manufacturer to ensure sufficient support/reinforcement, precision tooling and proper sealing methods.

PART 3 - EXECUTION

3.1 INSTALLATION CONDITIONS

A. Verification of Conditions

1. Verify openings are correctly prepared to receive doors and frames.

2. Verify openings are correct size and depth in accordance with shop drawings or submittals.

B. Installer's Examination

1. Door installer shall examine conditions under which construction activities of this section are to be performed and submit a written report to general contractor if conditions are unacceptable.

2. General Contractor shall submit two copies of the installer's report to the architect within 24 hours of receipt.

3. Installer shall not proceed with installation until all unacceptable conditions have been corrected.

3.02 INSTALLATION

A. Door shall be delivered at job site individually crated. Each crate to be clearly marked with the specific opening information for quick and easy identification.

B. All single doors to be shipped completely assembled in the frame with hardware installed. Double doors to be prehung at the factory to ensure a proper fit and that hardware functions properly, then broken down for shipping purposes.

C. Install door opening assemblies in accordance with shop drawings and manufacturer's printed installation instructions, using installation methods and materials specified in installation instructions.

D. Field alteration of doors or frames to accommodate field conditions is strictly prohibited.

E. Site tolerances: Maintain plumb and level tolerance specified in manufacturer's printed installation instructions.

F. Fire labeled doors and frames must be installed in strict accordance with manufacturer's instructions and the latest revision of NFPA 80.

3.03 ADJUSTING

A. Adjust doors in accordance with door manufacturer's maintenance instructions to swing open and shut without binding and to remain in place at any angle without being moved by gravitational influence.

B. Adjust door hardware to operate correctly in accordance with hardware manufacturer's maintenance instruction.

3.04 CLEANING

Clean surfaces of door opening assemblies and exposed door hardware in accordance with respective manufacturer's maintenance instructions.

3.05 PROTECTION OF INSTALLED PRODUCTS

Protect door opening assemblies and door hardware from damage by subsequent construction activities until final inspection.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 08710

FINISH HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Furnish and deliver finish hardware as listed, specified and required.

B. Related Work Specified Elsewhere:

1. Metal Doors and Frames – Division 8.

2. Wood Doors – Division 8.

3. Fiberglass Reinforced Plastic Doors and Frames – Division 8.

1.2 REFERENCES

A. Documents and Institutes that shall be used in estimating, detailing and installing the items specified:

1. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People. CABO/ANSI A117.1-1999

2. NFPA 80 - Fire Doors and Windows. 1999 Edition.

3. NFPA 101 - Life Safety Code. 2000 Edition

4. NFPA 105 - Installation of smoke-control door assemblies 1993 Edition

5. Local and state building codes.

6. UL Labeled for Rated Doors.

7. DHI - Door and Hardware Institute.

8. SDI - Steel Door Institute.

9. AWI - Architectural Woodwork Institute.

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Hardware Schedule: Final hardware schedule shall be submitted in the manner indicated below. Coordinate hardware with doors, frames and related work to insure proper size, thickness, hand, function and finish of hardware. The schedule is to be in a vertical form, organized into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:

1. Type, style, function, size and finish of each hardware item.

2. Name and manufacturer of each item.

3. Fastenings and other pertinent information.

4. Location of hardware set cross-referenced to indications on drawings both on floor plans and in door and frame schedules.

5. Explanation of all abbreviations symbols and codes contained in schedules.

6. Mounting locations for hardware.

7. Door and frame sizes and materials.

8. Keying schedule.

C. Product Data: Product data shall be provided, in the form of, manufacturer's technical product fact sheets for each item of hardware. Include whatever information may be necessary to show compliance with requirements, including instructions for installation and for maintenance of operating parts and finish.

D. Samples: Samples shall be provided as requested by owner or Engineer. All samples shall be returned to the finish hardware supplier when construction is completed.

E. Templates: Templates of finish hardware items to be supplied are to be furnished to each fabricator of doors, frames and other work to be factory-prepared for the installation of hardware.

F. Keying Schedule: A keying schedule shall be submitted using keyset symbols referenced in DHI manual "Keying Systems and Nomenclature". The keying schedule shall be indexed by door number, keyset, hardware heading number, cross keying instructions and special key stamping instructions.

G. Wiring Diagrams: Coordinate installation of the electronic hardware with the project electrical engineer and provide installation and technical data, including wiring diagrams, to the project electrical engineer and electrical sub-contractor. Upon completion of the electrical hardware installation, verify that all components are working properly and state in the required guarantee that this inspection has been performed.

H. Operations and maintenance data: At the completion of the job, furnish to the owner two copies of an owners operation and maintenance manual. The manual shall consist of a labeled hardcover three ring binder with the following technical information:

1. Maintenance instructions for each item of hardware.

2. Catalog pages for each product.

3. Parts list for each product.

4. Copy of final hardware schedule.

5. Copy of final keying schedule.

1.04 QUALITY ASSURANCE

A. Substitutions: Manufacturers and model numbers listed are to establish a standard of quality and design. The Engineer must approve all product substitutions. Any request for substitutions must be submitted 10 days before bid date, to allow sufficient time for addendum to be added to the bid document. In accordance with Section 01600, required data and physical samples must be provided.

B. Supplier Qualifications: Suppliers shall be recognized architectural finish hardware suppliers, with warehousing facilities, who have been furnishing hardware in the projects vicinity for a period of not less than 2 years and who is or employs a DHI Certified A.H.C., who is available at reasonable times during the course of the work for consultation about products hardware requirements, to owner, Engineer and contractor.

C. Fire-rated openings: Fire-rated openings shall be provided with fire-rated hardware in compliance with NFPA Standard No. 80 and local building code requirements. Provide only hardware tested and listed by U/L, for types and sizes of doors required and complying with requirements of door and doorframe labels.

1.05 DELIVERY, STORAGE AND HANDLING

A. Marking and Packaging: Mark each item or package separately, with identification related to hardware set number, door number and keyset symbol.

B. Delivery

1. Deliver individually packaged and properly marked finish hardware at the proper time and location to avoid any delays in construction or installation.

2. At time of delivery, inventory hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.

C. Storage

1. A secure, dry lock-up with strong and sufficient shelving shall be provided for hardware delivered to the project, to protect the material and the finishes.

2. Control handling and installation of hardware items, which are not immediately replaceable, so that completion of the work will not be delayed by hardware losses, both before and after installation.

1.06 WARRANTY

A. All finish hardware products shall be covered by a 1-year factory warranty against defects in material and workmanship from the date of substantial completion of the project.

B. Supply warranty verification to the owner for products that provide factory warranties for periods longer than one year. Locksets and exit devices shall have a 5-year factory warranty, door closers a 10-year factory warranty.

1.07 MAINTENANCE

A. Extra Materials

1. Furnish 3-dozen extra screws and other fasteners of each size, type, and finish used with the hardware items provided. These screws and fasteners are to be delivered to the hardware installer for use during installation. All extra screws and fasteners and all special installation tools furnished with the hardware shall be turned over to the owner at the completion of the job.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. List of manufacturers represented in this section:

1. Corbin-Russwin, 800-543-3658, www.yalesecurity.com
2. Door Controls International, 800-742-3634, www.doorcontrols.com
3. McKinney Products Co., 800-541-1073, www.mckinneyhinge.com
4. Norton Door Controls, 800-438-1951, www.yalesecurity.com
5. Rixson-Firemark, Inc., 800-457-5670, www.rixsondoorcontrols.com
6. Hager Companies, 800-325-9995, www.hagerco.com
7. Design Hardware, 800-503-1410, www.designhardware.net
8. Yale Commercial, 800-438-1951, www.yalecommercial.com

2.02 MATERIALS

A. Screws and Fasteners

1. Closers and exit devices provided for wood doors are to be furnished with thru-bolts.
2. All finish hardware shall be installed to manufacturer's recommendations, using screws, attachments and installation tools provided with the hardware. No other screws or attachments are acceptable.
3. All screws and fasteners shall be stainless steel.

B. Hinges

1. Template: Provide template units only.

2. All hinges shall be heavy weight (.180 or .190 ga.), stainless steel, five knuckle, four ball bearing, full mortise type with a stainless steel non-removable pin.

3. Size: Provide 4 1/2" x 4 1/2" hinges on doors up to 3'0" in width. Provide 5" x 4 1/2" hinges on doors from 3'2" to 4'0" in width.

4. Number of Hinges: Provide number of hinges indicated but not less than 3 hinges for door leaf for doors 90" or less in height and one additional hinge for each 30" of additional height.

   Supply from the following list of domestic manufacturers:

   i. Hager.

   ii. McKinney.

C. Flush Bolts

1. As codes and conditions permit, provide on the inactive door of pairs, extension flush bolts at top and bottom of the doors. Provide all necessary strikes, shims and guides to insure proper installation. Supply 12" length unless scheduled differently in the hardware sets. Provide DCI or approved equal.

2. Dust Proof Strikes: As conditions allow, provide dust proof strikes with each bottom flush bolt. Provide DCI or approved equal.

3. Flush bolts shall have a satin chrome finish.

D. Surface Bolts

1. Heavy duty commercial construction

2. US26D finish.

3. Conforms to ANSI/BHMA A156.16, L84161

4. Can be used for both in-swinging and out-swinging doors.

E. Locks

1. All locks and latch sets shall be mortise type with wrought steel case, 8" x 1 1/4" armor front, with 3/4" throw, two piece stainless steel latch bolts.

2. Locks and latch sets shall meet ANSI A156.13, Series 1000, Grade 1.

3. Furnish and install dust boxes with all strikes.

4. Provide Non-Ferris lock cases where listed.

5. Supply Corbin-Russwin ML2000 series or approved equal.

F. Lock Trim

1. All mortise trim shall have thru-bolted installation and meet the guidelines for ADA and requirements for UFAS and ANSI 117.1, which require ease of accessibility for the handicapped and disabled.

2. The lever trim shall have cast levers with reinforced forged roses.

3. Supply Corbin-Russwin LSA or approved equal for interior handles/levers.

4. Supply Design Hardware or engineered approved equal for exterior handles/levers, which shall be constructed of stainless steel. A Grade 1 stainless steel rim panic exit device, as manufactured by Design Hardware or equal, shall also be provided on inside of all exterior doors.

G. Surface Door Closers

1. All surface closers shall be full rack and pinion type with full molded cover and shall project no more than 2 1/8" from the mounting surface. Closers shall be non-handed and be provided with non-gumming and non-freezing hydraulic fluid. Closers shall have two valves, hex-key adjusted to independently regulate closing and latch speed. Closers shall have two valves, hex-key adjusted to independently regulate back check cushioning and back check position.

2. All closers shall also have multi-size spring power adjustment to permit setting of power from size 2 thru 6 (size 1 thru 4 on barrier free closers).

3. Supply from the following list of domestic manufacturers

   a. Yale 4400 Series.

   b. Norton 7500 Series.

4. Surface closers for all exterior and high traffic openings, where floor closers are not provided, shall be provided with a combination door closer, doorstop and shock absorber. The shock absorber shall provide heavy-duty springs to smoothly decelerate the door as it reaches the positive stop point.

5. Supply from the following list of domestic manufacturers:

   a. Yale UNI-4400 Series

   b. Norton UNI-7500 Series

6. Options: As dictated by codes or indicated in the drawings or hardware sets provide arm and feature options such as, corrosion resistant, adjustable delayed action, barrier free, positive stop and/or hold open arms, low profile arms, rigid parallel arm and special mounting brackets and plates.

7. All closers shall be installed with thru-bolts.

H. Door Stops and Holders

1. Wall and Floor Stops: Supply wall stops where needed to protect doors or door hardware. When wall conditions do not permit use of wall stop provide floor stops with risers as needed to adjust for floor conditions.

2. Overhead Stops: Where wall or floor stops are not applicable provide surface overhead stops. Supply overhead stops/holders with extruded bronze channels arms and brackets. All stops shall be supplied and installed with thru-bolts. Provide Rixson #9 Series.

I. Thresholds, Weather strip, Sweep, and Gasket

1. Aluminum Thresholds: All thresholds shall conform to state and local handicap codes.

2. Provide Zero 8878AA weather seal on all exterior frames.

3. Provide neoprene door sweep, as manufactured by National Guard, or equal.

J. Silencers

1. Provide Silencers on all doorframes that do not have gasket or weather strip specified.

2. Install 2 silencers on pairs and 3 silencers on single openings.

K. Drip Cap

1. Provide a drip cap on all exterior doors. Drip cap shall be National Guard 15D72 or equal.

2.03 FINISHES

1.	Hinges	630
2.	Flush Bolts	626
3.	Locks	630
4.	Surface Door Closers	689
5.	Door Stops and Holders	626-630
6.	Weather strip and Thresholds	689

2.04 KEYING

A. General: Supplier will meet with owner to finalize keying requirements and supply grand master key system for the project. If requested by the owner, locks shall be keyed to match owner's existing master keys and locks elsewhere.

B. Security: Provide all exterior doors with hi-security interchangeable core cylinders. The interior cylinders shall have an interchangeable core system compatible with the exterior system but not hi-security type. Both systems shall be 6-pin with cylinder parts from brass/bronze, stainless steel or nickel silver.

C. Keys: Provide nickel silver keys only. Furnish 4 change keys for each lock; 5 control keys; 5 master keys for each master system and 5 grandmaster keys for each grandmaster system. Deliver all keys to the owners' representative.

D Construction Keying: Provide all cylinders with temporary construction cores. The temporary construction cores are to be removed by the contractor after each section of the project is completed and replaced with the permanently keyed cores in the presence of the owner. Furnish 12 construction master keys and 3 removal tools and deliver to the contractor.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine doors, frames and related items for conditions that would prevent the proper application of any finish hardware items. Do not proceed with installation until all defects are corrected.

3.02 INSTALLATION

A. Mount hardware units at heights indicated in "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute, except as specifically indicated or required to comply with governing regulations, and except as may be otherwise directed by the Engineer.

B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces, which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protections with finishing work specified in the Division-9 sections. Do not install surface-mounted items until finishes have been completed on the substrate.

C. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

D. Drill and countersink units, which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant.

3.03 FIELD QUALITY CONTROL

After installation has been completed, obtain the services of a qualified hardware consultant to check for proper application of finish hardware, according to the finish hardware schedule and keying schedule. In addition, check all hardware for adjustment and proper operation.

3.04 ADJUST AND CLEAN

A. Adjust, clean and inspect all hardware, to ensure proper operation and function of every opening. Replace items, which cannot be adjusted to operate freely and smoothly as intended for the application made.

B. Clean adjacent surfaces soiled by hardware installation.

C. Final adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

D. Instruct owner's personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

E. Continued Maintenance: Approximately six months after the acceptance of hardware in each area, the installer, accompanied by the contractor, shall return to the project and re-adjust every item of hardware to restore proper function of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items, which have deteriorated or failed due to faulty materials or installation of hardware units. Prepare a written report of current and predictable problems in the performance of the hardware.

3.05 PROTECTION

The contractor shall use all means at his disposal to protect all finish hardware items from abuse, corrosion and other damage until the owner accepts the project as complete.

3.06 HARDWARE SCHEDULE

A. Reference is made to the construction plans for location of hardware. Hardware items listed in the hardware sets are listed in the catalogs of the following manufacturers:

1.	Hinges	McKinney (MCK)
2.	Flush Bolts	DCI (DCI)
3.	Cylinders & Keys	Corbin/Russwin (C/R)
4.	Locksets, Latch sets	Corbin/Russwin (C/R)
5.	Surface Closers	Norton (NOR)
6.	Overhead Stops/Holders	Rixson (RIX)
7.	Wall & Floor Stops	DCI (DCI)
8.	Thresholds	DCI (DCI)

9.	Weather strip	DCI (DCI)
10.	Silencers	DCI (DCI)

END OF SECTION

SECTION 09900

PAINTING

PART 1 - GENERAL

1.01 SCOPE:

This section covers surface preparation, materials, coating, application, inspection and testing of coatings for the painting of process piping, valves, hangers, and fittings, doors, handrails, catwalk structures, walls and ceiling including accessories and appurtenances not specified elsewhere. The section covers both shop coating, and field coating.

1.02 GENERAL:

A. Unless otherwise specified herein, all surface preparation, application, inspection and testing shall be in accordance with the applicable requirements of AWWA D102. Coating materials shall be in compliance with the products listed herein.

B. All interior wetted steel surfaces are to be coated with the specified interior Coating System.

C. The surfaces of the tank shall be cleaned and prepared as specified. The field coatings Contractor/Subcontractor shall submit a satisfactory experience record including application of the specified interior paint systems to steel structures of similar design and complexity.

1.03 RELATED SECTIONS

A. Submittals: Section 01300

B. Project Closeout: Section 01700

1.04 WORKMANSHIP

A. No shop painted materials shall be shipped or otherwise moved from the fabricating shop until coating has become dry and hard.

B. Care shall be taken to prevent coatings from being dropped, spilled, or windblown on concrete and masonry surfaces, buildings, structures, cars, or other property or facilities. All surfaces so damaged shall be cleaned, repaired, replaced, or coated to the satisfaction of Owner.

1.05 GOVERNING STANDARDS

All cleaning surface preparations, coating applications, thickness, and testing shall be in accordance with the referenced AWWA, NACE, SSPC, ASTM, and NSF requirements.

1.06 SUBMITTALS

A. Complete descriptive specification data sheets for all coatings and testing equipment proposed for use shall be submitted in compliance with the Section

01300. Color cards are to be submitted for color selections for exterior surfaces, including lettering, and interior dry locations.

B. Contractor shall submit certifications that the proposed coating systems for interior surfaces are in compliance with ANSI/NSF 61.

C. An affidavit of compliance with the applicable requirements of AWWA D102 shall be submitted in accordance with Section 6.3 of D102.

D. Adhesion test results specified in 3.10.

E. Contractor shall submit lead abatement measures that are in compliance with all federal, state and local safety regulations, including, but not limited to USEPA and Federal Occupational Safety and Health Act (OSHA) requirements.

1.07 DELIVERY, STORAGE AND HANDLING

All paint shall be delivered to the job in original unopened containers with labels intact. Paint shall be stored inside and shall be protected against freezing. Care shall be taken in handling of coating containers to prevent puncture, inappropriate opening or other action which may produce contamination.

1.08 SAFETY

A. Material Safety Data Sheet: The Contractor shall secure, from the coating manufacturer, the Material Safety Data Sheet (MSDS) for the paint systems specified herein.

B. General Safety Requirements: All safety requirements stated in this specification and its components parts apply in addition to any applicable federal, state and local rules and requirements. Instructions of the coating manufacturer and requirements of insurance underwriters must be considered.

C. Specific Safety Requirements: Proper safety requirements will be observed to protect against the potential toxicity and flammability of polyurethane coatings. Safe handling and application practices are required and should include, but not be limited to, the provisions of:

1. SSPC-PA3-"Guide to Safety in Paint Application"

2. SSPC-PS17.00; Section B - "Safety."

3. Coating Manufacturer's Material Safety Data Sheet.

PART 2 - PRODUCTS

2.01 MATERIALS

A. No adulterant, unauthorized thinner, or other material not included in the coating formulation shall be added to the coating materials for any purpose.

B. All coatings shall conform to the air quality regulations applicable at the location of use. Coating materials which cannot be guaranteed by the manufacturer to conform, whether or not specified by product designation, shall not be used.

C. The VOC content of all coatings shall not exceed 2.8 lbs per gallon. The coatings that are specified have been selected on the basis of the manufacturers' published data that the VOC content of the product is 2.8 lbs per gallon or less, unless otherwise indicated herein; however, it shall be Contractor's responsibility to use only coating materials that are in compliance with the requirements of all regulatory agencies. Local regulations may require coatings to have a lower VOC content than that specified herein. The coating specified may meet the VOC limits in the unthinned (as shipped) condition, but may exceed the limits if thinned according to the manufacturer's recommendations. Under these conditions, the coatings shall not be thinned beyond the 2.8 lbs per gallon limit, and if the project cannot be thinned to suit the application method or temperature requirements, another manufacturer's coating shall be used, subject to acceptance by Owner.

D. Contractor shall be responsible for ensuring the compatibility of field coatings with each other or with the coatings on shop coated surfaces. Coatings used in successive field coats shall be produced by the same manufacturer. Coatings used in the first field coat over shop coated or previously primed surfaces shall cause no wrinkling, lifting, or other damage to underlying coats.

E. All coatings applied on surfaces that will be in contact with potable or treated water shall be certified as being in compliance with ANSI/INSF 61. Coatings that cannot be so certified, whether or not specified by manufacturer and product designation, shall not be used.

2.04 COATING SYSTEMS

A. Unless otherwise authorized by Engineer, materials shall conform to the following:

Plant Process Piping, Valves, & Fittings Coating System – (PCS-1 or 2)
NSF Certified, Two Coat Epoxy System

System	Coat	Product	Dry-Film Thickness (mils)	Color
PCS-1	Primer	Sherwin Williams Macropoxy 5500	4.0 - 6.0	Apply in different color than Finish Coat
PCS-1	Finish	Sherwin Williams Macropoxy 5500	4.0 - 6.0	As shown on Drawings
Total System Dry-Film Thickness			Minimum 8.0	

System	Coat	Product	Dry-Film Thickness (mils)	Color
PCS-2	Primer	PPG Amerlock 2	4.0 - 6.0	Apply in different color than Finish Coat
PCS-2	Finish	PPG Amerlock 2	4.0 - 6.0	As shown on Drawings
Total System Dry-Film Thickness			Minimum 8.0	

Railing & Catwalk Coating System – (RCS - 1 or 2)
Two Coat Epoxy System

System	Coat	Product	Dry-Film Thickness (mils)	Color
RCS-1	Primer	Sherwin Williams Macropoxy 5500	4.0 - 6.0	Apply in different color than Intermediate Coat
RCS-1	Intermediate	Sherwin Williams Macropoxy 5500	4.0 - 6.0	Apply in different color than Primer & Finish Coat
RCS-1	Finish	Sherwin Williams Acrolon 218HS	3.0 - 6.0	Yellow
Total System Dry-Film Thickness			Minimum 11.0	

System	Coat	Product	Dry-Film Thickness (mils)	Color
RCS-2	Primer	PPG Amerlock 2	4.0 - 6.0	Apply in different color than Intermediate Coat
RCS-2	Intermediate	PPG Durethane DTM Urethane	3.0 - 5.0	Apply in different color than Primer & Finish Coat
RCS-2	Finish	PPG Durethane DTM Urethane	3.0 - 5.0	Yellow
Total System Dry-Film Thickness			Minimum 10.0	

Door and Door Frame Coating System – (DCS - 1 or 2)
Two Coat Exterior Acrylic Latex System

System	Coat	Product	Dry-Film Thickness (mils)	Color
DCS-1	Primer	Sherwin Williams A-100 Exterior Acrylic Latex Semi-Gloss	1.0 - 3.0	Match Existing Door Colors
DCS-1	Finish	Sherwin Williams A-100 Exterior Acrylic Latex Semi-Gloss	1.0 - 3.0	Match Existing Door Colors
Total System Dry-Film Thickness			Minimum 2.0	

System	Coat	Product	Dry-Film Thickness (mils)	Color
DCS-2	Primer	PPG Speedhide Exterior Acrylic Latex Semi-Gloss	1.0 - 3.0	Match Existing Door Colors
DCS-2	Finish	PPG Speedhide Exterior Acrylic Latex Semi-Gloss	1.0 - 3.0	Match Existing Door Colors
Total System Dry-Film Thickness			Minimum 2.0	

Wall Coating System – (WCS - 1 or 2)
Two Coat Exterior Acrylic Latex System

System	Coat	Product	Dry-Film Thickness (mils)	Color
WCS-1	Spot Primer (Bare Concrete or CMU)	Sherwin Williams A-100 Exterior Acrylic Latex Semi-Gloss	1.0 - 3.0	White
WCS-1	Intermediate	Sherwin Williams A-100 Exterior Acrylic Latex Semi-Gloss	1.0 - 3.0	White
WCS-1	Finish	Sherwin Williams A-100 Exterior Acrylic Latex Semi-Gloss	1.0 - 3.0	White
		Total System Dry-Film Thickness	Minimum 3.0	

System	Coat	Product	Dry-Film Thickness (mils)	Color
WCS-2	Spot Primer (Bare Concrete or CMU)	PPG Speedhide Exterior Acrylic Latex Semi-Gloss	1.0 - 3.0	White
WCS-2	Intermediate	PPG Speedhide Exterior Acrylic Latex Semi-Gloss	1.0 - 3.0	White
WCS-2	Finish	PPG Speedhide Exterior Acrylic Latex Semi-Gloss	1.0 - 3.0	White
		Total System Dry-Film Thickness	Minimum 3.0	

2.05 COLOR SCHEDULE

A. Process piping, valves, hangers, and fittings, doors, handrails, catwalk structures, and chlorinator room walls and ceiling including accessories and appurtenances shall be coated, as follows:

Process/Item	Color
Sanitary Sewer	Dark Brown
Railing	Yellow
Catwalks	Gray
Door & Frames	Match Existing Door Color
Compressed Air	Green

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. Process Piping, Hangers, & Fittings Preparation

1. All surfaces shall be dry when coated and free from dirt, dust, sand, mud, oil, grease, rust, mill scale, and other objectionable substances.

2. Solvent cleaning preparation is permitted if the Contractor can document through adhesion testing specified in 3.10 that the existing paint primer and top coat is durable and compatible with an overcoat paint application (see 2.04). Following approval from the Owner for an overcoat application, the surface shall be prepared through cleaning with Manufacturer's prep cleaner in accordance with SSPC SP-1, followed by spot preparation of deteriorated, rusted or scaling areas in accordance with SSPC-SP2/3, Hand or Power Tool Cleaning.

3. This surface preparation applies solely to Process Piping, Hangers, & Fittings.

B. Process Piping, Hangers, & Fittings Alternate Preparation –

NOTE: This item will be used only if directed by Engineer after evaluation of adhesion test (see 3.10) and other evaluations deemed necessary by Engineer.

1. All surfaces shall be dry when coated and free from dirt, dust, sand, mud, oil, grease, rust, mill scale, and other objectionable substances. All steel surfaces shall be prepared for coating by being thoroughly cleaned by blasting. The specified prime (first) coat shall be applied to blasted surfaces immediately after cleaning and abrading. In every case, the prime coat shall be applied before visible rust appears. Surface preparation for coating shall conform to SSPC-SP10 (near white blast cleaning) specifications.

2. After blast cleaning to SSPC-SP10, all weld seams shall be given a brush – applied coat of specified primer, thinned as recommended by the manufacturer. Application of the first coat may proceed as soon as the weld seam is dry.

C. Railing & Catwalk Preparation

1. All surfaces shall be dry when coated and free from dirt, dust, sand, mud, oil, grease, rust, mill scale, and other objectionable substances.

2. Pressure washing preparation is permitted if the Contractor can document through adhesion testing specified in 3.10 that the existing paint primer and top coat is durable and compatible with an overcoat paint application (see 2.04). Following approval from the Owner for an overcoat application, the surface shall be prepared through pressure washing in accordance with SSPC SP-1, followed by spot preparation of deteriorated, rusted or scaling areas in accordance with SSPC SP-11.

   a. High pressure wash shall be at a minimum of 4,500 psi sustained pressure at the nozzle as determined by a certified gauge at the nozzle to remove all water soluble contamination and faulty/loose/non-adhering existing paint.

3. This surface preparation applies solely to railing & catwalks.

D. Railing & Catwalk Alternate Preparation –

NOTE: This item will be used only if directed by Engineer after evaluation of adhesion test (see 3.10) and other evaluations deemed necessary by Engineer.

1. All surfaces shall be dry when coated and free from dirt, dust, sand, mud, oil, grease, rust, mill scale, and other objectionable substances. All steel surfaces shall be prepared for coating by being thoroughly cleaned by blasting. The specified prime (first) coat shall be applied to blasted surfaces immediately after cleaning and abrading. In every case, the prime coat shall be applied before visible rust appears. Surface preparation for coating shall conform to SSPC-SP10 (near white blast cleaning) specifications.

2. After blast cleaning to SSPC-SP10, all weld seams shall be given a brush – applied coat of specified primer, thinned as recommended by the manufacturer. Application of the first coat may proceed as soon as the weld seam is dry.

E. Door & Door Frame Preparation

1. All surfaces shall be dry when coated and free from dirt, dust, sand, mud, oil, grease, rust, mill scale, and other objectionable substances.

2. The surface shall be prepared through cleaning with Manufacturer's prep cleaner in accordance with SSPC SP-1, followed by spot preparation of deteriorated, rusted or scaling areas in accordance with SSPC-SP2/3, Hand or Power Tool Cleaning.

3. This surface preparation applies solely to Doors & Door Frames.

F. Wall Preparation

1. All surfaces shall be dry when coated and free from dirt, dust, sand, mud, oil, grease, rust, mill scale, and other objectionable substances.

2. The surface shall be prepared through cleaning with Chlor-Wash or an approved multi-purpose cleaner and salt remover in accordance with SSPC SP-1, followed by spot preparation of deteriorated, rusted, chipping, or scaling areas in accordance with SSPC-SP2/3, Hand or Power Tool Cleaning.

G. Protection (All Surface Preparation Operations)

1. Suitable containment for all surface preparation operations shall be provided to protect adjacent water treatment plant filter and equipment from damage and/or contamination. Containment should conform to applicable methods of SSPC Guide 6. Fugitive dust and /or debris shall not be allowed to escape into the atmosphere.

2. Lead abatement measures shall be of the contractor's own methods and be compliant with all local, state, and federal requirements, including but not limited to USEPA and OSHA requirements. The measure shall provide for soil and atmospheric capture of contaminants and removal of contaminated materials in accordance with all applicable laws and rules. The measure should provide protection the adjacent water treatment plant filter, plant equipment, plant personnel, and the contractor's workers.

3.02 MIXING AND THINNING

A. Coating shall be thoroughly mixed each time any is withdrawn from the container. Coating containers shall be kept tightly closed except while coating is being withdrawn.

B. Coating shall be factory mixed to proper consistency and viscosity for hot weather application without thinning. Thinning will be permitted only as necessary to obtain recommended coverage at lower application temperatures. In no case shall the wet film thickness of applied coatings be reduced, by the addition of thinner or otherwise, below the thickness specified herein and recommended by the coatings manufacturer. Any thinning shall be done only when permitted by the manufacturer and shall be done in compliance with applicable air quality regulations.

3.03 COATING SYSTEMS

A. Coatings specified in 2.05 shall be applied in a neat manner, with finished surfaces free of runs, sags, ridges, laps, and brush marks. Each coat shall be hard and dry through the entire coating film before the next coat is applied. Each coat shall be applied in a manner that will produce an even film of uniform and proper thickness. In no case shall coating be applied at a rate of coverage which is greater than the maximum coverage rate recommended by the manufacturer.

B. Dry film thickness of the coating systems shall be as specified herein.

C. For the coating systems, the color of alternate coats shall provide a contrast to assist in obtaining complete coverage.

D. Coatings for the exterior surfaces of the reservoirs, standpipes, or elevated tanks shall be applied using either hand brushes or rollers. Application by spray is not acceptable for tanks located in residential neighborhoods of the Owner or where overspray may damage adjacent private property.

E. Coating showing sags, checks, blisters, teardrops, or fat edges will not be accepted and shall be entirely removed and the surface repainted.

3.04 FIELD COATING

A. Unless otherwise authorized by Engineer, all field coating shall be done after erection, hydrostatic, and weld testing. If coating is done before testing, coating shall be repaired after all welding repairs have been made.

3.05 WEATHER CONDITIONS

A. Coating shall not be applied, except under shelter, during wet, damp, or foggy weather, or when windblown dust, dirt debris, or insects will collect on freshly applied coating. Coating applied with spray equipment, where permitted, shall be protected during application from being deflected or carried away by wind. Coating shall not be applied to surfaces of metals which have a temperature below 50º F for epoxies and 40º F for polyurethanes, regardless of air temperature; or when metal temperature and atmospheric conditions cause condensation on the surface of the metal.

3.06 FIELD QUALITY CONTROL

A. The surfaces shall be cleaned and prepared as required to properly conduct the visual inspection, film thickness, holiday testing, and adhesion testing. The Owner shall be given the opportunity to witness all inspection and testing. Contractor shall furnish all testing equipment.

B. Contractor will be required to furnish the following testing equipment:

1. Surface Profile Tester – Testex Set
2. Surface Temperature Thermometers (magnetic case)
3. Wet Film Thickness Gauge
4. Dry Film Thickness Gauge (non-destructive magnetic type)
5. NIST Certified Calibration Standards
6. Weather Meter (measure humidity, air temperature, surface temperature, calculate dew point).
7. Low Voltage Holiday Detector
8. Adhesion Tester

3.07 VISUAL INSPECTION

A. The surface of the coating shall be visually inspected.

3.08 FILM THICKNESS

A. Coating film thickness shall be verified by Engineer by measuring the film thickness of each coat as it is applied and the dry film thickness of the entire system. Wet film thickness shall be measured with a gauge that will measure the wet film thickness within an accuracy of ±0.5 mil.

B. Wet and dry film thickness of the coating systems shall be in accordance with the applicable requirements of AWWA D102, and SSPC PA2. Test reports shall be witnessed and certified by a representative of Contractor and submitted.

3.09 HOLIDAY TESTING

A. A low voltage discontinuity holiday spark test shall be conducted after the coating system has been allowed to cure sufficiently, as recommended by the coating manufacturer. This test shall be performed in accordance with NACE Standard RPO188 or ASTM D5162 and witnessed by Engineer.

B. The material manufacturer shall holiday-test all interior metal surfaces below the maximum water level and, interior metal surfaces above the maximum water level that are covered with a coating system. Contractor shall use an acceptable low-voltage electrical holiday tester set at the recommended voltage. Contractor shall verify the testing equipment is working properly before beginning the holiday testing of the lining. The electrode movement shall be continuous and shall proceed in a systematic manner that will cover 100 percent of the lining surface.

C. A detected holidays and pinholes shall be marked and repaired as recommended by the material manufacturer.

3.10 ADHESION TESTING

A. Before application of the exterior coating system, an adhesion test shall be conducted on three (3) separate properly prepared metal surfaces that are acceptable to the material manufacturer and Engineer. The test areas shall be at least 2 square feet to allow a minimum of three tests to be conducted at each location. The test areas shall be coated with the specified system and cured as recommended by the coating material manufacturer. Pull-off strength adhesion tests of the coating shall be conducted by the coating material manufacturer in accordance with ASTM D4541 using an Elcometer tensile adhesion tester. Adhesion strength shall equal or exceed the minimum adhesion strength recommended by the material manufacturer.

B. If the coating system fails the adhesion test, the cause of the failure shall be determined and corrected before re-conducting the test.

C. Adhesion testing shall be conducted at three locations to be specified at the time of the coating system preparation.

3.11 FIRST ANNIVERSARY INSPECTION

A first anniversary inspection shall be conducted in accordance with AWWA D102.

3.12 DISINFECTION

A. Standards

1. The tank structure shall be disinfected by the Contractor at the time of testing by chlorination Method 3 in accordance with AWWA Specification C652 "Disinfection of Water Storage Facilities".

2. Disinfection shall not take place until tank paint is fully cured.

3. Contractor is responsible to coordinate disposal of highly chlorinated water in accordance with the Maryland Department of Environment.

B. After chlorination is completed, and before the tank is placed in service, tank drinking water shall be sampled and tested in accordance with ANSI/AWWA D105-80, SECTION 4.4.

C. Labor, tools, materials and equipment necessary for field testing and disinfection shall be furnished by the Contractor.

D. The Contractor shall test and disinfect the storage tank in the presence of the Engineer.

PART 4 – SEQUENCE OF WORK

4.01 COORDINATION

A. All work shall be coordinated with Operations and with other trades completing the water treatment plant renovations.

4.02 PAINTING

A. Cleaning / Surface Preparation

1. Refer to Part 3 of this specification.

B. Painting

2. Refer to Part 3 of this specification.

3.04 DAMAGES

Contractor is responsible for any and all damages caused by or arising out of or from the specified work

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 10400

IDENTIFICATION DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included: Furnish labor, materials, tools, equipment, services and supervision required to complete the work of this Section, including all incidental and complementary work shown, specified or necessary to complete work.

1. Exterior signage.

2. Interior signage.

1.02 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

B. ADA - American Disabilities Act

1.03 SUBMITTALS

A. Shop Drawings

1. Contractor shall submit shop drawings for review in accordance with Conditions of Contract.

2. Indicate locations, dimensions, anchorage, types and gauges of materials being used, features included, elevations, etc.

B. Manufacturer's Literature: Submit manufacturer's latest publications of descriptive literature and product data.

C. Samples: Submit as follows:

1. Room Identification and Accessibility Signage

2. Fasteners

1.04 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Product Handling:

1. Deliver all materials in good condition. Store in dry place, off ground; keep dry at all times. Handle materials to prevent damage to product or structure.

PART 2 - PRODUCTS

2.01 ROOM IDENTIFICATION AND ACCESSIBILITY SIGNAGE

A. Provide plastic plaques with letters, numbers and Grade 2 Braille raised 1/32" above ground.

1. Letter and Number Height: 1"

2. Letter Style: Uppercase Helvetica Medium.

3. Colors: As selected by Owner and as follows:

a. Color integral part of Braille copy, letters and numbers.

b. Light characters on dark background.

c. Dark characters on light background.

4. Finish: Characters, letters, numbers and background shall have an eggshell finish.

5. Background: 1/8" thick plastic, 3" high x length required.

B. Provide one plaque at each entrance to rooms, lobbies, passages and alcoves. Provide room numbers for classrooms and room names at other locations.

C. International accessibility symbol shall be provided at the following locations if accessible:

1. Toilet Facilities

2. Accessible Entrances and Means of Egress

3. Drinking Fountains

4. Public Telephones

D. Mounting Materials: Provide silicone adhesive or screws for mounting signs.

E. Manufacturers

1. Best Manufacturing (303) 249-2378

2. ASI Sign Systems, Inc. (800) 274-7732

2.02 EXTERIOR SIGNS

A. Parking Signs

NOT USED

B. Non-Illuminated Signs (exterior and interior)

1. Metal Signs: 20 gauge aluminum with baked enamel finish.

2. Exit Signs: For Emergency Exits details in accordance with local safety code requirement for exit signs.

3. Fire Extinguishers: For identifying fire extinguisher locations. Coordinate locations of signs with Engineer and Owner.

4. Fasteners: Completely non-corrosive metal fasteners designed specifically for anchoring into substrates at points of installation. Type as specified.

2.03 EXTERIOR IDENTIFICATION SYSTEM

A. The exterior identification system for concrete structures (such as tanks) shall consist of stenciled on structure identification labels. Letters shall be black, and not less than 12" high. Location shall be as designated by the Engineer. Labels shall be not less than 20" high.

B. The exterior identification system for buildings shall consist of an aluminum faced acrylic backed non-illuminated panel sign. Aluminum face shall be zigged out for graphic destination. Letters shall not be less than 6" high and shall be Helvetica Medium upper case. Exterior signs shall not be less than 12" high for building names and 4" high letters, 10" high for sign on doors.

2.04 PROCESS EQUIPMENT, PIPE AND VALVE IDENTIFICATION MARKINGS

A. Equipment Identification

1. Mark each unit of process equipment including all pumps, air compressors, local control panels, local recorders, analyzers, chemical feed tanks, reset timer, flow meters, thermostats, switches, etc. with its functional name (example: “Raw Sewage Pump No. 1", “Chlorine Leak Detector”) by means of an etched aluminum name plate with permanent adhesive backing.

2. Name plates, unless otherwise specified, shall be 1-1/2" x 4" with a black enamel background and etched or engraved lettering.

3. Insure that equipment designations and their corresponding electrical control equipment designations coincide.

B. Piping Identification

1. Identify process piping with its process designation and direction of flow identified with semi-rigid, snap-on acrylic-plastic identification markers at 15-foot intervals, at each change of direction, and adjacent to each point it passes through a wall, floor or ceiling. Comply with ANSI and OSHA pipe marking requirements.

2. Identify pipes less than 1" in diameter with brass tags, 1-1/2" in diameter, with depressed 1/4" high black enamel-filled letters, securely fastened at 5-foot intervals.

C. Valve Identification

1. Identify each valve with an identifying letter designating the system and an identifying number designating the unit served (example: valve in discharge piping from High Service Pump No. 2 shall be designated as “High Service #2”). Identify solenoid valves with same designation indicated on process and instrumentation diagrams included in the Contract Drawings. Identify air valves with the designation “Air” and then the valve number.

2. Identify valves with brass identification tags, 1-1/2" in diameter, with depressed 1/4" high black enamel-filled letters, securely fastened to the valve.

3. Furnish a chart, in duplicate, of all valves. Include valve identification number, normal open/closed position, location, and purpose.

D. Locations and method of attachment of name plates, tags, and markers shall be approved by the Owner’s representative.

2.05 SIGN SCHEDULE

A. The following metal signs, as specified in paragraph 2.02, shall be provided at the location indicated by the Engineer.

1. Exit Signs

2. Fire Extinguishers

B. The following structure identification labels as described in Section 2.03.A shall be provided at the locations designated by the Engineer.

****None required for this project.****

C. The following structure identification labels as described in Section 2.03.B shall be provided at the locations designated by the Engineer.

1. “Hazardous Area” (to be fastened to exterior of double doors entering the wet well)

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. Identification devices shall be installed level, plumb and true, in correct relation to adjoining work.

2. Secure parts in rigid, substantial manner; attachment concealed wherever practicable.

3. All items shall be complete with bolts, anchors, clips, ready to install.

B. Room Identification and Accessibility Signage

1. Mount signs on wall adjacent to the latch side of the door 60" above finished floor.

2. Where no wall space available adjacent to latch side of door, place signs on nearest adjacent wall.

C. Exterior Signage: Mount signs on galvanized U-channel, set a minimum of 3'-0" into ground and encase with concrete.

D. Building Mounted Installation

1. Install signs with completely corrosion free anchorage.

2. Install signs level, plumb, and correctly positioned on the structure with respect to the visible lines of the structure.

3. Completed signs installation shall be free of twisting or other deformation.

4. Door Mounted Installations: Install nameplates with completely concealed anchorage system such as permanent adhesives designed specifically for such purpose.

3.02 CLEANING AND TOUCH-UP

A. At completion of installations, clean surfaces free of handling marks and all other forms of dirt. Use materials and methods that will not cause damage to the installed material surfaces or to adjacent structure surfaces.

B. Touch-up minor surface damage which can be job-repaired to satisfactory condition, subject to approval of the Engineer.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 10522

FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Fire extinguishers.

1.03 SUBMITTALS

General: Submittals according to the Conditions of the Contract and Division 1 Specification Sections.

1.04 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain extinguishers from one source, from a single manufacturer.

B. UL-Listed Products: Fire extinguishers shall be UL listed with UL listing mark for type, rating, and classification of extinguisher.

PART 2- PRODUCTS

2.01 MANUFACTURERS

Furnish two (2) extinguishers from the available manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but at not limited to the following:

A. Amerex

B. Larsen's Manufacturing Co.

2.02 FIRE EXTINGUISHERS

A. General: Provide fire extinguishers for locations indicated on plans, in colors and finishes selected by Engineer from manufacturer's standard that comply with authorities having jurisdiction.

B. Multipurpose Dry Chemical Type: UL-rated ABC, 5-lb nominal capacity, in enameled steel container.

PART 3- EXECUTION

3.01 EXAMINATION

Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Follow manufacturer's printed instructions for installation.

B. Install in locations and at mounting heights indicated or, if not indicated, at heights to comply with applicable regulations of governing authorities.

END OF SECTION

SECTION 11101

GENERAL PROCESS MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. The provisions of this entire section of the specifications are intended to govern the quality of design, fabrication, workmanship, operation, etc., of all materials, equipment and appurtenances to be furnished and installed under the various sections of the process mechanical specifications and all other sections that include process mechanical equipment as part of the specified items.

1.02 SUBMITTALS

A. Shop Drawings and Product Data

1. Shop drawings, including dimensioned drawings, descriptive literature, performance data, electrical characteristics, and in general all information necessary to provide compliance with the specifications, shall be submitted as required in Section 01300.

B. Maintenance Data and Operating Instructions

1. Submit an Operation and Maintenance Manual for the equipment furnished including a detailed description of the function of each principal component, procedures for operation, instructions for overhaul and maintenance in accordance with Section 01300. Include lubrication schedule, safety precautions, test procedures, electrical schematics, and parts lists.

1.03 GUARANTEE

All materials, equipment, workmanship and performance shall be guaranteed for the period and in accordance with the provisions of Section 01700.

1.04 MANUFACTURER'S OPERATION AND MAINTENANCE MANUALS

The Contractor shall provide manufacturer's operation and maintenance manuals as required in Section 01300.

1.05 STANDARDS

Where standards, codes or specifications are referred to, the reference is to particular standards, codes or specifications together with all the latest amendments and errata applicable at the time the bids are taken. These are listed on the following page:

I.E.E.E.	Institute of Electrical & Electronics Engineers
A.S.T.M.	American Society for Testing Materials
A.S.M.E.	American Society of Mechanical Engineers
A.N.S.I.	American National Standards Institute

A.W.S.	American Welding Society
A.W.W.A.	American Water Works Association
N.F.P.A.	National Fire Protection Association
N.E.M.A.	National Electrical Manufacturer's Association
Federal	Federal Government Specifications
O.S.H.A.	Occupational Safety and Health Act
U.L.	Underwriters Laboratories
A.A.B.C.	Associated Air Balance Council
A.D.C.	Air Diffusion Council
A.G.A.	American Gas Association
A.R.I.	Air Conditioning and Refrigeration Institute
C.S.	Commercial Standard
I.B.R.	Institute of Boiler and Radiator Manufacturers
M.S.S.P.	Manufacturers Standards Society of the Valve and Fitting Industry
S.M.A.C.N.A.	Sheet Metal and Air Conditioning Contractors National Association
N.E.C.	National Electrical Code

1.06 GENERAL DESIGN OF EQUIPMENT AND MACHINERY

A. All equipment and machinery furnished under this contract shall be of the latest and most improved design suitable for the service of which it is to be used. All equipment and machinery shall be designed and constructed to operate efficiently, continuously and quietly under the specified requirements with a minimum of labor, power, maintenance, renewals and repairs. The design and construction of all equipment and machinery shall be such as to permit operation with minimum noise, wear and vibration (maximum amplitude of 3.0 mils unless otherwise specified) when properly installed.

B. Ample room for erecting, repairs, inspecting and adjusting all equipment and machinery shall be provided. The design, construction and installation of all equipment and machinery shall conform to and comply with the latest safety codes and regulations.

C. The design and construction of the several units shall be such that they shall present a uniform appearance and the arrangement shall be such that their operation shall be in harmony in every respect. Whenever possible, fittings and fixtures of the same make and model shall be used for the several units and their connections. All equipment of identical type and service shall be the product of the same manufacturer.

D. All equipment selected shall be of such size and general arrangement to suit the space in which it is to be installed.

E. The various parts of the equipment and machinery shall be of plain shape and good lines, especially designed and constructed for strength and durability.

Casting shall be designed and constructed to cool uniformly without shrinking strains and shall have good sized fillets at all re-entrant corners. Sudden change of section shall be avoided.

F. Whenever possible, parts of each unit shall be made to gauge and be a duplicate of and interchangeable with the same parts of other machines of the same size and kind.

G. The workmanship shall be of the highest class throughout.

H. All assembles shall be completely shop fabricated and structural steel parts shall be shop erected. Assemblies and structural steel parts shall be match-marked before being disassembled for shipment. Parts shall be shipped assembled in as large unit as possible to minimize field reassembly. All parts shall be amply proportioned for all stresses which may occur during operation, and for any additional stresses which may occur during fabrication and erection.

I. Unless otherwise specified, welding shall be in accordance with the latest standard specifications for “Gas Tight Welding” of the American Welding Society.

J. Unless otherwise specified, galvanizing shall be hot-dipped in accordance with the latest standard specifications for “Zinc Coating” of the ASTM, Serial Designation A-123.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Unless otherwise specified, materials shall be in accordance with the following latest Standard Specifications of the ASTM:

Structural Steel	A-36
Welding Steel Pipe	A-53
Iron Castings	A-48
Babbitt	B-23
Bronze Castings	B-30
Bronze (Manganese)	B-138
Bronze (Silicone)	B-98
Steel Bolts	A-307
Hot Dip Zinc Coating	A-123
Stainless Steel Bolts	A-193, Grade B, Type 2

B. All materials shall, if required, be tested and shall fulfill all requirements specified. Physical tests may be made by the Charles Town Utility Board or their representative. The Contractor at his own expense shall furnish test pieces and samples in the number, shape, size and finish required by the Engineer. All broken material shall become the property of the GCDPU. The failure of test specimens to fully conform to the requirements of the specifications shall be sufficient cause for rejection of the whole melt or stock from which samples were obtained.

C. Iron castings shall be smooth, clean and free from scale, lumps, blisters and other defects. No plugging, welding or filling will be allowed.

D. The alloy grade number of all Babbitt shall be that bearing alloy of a composition recommended by the manufacturer of the equipment or machinery for the service required, subject to the approval of the Engineer.

E. All bronze shall be made of new material and shall be free from objectionable imperfections. If the materials show signs of improper mixing when being machined, the castings will be rejected.

2.02 JOURNALS, BEARINGS AND KEYS

A. Journals and bearing surfaces shall be of sufficient size and properly proportioned for the least wear and to avoid heating under all conditions, and where necessary, provisions shall be made for each removal and for proper adjustments. Journals shall be suitable boxes which, where necessary, shall be lined with Babbitt metal hammered into grooves and bored in place. If bearings are of the ball bearing type, both inner and outer races as well as the balls shall be heat treated steel to resist wear. The balls shall be of ample size to carry the maximum loads with a large factor of safety to prevent flaking, spalling, or crushing. The balls shall be properly spaced and held in position by rugged continuous spacing or retainer rings.

B. Pins and keys shall be properly proportioned. Keys, nuts and all other parts which might otherwise work loose shall be secured with approved locking devices.

2.03 LUBRICATION

A. All bearings, except those specifically requiring oil or water lubrication, shall be pressure grease lubricated. All lubrication points shall be readily accessible, away from locations dangerous to workmen. Pressure grease lubrication fittings shall be the “Alemite” type as made by the Stewart Warner Corporation, or equal. The pattern of the fitting shall be selected for accessibility in lubricating and shall meet the approval of the Engineer. Housings of grease lubricated bearings shall be automatically exhausted to atmosphere to prevent excessive greasing. The Contractor shall furnish three Alemite Hydraulic guns, or equal.

B. The Contractor shall furnish lubrication charts or schedules for each piece of equipment or machinery. The charts or schedules shall designate each point of lubrication, the type of lubricant to be applied and the frequency of lubrication. Charts and schedules shall be submitted to the Engineer in quadruplicate, bound in folios, with each chart or schedule protected by a transparent plastic envelope.

C. The Contractor shall furnish one (1) year supply of each type of lubricant. A typewritten list shall be furnished with the lubricants, designating the specific lubricant to be used for each piece of equipment. This is in addition to the required operating and maintenance manuals which will also contain lubrication requirements.

2.04 MOTORS AND CONTROLS - GENERAL

A. Motors and controls shall conform to the latest requirements of IEEE and NEMA, and where applicable, shall be UL listed. Minimum sizes are specified with the

driven equipment. Motor starting and control equipment is specified either with the motor which is controlled or in an electrical specification section. The Contractor is advised to consult all specification sections to determine responsibility for motors and controls.

B. Motors shall be designed, built and tested in accordance with the latest revision of NEMA Standard MG 1.

C. Motors shall be suitable for use under the conditions and with the equipment to which applied, and designed for operation on the electrical systems specified or indicated.

1. Motor capacities shall be such that the horsepower rating and the rated full-load current will not be exceeded while operating under the specified operating conditions. Under no condition shall the motor current exceed that indicated on the nameplate.

2. Motor sizes noted in the individual equipment specifications are minimum requirements only. It is the responsibility of the equipment manufacturers and of the Contractor to furnish motors, electrical circuits and equipment of ample capacity to operate the equipment without overload, without exceeding the rated full-load current, or overheating at full-load capacity under the most severe operating service of this equipment. Motors shall have sufficient torque to accelerate the total WR^2 of the driven equipment to operating speed.

3. Motors shall be continuous duty type and shall operate quietly at all speeds and loads.

4. Motors shall be designed for operation on 60 hertz power service. Unless otherwise specified or shown, motors less than 1/2 horsepower shall be single phase, and motors 1/2 horsepower and larger shall be 3 phase.

5. Motors shall be mounted so that the motor can be removed without removing the entire driven unit.

D. Single phase motors smaller than 1/20 horsepower shall be ball or sleeve bearing, drip-proof, totally enclosed or explosion proof, as specified, 115 volts, permanent split capacitor or shaded pole type. These motors shall not be used for general power purposes and shall only be provided as built-in components of such mechanical equipment as fans, unit heaters, humidifiers and damper controllers.

E. Single phase motors 1/20 horsepower and larger shall be ball bearing, drip-proof, totally enclosed or explosion proof, as specified, with Class A or B insulation, as standard with the motor manufacturer; 115, 115/230, 200 or 230 volts as required; capacitor start-induction run, permanent split capacitor, or repulsion start-induction run type.

F. Except as otherwise specified in the various specification sections, 3 phase motors shall meet the requirements of this paragraph. Motors shall be NEMA design B squirrel cage induction type. Insulation shall be Class F and motor shall be rated at no greater than 50 degrees C rise for open motors and 65 degrees C rise for closed motors both above an ambient temperature of 45 degrees C. At

40 degrees C ambient temperature explosion proof and totally enclosed motors shall have a 1.00 service factor and drip-proof motors shall have a service factor of 1.15 or higher. Motors specified for operation at 480 volts shall be name-plated 460 volts.

G. Minimum three phase motor efficiencies at full load for motors having nominal rated speeds of 1200 RPM and higher shall be as follows:

Horsepower	Minimum Efficiency
1	80.0
1-1/2	81.5
2	82.5
3	84.0
4	85.5
5	87.5
7-1/2	87.5
10	87.5
15	88.5
20	90.2
25	91.0
30	91.0
40	91.7
50	92.4
60	93.0
75	93.0
100	93.6
125	93.6
150	94.1
200	94.5
250	95.0

Three phase motors shall be E-plus Energy Efficient Standard Duty Motor of the Electric Motor Division of Goulds, Inc., the MAC II High Efficiency motor of Westinghouse Electric Corporation, the equivalent product of Baldor Company, or equal.

H. Motors seventy-five (75) horsepower and larger shall be as specified with the driven equipment in these specifications.

I. Belt-connected motors shall have adjustable bases and set screws to maintain proper belt tension. All fan motors shall have adjustable sheaves for speed adjustment.

2.05 FLANGES AND BOLTS

A. Flanges, except as otherwise specified, shall be cast solid, and bolt holes shall be drilled and spot-faced on the back. Stud holes shall not be drilled through. Flanges shall be uniform in thickness and shall come fair and, if required, shall be turned or chipped in a neat and workmanlike manner.

B. Jacking screws shall be provided for covers, etc. where required, and also suitable eye bolts for lifting. Bolts and nuts shall be of the best quality of open hearth, free machining steel. Bolts shall have good, sound, well-fitting threads; nuts shall be cold pressed. All heads, nuts and threads shall be of the American

Standard regular sizes. All ferrous bolts and nuts shall be galvanized by the hot dipped process.

C. Bolts and nuts connecting pumps, valves and meters (as in flange connections) shall be Stainless Steel - Grade 416.

2.06 COUPLINGS

A. Except where otherwise specified for a particular item of equipment, all equipment where flexible couplings are specified or are required for the purpose, a standard self-aligning forged steel coupling with sealed lubrication, as manufactured by Thomas, Koppers, Falk, Sier-Bath, or equal shall be provided between each motor and its driven equipment. One hub of the coupling shall be firmly fixed and keyed to the equipment shaft with the other hub similarly secured to the abutting drive shaft. Couplings shall be placed as close as possible to the driven equipment and the motor bearings to make compactly arranged units. Couplings shall be of all metal construction and shall be moisture-proof and dustproof. Arrangement of couplings shall be such that there is sufficient room to place a dial indicator for alignment checking of shafts of the motor driven equipment. Each coupling shall be provided with an easily removable guard meeting all OSHA requirements.

B. All equipment and motors/drives shall be field aligned using a dial indicator in accordance with the procedures established by the latest revision of the Hydraulic Institute Standards. Parallel and angular misalignment shall not exceed the limits recommended by both the equipment and the coupling manufacturer.

2.07 EQUIPMENT BEDPLATES

A. The various items of motor driven equipment, such as pumps, shall be mounted on structural steel bedplates. The bedplates shall be adequate size to accommodate the equipment and its motor, to form an integral rigid mounting platform. Steel or brass shims shall be used to level equipment bedplates mounted in contact with concrete pads or floors. Jacking bolts or jacking (leveling) nuts on mounting studs shall not be used in lieu of shims. Bedplates shall be grouted to the concrete base and shall be filed with grout in all instances where the manufacturer has made provision for introducing grouting mixture into bedplate cavities. It shall be the contractor's complete responsibility to determine the proper method, to provide all materials and components required, and to coordinate the work, to set, couple, align and install all equipment in a satisfactory manner.

PART 3 - EXECUTION

3.01 MANNER OF INSTALLATION

A. The general arrangement of pipe and equipment shall be as shown on the drawings. Detailed drawings of proposed departures due to actual field conditions or other causes shall be submitted to the Engineer for approval. The Contractor shall carefully examine the drawings and shall be responsible for the proper fitting of materials and equipment as indicated, without substantial alteration. Because of the small scale of the drawings, it is not possible to indicate the exact location of piping, all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the space

requirements for proper clearances and the structural and finish conditions affecting his work and shall arrange such work accordingly, furnishing such offsets, fittings, valves and accessories as may be required to meet such conditions.

B. Each trade shall determine the location, size, etc. of all chases and openings required for the proper installation of its work, and shall see that such are provided. Where it is necessary to run pipes or ductwork through walls or fittings, the trade performing the work shall notify the Contractor so that proper provisions can be made for same. Each trade shall furnish and set all inserts, sleeves, hanger supports, etc. required for its work and shall be responsible for their proper and permanent location.

C. All piping and ductwork exposed to view shall be run generally parallel with the lines of the building and as close to walls and column as may be practical and consistent with proper grade and the maintenance of proper clearances for access to all parts requiring servicing.

D. The Contractor, in the prosecution of the work, shall do no cutting of woodwork, masonry, concrete or other materials after same have been installed, without the written permission of the Engineer. No waterproofing shall be cut for any purpose except on written approval of the Engineer.

3.02 TESTING

A. After erection, the Contractor shall adjust and balance all equipment and systems, and shall demonstrate that all equipment is operating in a satisfactory manner. All rotating equipment shall be lubricated according to recommendations of the manufacturer and all adjustments shall be made to suit anticipated station operating conditions. Each piece of machinery shall be tested to show that it operates quietly, without vibration, overheating, or sign of distress at full specified capacity. Adjustments shall be made as necessary. All defective parts on machinery shall be replaced.

B. The Engineer shall be notified in advance of all tests and all tests shall be conducted to his entire satisfaction.

3.03 MISCELLANEOUS

A. Finished parts shall be well protected in the shop, during transportation and before and after erection to prevent injury of any kind. Injured parts which in the opinion of the Engineer are damaged or which cannot be refitted, shall be promptly replaced by the Contractor without expense to the Owner. All exposed finished parts of machinery shall be greased or oiled before shipment.

B. The Contractor shall furnish all tools of special nature which are required for making adjustments (by the Owner after the work has been turned over to him) to equipment, but will not be required to furnish standard tools.

C. All exposed belts, gears, and drives shall be protected with guards. Guards may be of the equipment manufacturer's standard design, but must meet all the OSHA Standards.

3.04 PAINTING AND LABELING

A. All fabricated or assembled surfaces normally painted shall be thoroughly dry and free from all rust, grease, dirt or scale. The Contractor is reminded to correlate the selection of shop prime coats to be compatible with subsequent field applied coats of paint. The Contractor shall touch up paint any item damaged during shipping or installation.

B. Each piece of equipment (including mechanical operators, and electrical switches for the equipment) shall be identified by hand painting or stenciled, two inch letters and numbers, to indicate the service or function. Unless specified otherwise in the mechanical and electrical sections of these specifications, each motor and motor controller shall be similarly numbered (or lettered) to correspond to the number (or letter) of the driven unit.

3.05 ADJUSTMENTS TO RELATED WORK

The final work shall include any adjustment that may be required by the approved equipment furnished, with modifications made to concrete shapes and to dimensions shown on the contract drawings as may be required to suit the details of the approved equipment furnished, all at no additional cost to the Owner.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 11320

WET PIT SUBMERSIBLE NON-CLOG SEWAGE PUMPS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Submersible Non-Clog Pumps

1.02 DESCRIPTION

A. Under this section, the contractor shall provide all labor, equipment and materials necessary to furnish, install, test and place in operation submersible pumping units as shown in the plans and as specified herein.

B. Intended Purpose: The purpose of the pumps is to convey raw, un-screened, un-treated sewage under the conditions and installation described in this specification and shown in the project plans.

1.03 RELATED SECTIONS

A. Section 01300 - Submittals

B. Section 15010 - General Building Mechanical Requirements

C. DIVISION 16 - Electrical

1.04 SUBMITTALS

A. Submit for approval complete characteristic curves of pumps prior to fabrication.

B. Submit completely assembled pump weight for each pump model to be provided.

C. Submit the following pump electric motor data:

1. Horsepower Rating
2. Voltage
3. Number of Phases
4. Service Factor
5. RPM @ Full Load
6. Locked-Rotor kVA Code (letter)
7. LRA (Locked Rotor Amps)
8. Design Letter (A, B, C, or D)
9. FLA (Full Load Amps)
10. Efficiency (%)
11. Power Factor

D. Prior to pump delivery submit for approval certified copies of factory-run pump performance tests. Characteristics of pumps may have a tolerance of plus 10 percent of rated capacity at rated head or plus 5 percent of rated head at rated capacity. No minus tolerance will be acceptable. Give the Engineer seven days advance notice of performance test date.

E. Dimension drawings suitable for installation purposes, showing in particular distance from centerline of the pump to the face of the suction and discharge flanges, location and size of pump base anchor bolts, motor dimensions and the location and number of motor lifting lugs.

F. Complete material specifications for the pump.

G. Complete material specifications and drawings for the pump rail system.

H. Complete “Manufacturer’s Equipment Warranty & Certification” form included at the back of this section.

I. Submit in accordance with Section 01300.

1.05 QUALITY ASSURANCE

A. Design and construct the pumps in accordance with standards of the Hydraulic Institute. The efficiency of the pumps, when operating under conditions of the specified capacities and heads, shall be as near peak efficiency as practicable.

B. Obtain pumping equipment, motors, pump controls and appurtenances from the pump supplier whose responsibility is to ensure that the pumping equipment is properly coordinated and operated in accordance with these Specifications.

C. The pumps shown and specified within the project drawings and these specifications are based on the products manufactured by the Barnes Brand of Crane Pumps & Systems, Piqua, Ohio. References are given only as an indication of the quality of materials and workmanship to be used. Equal pump manufacturer(s) must be submitted for approval during the submittal review process. Equal pump manufacturer must also complete the Equipment Guarantee Certification Form included at the end of these specifications.

PART 2 – PRODUCTS

2.01 NON-CLOG WASTE WATER PUMPS

A. GENERAL – Furnish and install a complete non-clog sewage pumping system, consisting of: three (3) submersible non-clog sewage pumps and lift-out rail systems, valves, controls, and all other appurtenances to make a complete system. Complete pump and lift-out system shall be explosion proof and spark-resistant, FM listed or T4 certified by CSA for Class 1, Groups C and D hazardous location service.

The design shall be such that the pumping units will be automatically connected to the discharge piping when lowered into place on the discharge connection. The pump shall be easily removable for inspection or service without the need for removal of nuts, bolts, or other fasteners and without the need for personnel to enter the lower wet well. Each pump shall be fitted with a stainless-steel chain of

adequate strength and length to permit raising the pump for inspection and removal.

B. PUMP MODEL - Each pumping unit, including motor and guide rails, shall be under the unified responsibility of the furnishing pump manufacturer. The pumps shall be Barnes 6XSHDK with 285 mm (11.25") impeller, or approved equal. Pump motors shall be inverter rated for VFD control, operating on 460 Volt, 3-phase, 60 Hz. electrical service. All openings in pump shall be large enough to pass a 3" diameter sphere.

C. OPERATING CONDITIONS – Pumps shall be sized to have a capacity of 1,800 GPM @ 102' TDH with two (2) pumps operating simultaneously in parallel. Each pump motor shall be 50 HP operating at 1750 RPM.

D. MOTOR – Pump motor shall be of the sealed submersible type rated 50 HP @ 1750 RPM, 60 Hertz. Motor shall be for three phase 460 volts. Motor shall be NEMA B type.

Motor shall be inverter rated to be used with Variable Frequency Drives.

Stator winding shall be of the open type with Class H insulation good for 150°C maximum temperature. Winding housing shall be filled with a clean high dielectric oil that lubricates bearings and seals and transfers heat from winding and rotor to outer shell. Air-filled motors that do not have the superior heat dissipating capabilities of oil-filled motors shall not be considered equal.

Motor shall have two heavy duty ball bearings to support pump shaft and take radial and thrust loads and a sleeve guide bushing directly above the lower seal to take radial load and act as flame path for seal chamber. Ball bearings shall be designed for 50,000 hours B-10 life. Stator shall be heat shrunk into motor housing.

A heat sensor thermostat shall be attached to and embedded in the winding and be connected in series with the motor starter contactor coil to stop motor if temperature of winding is more than 130°C. Thermostat to reset automatically when motor cools to safe operating temperature. The common pump, motor shaft shall be of 416 stainless steel.

E. SEALS – Motor shall be protected by two mechanical seals mounted in tandem with a seal chamber between the seals. Seal chamber shall be oil filled to lubricate seal face and to transmit heat from shaft to outer shell.

Seal face shall be carbon and ceramic and lapped to a flatness of one light band. Lower seal faces shall be silicon carbide.

Mechanical seals shall be readily and commercially available from third party sources other than the pump and motor manufacturer, their agents, dealers and/or distributors.

F. MOISTURE DETECTION SYSTEM – A double electrode shall be mounted in the seal chamber to detect any water entering the chamber through the lower seal. Water in the chamber shall cause a red light to turn on at the pump control panel. This signal shall not stop the motor but shall act as a warning only, indicating service is required. The use of single probe or float switch type sensor systems shall not be acceptable. The moisture sensing probe leads shall terminate at a

conductance relay located in the control panel, which shall provide an alarm in the event of moisture intrusion. The sensing relay (if not specifically ordered from the pump manufacturer) shall be approved by the pump/motor manufacturer.

G. IMPELLER – The impeller shall be ductile iron and of the 2-vane solids handling enclosed type. Vane inlet tips shall be carefully rounded to prevent stringy material from catching in vanes. Pump-out vane shall be used in front and back chamber. Impeller shall be dynamically balanced. Impeller shall be driven by stainless steel shaft key and impeller held in place with lock screw and washer. Impeller and motor shall lift off case as a unit without disturbing discharge piping. Impeller neck shall run in bronze wear ring that is pressed into volute case.

H. PUMP CASE – The volute case shall be cast iron and have a flanged center line discharge. Discharge flange shall be 6" ANSI standard with bolt holes straddling center line. A bronze wear ring shall be pressed into case for guiding impeller neck and to prevent corrosion freeze-up. Wear ring to be held from rotating by locking with stainless steel set screw in end of ring.

I. PROTECTIVE COATING – All external casting surfaces of the pump/motor coming into contact with the pumped liquid shall be factory coated with Tnemec 61 (or equal) epoxy paint. Surfaces that are to be painted shall be cleaned and prepared according to the paint manufacturer's specifications prior to paint application. Final dry film thickness (DFT) of 0.010" – 0.012" (10-12 mils).

J. PUMP AND MOTOR CASTING

All external hardware including nameplates on the pump/motor shall be 300 Series stainless steel.

The top end bracket shall be fitted with a lifting bail and shall be capable of supporting four (4) times the combined weight of the pump and motor.

All mating fittings on the motor frame shall have rabbet joints with large overlap as well as O-ring seals to provide for a watertight seal. O-rings shall be Buna-N.

K. BEARING END CAP – Upper motor bearing cap shall be a separate casting for easy mounting and replacement.

L. POWER CABLES – Power cord and control cord shall be triple sealed. The power and control conductor shall be single strand sealed with epoxy potting compound and then clamped in place with rubber seal bushing to seal outer jacket against leakage and to provide for strain pull. A third sealing area shall be provided by a terminal board to separate the cable entry chamber from the motor chamber. Cords shall withstand a pull strain to meet FM requirements.

Insulation of power and control cords shall be type SOOW or W. Both control and power cords shall have a green carrier ground conductor that attaches to motor frame.

2.02 SLIDING GUIDE BRACKET & RAIL SYSTEM

A. GENERAL – Pump lift-out rail system shall be Myers model SRAX-66. Lift-out rail system shall be of non-sparking design and shall be listed for explosion-proof service.

B. COMPONENTS – Each lift-out rail system shall consist of: a ductile iron ANSI flange discharge base, brass pump attaching and sealing plate, and brass pump guide plate. Discharge elbow shall not be provided for this project. A spool piece shall be provided by the installing contractor as shown on the construction drawings in place of the discharge base elbow. All exposed nuts, bolts, and fasteners shall be of 300 series stainless steel. No fabricated steel parts shall be used.

C. SEALING – A sealing plate shall be attached to the pump. A simple downward sliding motion of the pump and guide plate on the guide rails shall cause the unit to be automatically connected and sealed to the base. The open face of the sealing plate shall have a dove-tailed groove machined into the face to hold a sealing “o”-ring. The “o”-ring shall provide a redundant leak-proof seal at all operating pressures.

D. GUIDE RAILS – Two rail pipes shall be used to guide the pump from the surface to the discharge base connection. The guide rails shall be 2” schedule 40 stainless steel pipe. The weight of the pump shall bear solely on the discharge base and not on the guide rails. Rail systems which require the pump to be supported by legs which might interfere with the flow of solids into the pump suction will not be considered equal. The top of the guide rails shall be firmly attached to the upper concrete floor/curb. Systems deeper than 21’ shall use an intermediate guide for each 21’ of wet well depth. Install additional guide rail supports, if any, as shown on the construction drawings.

E. LIFTING CHAIN – An adequate length of stainless steel lifting chain shall be supplied for removing the pump. The chain shall be of sufficient length and shall include an adequate number of lifting rings for easy removal.

PART 3 - EXECUTION

3.01 TESTING

A. Each completed and assembled motor shall receive a routine factory test.

B. The pumps shall be performance tested at the manufacturer’s plant prior to shipment. The performance shall be within the limits set forth by the Hydraulic Institute. Certified curves shall be submitted to the design engineer upon request.

C. As a minimum, each finished pump shall be performance tested for total dynamic head, capacity, efficiency and power requirements at six (6) operating points plus shut-off head for the selected impeller diameter, of which, the design capacity operating point shall be included.

D. After installation, a Field Test shall be performed by the installing contractor on each completed Submersible Pump and easy lift assembly under the supervision of the manufacturer’s authorized representative. The test shall demonstrate to the satisfaction of the Owner that the equipment meets all specified performance criteria, is properly installed and anchored, and operates smoothly without exceeding the full load amperage rating of the motor or excessive motor heating.

3.02 WARRANTY

A. The Pump Manufacturer shall Warrant to the Owner the Submersible Pump Units against defects in material and workmanship for a period of 1 year from date of

acceptance or 15 months from date of shipment, whichever is sooner. This warranty shall cover the cost of labor and materials, excluding removal and reinstallation costs, required to correct any warrantable defect, FOB, Manufacturer's authorized Warranty Service Center.

B. Additionally, the Pump Manufacturer shall provide and administer a 5-year, prorated materials warranty on the Submersible Pump against defects in materials and workmanship. The warranty shall provide for the replacement of any part of the pump found to be defective in accordance with the following schedule:

19 to 31 Months	Payment of 75% of the Current Replacement Parts Cost.
32 to 45 Months	Payment of 50% of the Current Replacement Parts Cost.
46 to 60 Months	Payment of 25% of the Current Replacement Parts Cost.

3.03 FIELD SERVICE

A. One (1) day of Field Service shall be provided by an authorized, factory trained representative of the Pump Manufacturer. Services shall include, but not necessarily be limited to, inspection of the completed installation to ensure that it has been performed in accordance with the manufacturer's instructions and recommendations, supervision of all field-testing and activation of the Manufacturer's Prescribed Warranty.

B. The Contractor shall be responsible for coordinating the required field services with the Pump Manufacturer.

3.04 PUMP ACCESSORIES

A. Installing contractor is to provide the following accessories with each pumping unit (including spare pumps) and install as shown on the construction drawings:

1. One (1) discharge gauge, glycerin filled, 4½" diameter, ½" NPT, 0-100 PSI range (Ashcroft Type 1259 or engineer approved equal).

2. One (1) threaded capsule diaphragm seal w/ flushing port (Ashcroft Type 101 or engineered approved equal). Diaphragm seal shall be fully constructed of stainless steel and filled with glycerin. Process port shall be 1" NPT and sensor port shall be ½" NPT. Diaphragm seal is to protect the pressure gauge from the solids-containing liquid being pumped.

3. One (1) 1" NPT stainless steel shut-off ball valve.

3.05 SPARE PARTS

A. All spare parts shall be packaged and labeled for storage.

B. Include the following spare parts:

1. One (1) Shaft Mechanical Seal Set

2. One (1) Impeller

3. One (1) Set of Wear Rings

4. One (1) Bearing Set

5. O-rings

6. Gaskets

7. Seal leak wires and grommets

3.06 ACCEPTABLE MANUFACTURERS

A. Barnes brand of Crane Pumps & Systems

B. Equal Manufacturer as approved by the Engineer and Owner

END OF SECTION

THIS PAGE LEFT BLANK

EQUIPMENT GUARANTEE CERTIFICATION FORM

Reference: Washington County Department of Water Quality
Oak Ridge Pump Station Upgrades

THE UNDERSIGNED HEREBY ATTESTS THAT HE/SHE HAS EXAMINED THE REFERENCED PROJECT DRAWINGS **G-3, M-1, & M-2** AND SPECIFICATIONS SECTION **11320** AND CERTIFIES THAT THE "**WET PIT SUBMERSIBLE NON-CLOG PUMPS"** THAT HE/SHE PROPOSES TO FURNISH AND DELIVER MEETS OR EXCEEDS CONTRACT SPECIFICATIONS, IS SUITABLE FOR THE INTENDED PURPOSE STATED IN SPECIFICATIONS SECTION **1.02.B**, IS SUITABLE FOR INSTALLATION AS PRESENTED IN THE ABOVE PROJECT DRAWINGS AND SPECIFICATIONS, AND WILL PROVIDE SATISFACTORY PERFORMANCE AT THE DESIGN CRITERIA SPECIFIED. THIS GUARANTEE OF SUITABILITY FOR INTENDED PURPOSE IS IN ADDITION TO AND SHALL NOT BE IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED.

EQUIPMENT: **"Wet Pit Submersible Non-Clog Pumps"**

MANUFACTURER: _____

Address: _____

_____

By: _____
(Typed Name and Title)

_____/s/_____ (SEAL)
(Signature) (Date)

Equipment Guarantee Certification must be signed by a Principal Person (President, Vice-President, etc.) of the equipment manufacturer. In the event the manufacturer is not the Supplier then a Principal Person of the Supplier must also sign this form.

SUPPLIER: _____

Address: _____

By: _____
(Typed Name and Title)

(SEAL)

_____/s/_____

THIS PAGE LEFT BLANK

SECTION 11375

WET WELL AERATION SYSTEM

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. A complete wet well aeration system that includes a positive displacement blower, piping, valves, and fiberglass enclosure.

1.02 DESCRIPTION

A. Under this section, the contractor shall provide all labor, equipment and materials necessary to furnish, install, test and place in operation a wet well aeration system. The aeration system shall be complete with all equipment specified herein, factory assembled within a fiberglass enclosure.

B. Intended Purpose: The purpose of the aeration system is to induce dissolved oxygen and mixing energy into the stored raw sewer to prevent it from turning septic and to mitigate grease build-up.

C. The aeration system shall be Model 115FE3B, as supplied by Envirep, Inc., Camp Hill, PA, or engineer approved equal.

1.03 RELATED SECTIONS

A. Section 01300 - Submittals

B. Section 15010 - General Building Mechanical Requirements

C. DIVISION 16 - Electrical

1.04 SUBMITTALS

A. Complete material specifications and drawings, suitable for installation purposes, for the aeration system.

B. Complete “Manufacturer’s Equipment Warranty & Certification” form included at the back of this section.

C. Submit in accordance with Section 01300.

1.05 QUALITY ASSURANCE

A. Obtain aeration equipment, motors, and appurtenances from the aeration equipment supplier whose responsibility is to ensure that the aeration equipment is properly coordinated and operated in accordance with these Specifications.

PART 2 – PRODUCTS

2.01 AERATION SYSTEM

A. Aeration Blower Assembly

1. The aerator shall be capable of producing sustained aeration and sufficient agitation to mitigate formation of grease build-up. The aerator shall be

suitable to operate with discharge piping submerged at a depth of at least four feet. The aerator shall produce continuous, non-pulsating, oil-free air. Inlet and outlet ports shall be 1-1/2-inch FNPT.

2. The aeration blower shall be rated for continuous duty at a maximum speed of 3,450 RPM and operate at a maximum ambient temperature of 104°F. The motor shall be 1.5 HP, 3 phase, 480 volt, 60 Hz with TEFC enclosure and Class B insulation.

3. The following accessories shall be installed with the wet well aeration system:

   a. (1) Gauge Kit – including independent, full-range indication of aeration blower inlet and outlet conditions. Total pressure across the aeration blower shall be the difference of the gauge indications.

   b. (1) Inlet filter kit with replaceable filter element and shall be designed to protect the aerator from pre-mature wear.

   c. (1) discharge ball valve, full port, 2”

   d. (1) relief valve of adequate capacity to provide system protection

   e. (1) flexible mounting system

   f. (1) inlet muffler/silencer

4. The discharge piping for the aeration blower shall be installed as shown on the plan sheets. Discharge piping to the wet well shall be minimum 3” diameter.

5. Aeration system, including aeration blower, inlet filter, relief valve, gauges, muffler, ball valve, and check valve, shall be pre-assembled using schedule 40 - 304 stainless steel pipe and mounted on a fiberglass base using eight flexible vibration isolation mounts.

6. Blower shall be of the positive displacement type.

B. Fiberglass Enclosure

1. A fiberglass enclosure with exterior dimensions of 41-3/4” long x 24” wide x 32-1/2” tall shall be provided to protect the aeration blower assembly. The control panel shall not be mounted inside the fiberglass enclosure.

2. The enclosure shall be provided with an intake louver with sufficient open area to supply air to the blower near the top in the end of the enclosure.

3. The enclosure shall be provided with a hinged lid with locking hasp for easy maintenance and service.

4. Interior of enclosure shall have foam insulation for sound attenuation, 1” thick minimum.

5. Aeration blower assembly shall fit inside this fiberglass enclosure.

6. The pressure relief valve shall discharge to the outside through the fiberglass enclosure at a height at least 24” min. above the concrete slab. In no case shall the pressure relief valve discharge inside or through the floor of the fiberglass enclosure.

C. Wet Well Aeration Diffusers

1. Quantity six (6) 24” long coarse band diffusers, as manufactured by Aquarius Technologies, Inc., as supplied by the wet well aeration supplier.

2. Diffusers shall be constructed of 316 SST, and shall be capable of 5-50 SCFM airflow.

3. Diffuser shall have a full-length deflector, to prevent material from entering the diffuser body.

4. Diffuser shall be connected to the header piping, using a ¾” NPT connection.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Immediately after off-loading, contractor shall inspect equipment and appurtenances for shipping damage or missing parts.

B. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all serial numbers and parts lists with shipping documentation. Notify manufacturer’s representative of any unacceptable conditions noted with shipper.

3.02 INSTALLATION

A. Install, level, and align system as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.

B. Check motor and control data plates for compatibility to site voltage. Install and test the electrical ground prior to connecting line voltage to pump control panel.

C. Prior to applying electrical power to motors or control equipment, check all wiring for tight connection. Verify that fuses and circuit breakers conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

3.03 MANUFACTURER’S STARTUP

A. One (1) day of Field Service shall be provided by an authorized, factory trained representative of the Pump Manufacturer. Services shall include, but not

necessarily be limited to, inspection of the completed installation to ensure that it has been performed in accordance with the manufacturer's instructions and recommendations, supervision of all field-testing and activation of the Manufacturer's Prescribed Warranty.

B. Coordinate system start-up with manufacturer's factory-trained service technician. The factory trained service technician will inspect the completed installation, calibrate and adjust instrumentation, and correct or supervise correction of defects or malfunctions. Startup shall be performed in the presence of the Engineer and/or Owner.

3.04 SPARE PARTS

A. All spare parts shall be packaged and labeled for storage.

B. Include the following spare parts:

1. One (1) spare filter element for the blower

END OF SECTION

SECTION 14300

PORTABLE GANTRY CRANE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Portable Gantry Crane

B. Manual Chain Hoist

1.02 DESCRIPTION

A. Under this section, the contractor shall provide all labor, equipment and materials necessary to furnish, install, test, and place in operation a portable gantry crane with manually operated chain hoist and push trolley as shown in the plans and as specified herein.

B. Intended Purpose: The purpose of the portable gantry crane and chain hoist is to hoist sewer pump station equipment during removal and installation from their respective vault and/or wet well under the conditions and installation described in this specification.

1.03 REFERENCES

A. American Institute of Steel Construction (AISC): Manual of Steel Construction, Part 5, Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts.

B. American Society for Testing and Materials (ASTM) A36: Carbon Structural Steel

C. American Society for Testing and Materials (ASTM) A325: Structural Bolts, Steel, Heat Treated, 120/150 ksi Minimum Tensile Strength

D. American Society for Testing and Materials (ASTM) B221: Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.

E. American Welding Society (AWS) D1.1: Structural Welding Code

F. American Welding Society (AWS) D1.1: Certified Shop

G. Occupational Safety and Health Administration (OSHA): Specification 1910.179: Overhead and Gantry Cranes

H. American Recovery and Reinvestment Act (ARRA): Buy American Clause of May 2009

1.04 RELATED SECTIONS

A. Submittals: Section 01300

B. Miscellaneous Metals: Section 05500

C. Wet Pit Submersible Non-Clog Sewage Pumps: Section 11320

D. General Building Mechanical Requirements: Section 15010

1.05 SUBMITTALS

A. Complete material specifications and drawings for the portable gantry crane and hoist which outline product capacities, performance, standard operations, applied forces to foundation, crane configuration, dimensions, construction, and installation details.

B. Manufacturer's Warranty

C. Manufacturer's Installation Instructions

D. Manufacturer's Operation and Maintenance Manual

E. Submit in accordance with Section 01300.

1.06 QUALITY ASSURANCE

A. Standard cranes shall be designed, fabricated, and installed in accordance with ANSI B30.11, MH27.2, OSHA 1910.179, and IBC. Manufacturer shall assure the safety and quality of all systems when installed and maintained according to their Installation and Maintenance Manual.

B. If different specifications are required, alternate specifications need to be requested before the order is placed. Crane modifications may be required at additional cost to conform to specifications other than IBC and ASNI.

C. Manufacturer's Qualifications: A company with more than 30 years of experience successfully designing and manufacturing cranes and material handling solutions for numerous industries.

D. Installer's Qualifications: a company that is acceptable to the crane manufacturer and with five years of experience assembling the installing cranes for multiple applications. Installer should be able to:

1. Perform welding using certified operators in accordance with AWS D1.1.

2. Bolt connections in accordance with torque tightening procedures specified in AISC Manual, Part 5.

3. Clearly label crane with rated load capacity with label visible from floor level and loading position.

4. Perform OSHA Load Test Certification.

PART 2 - PRODUCTS

2.01 PORTABLE GANTRY CRANE

A. The portable gantry crane shall be Spanco A-Series Aluminum Gantry Crane, model 2ALU1508, or engineer approved equal.

B. The crane shall be sized to facilitate equipment placement and removal. The portable gantry crane shall have a maximum load rating of 4,000 pounds.

C. The gantry crane shall be portable, corrosion resistant, height and span adjustable, with swivel lock casters and polyurethane wheels.

D. Crane shall be fabricated from T6061 aluminum sections with finished ends and surfaces.

E. Gantry crane shall be designed to meet all specifications using a 25% factor of rated load for impact and 15% factor of rated load for hoist and trolley weight.

F. Gantry crane shall be designed for operation in high humidity and corrosive environments.

G. Crane shall have an operating temperature range of 5°F to 200°F.

H. Designed maximum deflection shall be L/450.

I. Crane system shall be designed with height and span adjustment capabilities, disassembly, relocation, and for minimum effort manual operation. Crane shall be designed, fabricated, and installed in accordance with ANSI B30.11 and OSHA 1910.179.

J. Gantry crane shall provide coverage of a rectangular area of size as shown on the project drawings.

K. Crane shall be designed for moderate usage (Class C Normal/Industrial service) as defined:

1. System or equipment is used where operational tie is up to 100% of the work period and lifted load is at 50% or below rated capacity.

2. System or equipment is used where operational time is less than 50% of the work period and lifted load is greater than 50% of rated capacity.

3. Applications involving vacuums, magnets, and other high impact lifters are considered severe usage and required special design considerations.

L. System Components:

1. Standard aluminum ALU12” x 10.99# adjustable span I-Beam. Beam length shall be 15’-0” for a maximum span of 15’-0” (clear span of 13’-9”).

2. A-Frame fabricated from mechanical tubing. Height shall be adjustable using spring loaded steel locking pins. Center tube adjusts in six-inch increments.
3. Four-position swivel locking caster with 8” diameter polyurethane wheels.

M. Crane shall have a brushed aluminum finish.

2.02 CHAIN HOIST AND TROLLEY SYSTEM

A. Chain hoist and trolley system shall be Budgit model 8314SR, or engineer approved equal.

B. Hoist shall be an USA Army type trolley hoist.

C. Hoist and trolley system shall have capacity of 4,000 pounds.

D. Hoist shall have a working lifting height of 15'. Hand chain shall be of suitable length from a floor elevation of 7' below hoist elevation.

E. Hoist shall be chain type, manually operated. Trolley shall be rigid-mount push type.

F. Hoist shall be lug suspended from the trolley to allow for maximum headroom clearances.

G. Entire hoist and trolley system shall be spark and corrosion resistant. Hoist shall have bronze alloy hooks, bronze hook sleeve, chrome nickel stainless steel alloy load chain, and aluminum hand chain.

H. Hoist frame shall be impact resistant, lightweight, heat-treated, permanent mold cast aluminum alloy.

I. Hoist shall be an integrated overload devise calibrated for the capacity of the hoist and factory installed as an added measure of protection for the load, hoist, and operator.

J. Gearing shall be straight cut spur gears. All gears shall be grease packed in a grease tight gearcase.

K. An automatic, screw actuated, Weston-type load brake shall hold the load under all conditions and permit fine smooth control in lowering. The brake shall be self-adjusting with the friction washers long wearing, requiring low maintenance.

L. Chain hoist and trolley shall be of the same manufacturer.

PART 3- EXECUTION

3.01 Manufacturer's Warranty – Included on manufacturer's standard form and outlines the manufacturer's agreement to repair or replace assemblies and components that fail in materials and/or execution within warranty period from date of substantial completion.

A. Warranty covers (10) years or 20 thousand (20,000) hours for manual crane products to cover defects in materials and execution.

3.02 Preparation

A. Do not start installation until support structures are properly prepared.

B. Check materials to ensure all parts are present.

C. Gantry crane shall be completely portable and require no foundation or structural support.

3.03 Conditions/delivery, Storage, Handling

A. Project Conditions – Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Delivery, Storage, and Handling – Store products in manufacturer's packaging until ready for installation. Store and dispose of solvent-based materials in accordance with requirements of local authorities.

3.04 Installation

A. Units and accessories should be installed in accordance with manufacturer's instructions and shop drawings.

B. Do not modify crane components without manufacturer's approval.

C. Clearances for moving crane components:

1. Minimum vertical clearance: 3" from any overhead obstruction

2. Minimum horizontal clearance: 2" from any lateral obstruction

D. Units and accessories should be installed in accordance with manufacturer's instructions and shop drawings.

E. Assembly:

1. Select an area under an overhead hoist to raise the I-beam.

2. Lay both "A" frames flat on the floor, and slide upright tube into top of center tube. Pin upright tube in its lowest position to ensure that load pin is fully engaged.

3. Lock the caster wheels in position parallel to the "A" frame. This will prevent the frame assembly from rolling away when lifted to the upright position.

4. Lift the I-beam to the gantry's minimum height. Be sure that the holes in the I-beam flange are on the bottom and that the capacity rating is legible.

5. Lift one end of the frame assembly into position under one end of the I-beam, and bolt I-beam to top plate of the upright with the hardware supplied. Be sure the lifting lug is on the outside of the frame assembly. Raise the other end frame into position and bolt together as outlined above.

6. Install manual chain hoist and trolley system according to manufacturer's specifications.

3.05 Field Quality Control

A. Inspection – Verify all bolts are tight and lock washers fully compressed.

B. Field Test – Ensure crane operates properly (movement is smooth and consistent). Make adjustments as needed, and correct inadequacies.

C. Acceptance Test – After the crane system has been installed, OSHA requires an acceptance test before operating and also after any modifications. An authorized dealer or installer should perform acceptance tests.

D. Maintenance – To keep a gantry crane in good operating order, engineers recommend establishing a regular schedule of inspection and lubrication. All parts should be inspected, all loose parts adjusted, and worn parts replaced at once. Recommended lubrication schedule varies based on crane use/application. A crane that operates daily for multiple times should be lubricated weekly. Operating a crane at “standard duty” requires lubrication once every two or three weeks. Operating a crane on “standby classification” requires lubrication once every six months. The interval of lubrication depends on the application.

E. Clean Surfaces – Keep surfaces clean and clear of build-up and residue.

F. Protect Crane – Protect installed products until completion of project. Touch-up, repair, or replace damaged products before substantial completion.

END OF SECTION

SECTION 15010

GENERAL BUILDING MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. The provisions of this entire section of the specifications are intended to govern the quality of design, fabrication, workmanship, operation, etc., of all materials, equipment and appurtenances to be furnished and installed under the various sections of the mechanical equipment as part of the specified items.

1.02 SHOP DRAWINGS

A. Shop drawings, including dimensioned drawings, descriptive literature, performance data, electrical characteristics, and in general all information necessary to prove compliance with the specifications, shall be submitted as required in Section 01300 entitled SUBMITTALS.

1.03 GUARANTEE

A. All materials, equipment, workmanship and performance shall be guaranteed for the period and in accordance with the provisions of Section 01700 entitled PROJECT CLOSEOUT.

1.04 MANUFACTURER'S OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall provide manufacturer's operation and maintenance manuals as required in Section 01300 entitled SUBMITTALS.

1.05 STANDARDS

A. Where standards, codes or specifications are referred to, the reference is to particular standards, codes or specifications together with all the latest amendments and errata applicable at the time the bids are taken. These are listed below:

B.

IEEE -	Institute of Electrical and Electronics Engineers
AMCA -	Air Moving and Conditioning Association, Inc.
ASTM -	American Society for Testing Materials
ASME -	American Society of Mechanical Engineers
ANSI -	American National Standards Institute
ASHRAE -	American Society of Heating, Refrigerating & Air Conditioning Engineers
AWS -	American Welding Society
AWWA -	American Water Works Association
NFPA -	National Fire Protection Association
NEMA -	National Electrical Manufacturer's Association
Federal -	Federal Government Specifications
OSHA -	Occupational Safety and Health Act

1.06 GENERAL DESIGN OF EQUIPMENT AND MACHINERY

A. All equipment and machinery furnished under this contract shall be of the latest and most improved design suitable for the service of which it is to be used. All

equipment and machinery shall be designed and constructed to operate efficiently, continuously and quietly under the specified requirements with a minimum of labor, power, maintenance, renewals and repairs. The design and construction of all equipment and machinery shall be such as to permit operation with minimum noise, wear and vibration (maximum amplitude of 3.0 mils unless otherwise specified) when properly installed.

B. Ample room for erecting, repairs, inspecting and adjusting all equipment and machinery shall be provided. The design, construction and installation of all equipment and machinery shall conform to and comply with the latest safety codes and regulations.

C. The design and construction of the several units shall be such that they shall present a uniform appearance and the arrangement shall be such that their operation shall be in harmony in every respect. Whenever possible, fittings and fixtures of the same make and model shall be used for the several units and their connections. All equipment of identical type and service shall be the product of the same manufacturer.

D. All equipment sleeted shall be of such size and general arrangement to suit the space in which it is to be installed.

E. The various parts of the equipment and machinery shall be of plain shape and good lines, especially designed and constructed for strength and durability. Casting shall be designed and constructed to cool uniformly without shrinking strains and shall have good-sized fillets at all re-entrant corners. Sudden change of section shall be avoided.

F. Whenever possible, parts of each unit shall be made to gauge and be a duplicate of and interchangeable with the same parts of other machines of the same size and kind.

G. The workmanship shall be of the highest class throughout.

H. All assemblies shall be completely shop fabricated and structural steel parts shall be shop erected. Assemblies and structural steel parts shall be match-marked before being disassembled for shipment. Parts shall be shipped assembled in as large unit as possible to minimize field reassembly. All parts shall be amply proportioned for all stresses which may occur during operation, and for any additional stresses which may occur during fabrication and erection.

I. Unless otherwise specified, welding shall be in accordance with the latest standard specifications for “Gas Tight Welding” of the American Welding Society.

J. Unless otherwise specified, galvanizing shall be hot-dipped, in accordance with the latest standard specifications for “Zinc Coating” of the ASTM, Serial Designation A-123.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Unless otherwise specified, materials shall be in accordance with the following latest Standard Specifications of the ASTM:

1. Structural Steel A-36

Welding Steel Pipe	A-53
Iron Castings	A-48
Babbitt	B-23
Bronze Castings	B-30
Bronze (Manganese)	B-138
Steel Bolts	A-307
Hot Dip Zinc Coating	A-123

B. All materials shall, if required, be tested and shall fulfill all requirements specified. Owner may make physical tests. The Contractor at his own expense shall furnish test pieces and samples in the number, shape, size and finish required by the Engineer. All broken material shall become the property of Owner. The failure of test specimens to fully conform to the requirements of the specifications shall be sufficient cause for rejection of the whole melt or stock from which samples were obtained.

C. Iron castings shall be smooth, clean and free from scale, lumps, blisters and other defects. No plugging, welding or filling will be allowed.

D. The alloy grade number of all babbitt shall be that bearing alloy of a composition recommended by the manufacturer of the equipment or machinery for the service required, subject to the approval of the Engineer.

E. All bronze shall be made of new material and shall be free from objectionable imperfections. If the materials show signs of improper mixing when being machined, the castings will be rejected.

2.02 JOURNALS, BEARINGS AND KEYS

A. Journals and bearing surfaces shall be of sufficient size and properly proportioned for the least wear and to avoid heating under all conditions, and where necessary, provisions shall be made for easy removal and for proper adjustments. Journals shall be suitable boxes which, where necessary, shall be lined with babbitt metal hammered into grooves and bored in place. If bearings are of the ball bearing type, both inner and outer races as well as the balls shall be heat treated steel to resist wear. The balls shall be of sample size to carry the maximum loads with a large factor of safety flaking, spilling, or crushing. The balls shall be properly spaced and held in position by rugged continuous spacing or retainer rings.

B. Pins and keys shall be properly proportioned. Keys, nuts and all other parts which might otherwise work loose shall be secured with approved locking devices.

2.03 LUBRICATION

A. All bearings, except those specifically requiring oil or water lubrication shall be pressure grease lubricated. All lubrication points shall be readily accessible, away from locations dangerous to workmen. Pressure grease lubrication fittings shall be the “Alemite” type as made by the Stewart Warner Corporation, or equal. The pattern of the fitting shall be selected for accessibility in lubricating and shall meet the approval of the Engineer. Housings of grease lubricated bearings shall be automatically exhausted to atmosphere to prevent excessive greasing. The Contractor shall furnish three Alemite Hydraulic guns, or equal.

B. The Contractor shall furnish lubrication charts or schedules for each piece of equipment or machinery. The charts or schedules shall designate each point of lubrication, the type of lubricant to be applied and the frequency of lubrication. Charts and schedules shall be submitted to the Engineer in quadruplicate, bound in folios, with each chart or schedule protected by a transparent plastic envelope.

C. The Contractor shall furnish one (1) year supply of each type of lubricant. Ten copies of a typewritten list shall be furnished with the lubricants, designating the specific lubricant to be used for each piece of equipment. This is in addition to the required operating and maintenance manuals which will also contain lubrication requirements.

2.04 MOTORS AND CONTROLS - GENERAL

A. Motors and controls shall conform to the latest requirements of IEEE and NEMA, and where applicable, shall be UL listed. Minimum sizes are specified with the driven equipment. Motor starting and control equipment is specified either with the motor which is controlled or in an electrical specification section. The Contractor is advised to consult all specification sections to determine responsibility for motors and controls.

B. Motors shall be designed, built and tested in accordance with the latest revision of NEMA Standard MG 1.

C. Motors shall be suitable for use under the conditions and with the equipment to which applied and designed for operation on the electrical systems specified or indicated.

1. Motor capacities shall be such that the horsepower rating and the rated full-load current will not be exceeded while operating under the specified operating conditions. Under no condition shall the motor current exceed that indicated on the nameplate.

2. Motor sizes noted in the individual equipment specifications are minimum requirements only. It is the responsibility of the equipment manufacturers and of the Contractor to furnish motors, electrical circuits and equipment of ample capacity to operate the equipment without overloading, without exceeding the rated full-load current, or overheating at full-load capacity under the most severe operating service of this equipment. Motors shall have sufficient torque to accelerate the total WR^2 of the driven equipment to operating speed.

3. Motors shall be continuous duty type and shall operate quietly at all speeds and loads.

4. Motors shall be designed for operation on 60-hertz power service. Unless otherwise specified or shown, motors less than 1/2 horsepower shall be single phase, and motors 1/2 horsepower and larger shall be 3 phase.

5. Motors shall be mounted so that the motor can be removed without removing the entire driven unit.

D. Single-phase motors smaller than 1/20 horsepower shall be ball or sleeve bearing, drip-proof, totally enclosed or explosion proof, as specified, 115 volts, permanent split capacitor or shaded pole type. These motors shall not be used

for general power purposes and shall only be provided as built-in components of such mechanical equipment as fans, unit heaters, humidifiers and damper controllers.

E. Single phase motors 1/20 horsepower and larger shall be ball bearing, drip-proof, totally enclosed or explosion proof, as specified, with Class A or B insulation, as standard with the motor manufacturer; 115, 115/230, 200 or 230 volts as required; capacitor start-induction run, permanent split capacitor, or repulsion start-induction run type.

F. Except as otherwise specified in the various specification sections, 3 phase motors shall meet the requirements of this paragraph. Motors shall be NEMA design B squirrel cage induction type. Insulation shall be Class F and motor shall be rated at no greater than 50 deg. C ambient temperature explosion proof and totally enclosed motors shall have a 1.00 service factor and drip proof motors shall have a service factor of 1.15 or higher. Motors specified for operation at 480 volts shall be nameplated 460 volts.

G. Minimum three phase motor efficiencies at full load for motor-shaving nominal rated speeds of 1200 RPM and higher shall be as follows:

Horsepower	Minimum Efficiency
2	71
3/4	74
1	75
1-1/2	78
2	80
3	82
5	85
7-1/2	86
10	86
15	88
20	89
25	90
30	91
40	91
50	91
60	91
75	92

Three phase motors shall be E-plus Energy Efficient Standard Duty Motor of the Electric Motor Division of Goulds, Inc., the MAC II High Efficiency motor of Westinghouse Electric Corporation, the equivalent project of Baldor Company, or equal.

H. Motors seventy-five (75) horsepower and larger shall be as specified with the driven equipment in these specifications.

I. Belt-connected motors shall have adjustable bases and set screws to maintain proper belt tension. All fan motors shall have adjustable sheaves for speed adjustment.

2.05 FLANGES AND BOLTS

A. Flanges, except as otherwise specified, shall be cast solid, and bolt holes shall be drilled and spot-faced on the back. Stud holes shall not be drilled through.

Flanges shall be uniform in thickness and shall come fair and, if required, shall be turned or chipped in a neat and workmanlike manner.

B. All equipment and motors/drives shall be field aligned using a dial indicator in accordance with the procedures established by the latest revision of the Hydraulic Institute Standards. Parallel and angular misalignment shall not exceed the limits recommended by both the equipment and the coupling manufacturer.

2.06 COUPLINGS

A. Except where otherwise specified for a particular item of equipment, all equipment where flexible couplings are specified or required, a standard self-aligning forged steel coupling with sealed lubrication, as manufactured by Thomas, Koppers, Falk, Sier-Bath, or equal, shall be provided between each motor and its driven equipment. One hub of the coupling shall be firmly fixed and keyed to the equipment shaft with the other hub similarly secured to the abutting drive shaft. Couplings shall be placed as close as possible to the driven equipment and the motor bearings to make compactly arranged units. Couplings shall be of all metal construction and shall be moisture proof and dust proof. Arrangement of couplings shall be such that there is sufficient room to place a dial indicator for alignment checking of shafts of the motor driven equipment. Each coupling shall be provided with an easily removable guard meeting all OSHA requirements.

B. All equipment and motors/drives shall be field aligned using a dial indicator in accordance with the procedures established by the latest revision of the Hydraulic Institute Standards. Parallel and angular misalignment shall not exceed the limits recommended by both the equipment and the coupling manufacturer.

2.07 EQUIPMENT BEDPLATES

A. The various items of motor driven equipment, such as pumps, shall be mounted on structural steel bedplates. The bedplates shall be adequate size to accommodate the equipment and its motor, to form an integral rigid mounting platform. Steel or brass shims shall be used to level equipment bedplates mounted in contact with concrete pads or floors. Jacking bolts or jacking (leveling) nuts on mounting studs shall not be used in lieu of shims. Bedplates shall be grouted to the concrete base and shall be filled with grout in all instances where the manufacturer has made provision for introducing grouting mixture into bedplate cavities. It shall be the Contractor's complete responsibility to determine the proper method, to provide all materials and components required, and to coordinate the work, to set, couple, align and install all equipment in a satisfactory manner.

B. All centrifugal fans shall be mounted on steel springs or rubber-in-shear vibration isolation units. These may be either shop provided with the equipment or separately field mounted.

PART 3 - EXECUTION

3.01 MANNER OF INSTALLATION

A. The general arrangement of pipe and equipment shall be as shown on the Drawings. Detailed drawings of proposed departures due to actual field

conditions or other causes shall be submitted to the Engineer for approval. The Contractor shall carefully examine the drawings and shall be responsible for the proper fitting of materials and equipment as indicated, without substantial alteration. Because of the small scale of the drawings, it is not possible to indicate the exact location of piping, all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the space requirements for proper clearances and the structural and finish conditions affecting his work and shall arrange such work accordingly, furnishing such offsets, fittings, valves and accessories as may be required to meet such conditions.

B. Each trade shall determine the location, size, etc. of all chases and openings required for the proper installation of its work, and shall see that such are provided. Where it is necessary to run pipes or ductwork through walls or fittings, the trade performing the work shall notify the Contractor so that proper provisions can be made for same. Each trade shall furnish and set all inserts, sleeves, hanger supports, etc. required for its work and shall be responsible for their proper and permanent location.

C. All piping and ductwork exposed to view shall be run generally parallel with the lines of the building and as close to walls and column as may be practical and consistent with proper grade and the maintenance of proper clearances for access to all parts requiring servicing.

D. The Contractor, in the prosecution of the work, shall do no cutting of woodwork, masonry, concrete or other materials after same have been installed, without the written permission of the Engineer. No waterproofing shall be cut for any purpose except on written approval of the Engineer.

3.02 TESTING

A. After erection, the Contractor shall adjust and balance all equipment and systems, and shall demonstrate that all equipment is operating in a satisfactory manner. All rotating equipment shall be lubricated according to recommendations of the manufacturer and all adjustments shall be made to suit anticipated station operating conditions. Each piece of machinery shall be tested to show that it operates quietly, without vibration, overheating, or sign of distress at full specified capacity. Adjustments shall be made as necessary. All defective parts on machinery shall be replaced.

B. The Engineer shall be notified in advance of all tests and all tests shall be conducted to his entire satisfaction.

3.03 MISCELLANEOUS

A. Finished parts shall be well protected in the shop, during transportation and before and after erection to prevent injury of any kind. Injured parts which in the opinion of the Engineer are damaged or which cannot be refitted, shall be promptly replaced by the Contractor without expense to Owner. All exposed finished parts of machinery shall be greased or oiled before shipment.

B. The Contractor shall furnish all tools of special nature which are required for making adjustments (by Owner after the work has been turned over by the Contractor) to equipment, but will not be required to furnish standard tools.

C. All exposed belts, gears and drives shall be protected with guards. Guards may be of the equipment manufacturer's standard design, but must meet all the OSHA Standards.

3.04 PAINTING AND LABELING

A. All fabricated or assembled surfaces normally painted shall be thoroughly dry and free from all rust, grease, dirt or scale. The Contractor is reminded to correlate the section of ship prime coats to be compatible with subsequent field applied coats of paint. The Contractor shall touch up paint any time damaged during shipping or installation.

B. Each piece of equipment (including mechanical operators and electrical switches for the equipment) shall be identified by hand painting or stenciled two-inch letters and numbers, to indicate the service or function. Unless specified otherwise in the mechanical and electrical sections of these specifications, each motor and motor controller shall be similarly numbered (or lettered) to correspond to the number (or letter) of the drive unit.

3.05 ADJUSTMENTS TO RELATED WORK

The final work shall include any adjustment that may be required by the approved equipment furnished, with modifications made to concrete shapes and to dimensions shown on the contract drawings as may be required to suit the details of the approved equipment furnished, all at no additional cost to Owner.

END OF SECTION

SECTION 15060

INTERIOR PROCESS PIPING, FITTINGS AND SPECIALTIES

PART 1 - GENERAL

1.01 DESCRIPTION

The Contractor shall furnish and install all materials, equipment and appurtenances necessary for the complete and satisfactory installation of all interior process piping systems within and under structures except as noted, as shown on the drawings and as required for a complete installation as specified herein.

1.02 SUBMITTALS

Submit detailed certified dimensional shop drawings and manufacturer's product data for materials and equipment as specified under Section 01300. Show complete information concerning materials of construction, fabrication, protective coatings, installation and anchoring requirements, fasteners and other details.

1.03 QUALITY ASSURANCE

A. Certification of Welders

1. All shop and field welding under this contract for stainless steel piping and other piping systems shall be done by experienced welders who are skilled and have experience in the method and materials used. All welders shall be qualified as specified in the ASME Code for Unfired Pressure Vessels, Paragraph U-70.

2. For field welding, the Contractor shall submit to the Engineer for his review and approval a certified statement, from an approved testing agency for each welder he proposes to use for welded piping. Each certified statement shall indicate that the welder has, within six months from proposed employment on this project, been successfully qualified under the requirements of Section IX of the ASME Boiler Construction Code. All certificates and qualifications shall be at the Contractor's expense. The Engineer will return the certified statements to the Contractor for retention on job in the Contractor's field office. Any work installed by an individual who has not been approved by the Engineer shall be removed by the Contractor and shall be replaced with work installed by qualified and approved welders at the Contractor's expense.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS SCHEDULE

Pipe and fittings shall be as indicated on the drawings and as listed in the schedule included at the end of this section, which schedule is intended to serve as a general guide and is not necessarily a complete listing of every piping system. Systems which may not be listed shall be comprised of the same kind of pipe and fittings as in similar systems which are listed, or as directed by the Engineer. Underground piping shall be as specified in Section 02510 and/or 02732.

2.02 GENERAL NOTES – PIPING

A. It is to be noted that in the relatively small piping systems, the drawings do not necessarily show all fittings, offsets, unions, hangers, supports, etc. All such items shall be furnished and installed, however, as required for complete and satisfactory installation of the equipment shown.

B. Piping for plumbing and HVAC systems is specified in other sections of the specifications. Miscellaneous piping systems which may not be described specifically by any section of these specifications shall be of the type of pipe and fittings as directed by the Engineer or as shown on the drawings.

C. The Contractor shall verify all dimensions of valves, special castings and fittings, pipe equipment, etc., so that all of the pipe work performed will fit together properly and will conform to the arrangement as shown on the drawings. In selecting laying lengths of fittings, the Contractor shall be guided by the dimensions of equipment to which connections are made and by the indicated dimensions on the drawings. All pipe and specials shall be accurate to the dimensions shown. Hubs, spigots, and flanges shall be at right angles to the axis of the opening, and openings shall be at the exact angle specified.

D. All piping shall be pressure and leak tested as specified in accordance with the requirements herein. All potable water piping shall be disinfected.

2.03 GENERAL NOTES – FITTINGS

A. All fittings shall be of the type indicated on the drawings unless otherwise specified. Ferrous piping shall be provided with ferrous fittings; stainless steel piping shall be provided with stainless steel fittings. In general, all fittings shall be as specified hereinafter in paragraph entitled “Pipe and Fittings Schedule”.

B. Nipples shall be extra heavy of same material as piping system in which they are installed. Close nipples are not acceptable.

C. Wherever the sizes of pipes are reduced, the fittings shall be made to suit these changes without the use of bushings.

D. All flanges shall come fairly face to face with the pipe perfectly aligned. The pipes shall not be sprung to make a joint. Gaskets for flanged joints shall be as specified under “Joints”. All joints shall be neatly made and with care.

E. Screwed type systems shall contain ample unions in piping at equipment to allow easy removal of the equipment.

F. All piping with flanges shall have stainless steel bolts. All stainless steel bolt threads shall be coated with nickel anti-seize compound prior to assembly.

2.04 DUCTILE IRON PIPE AND FITTINGS – CEMENT LINED **(REFER TO SECTION 02732)**

A. All ductile iron pipe shall be manufactured in accordance with ANSI A21.51 (AWWA C115) for Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water and Other Liquids.

B. All ductile iron fittings and specials shall be manufactured in accordance with ANSI A21.10 (AWWA C-110) for Gray-Iron and Ductile Iron Fittings, 4” through 48”, for

Water and Other Liquids. Sizes 4" through 12" shall be pressure rated for 350 psi water pressure plus water hammer; sizes 14" in diameter and larger shall be pressure rated for 250 psi water pressure plus water hammer.

C. Joints for pipe, fittings and specials shall conform to ANSI A21.11 (AWWA C-110) Specification for Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings. Joints shall be flanged. Pipe shall be Class 53. Fittings 14" and larger shall be rated for minimum 150 psi. Flanges shall be drilled and faced for ANSI Class 125.

D. Pipe and fittings shall be cement lined in with ANSI Specifications A21.4 Section 4-10.1, with curing to be effected by an application of a bituminous seal coating which shall cover and seal the cement mortar. The thickness of the cement lining shall be that specified in Section 4.8.2, Double Thickness. For description of exterior surfaces, see paragraph entitled "General Notes".

E. Ductile iron pressure pipe shall be made of ductile iron of good quality and of such character as shall make the metal casings strong, tough and of even grain and soft enough to satisfactorily permit drilling, tapping and cutting. All piping shall be smooth, free from scale, lumps, blisters, and sand holes and defects of every nature which make it unfit for the use intended. All piping shall be straight and shall be true circles in section with its inner and outer surfaces concentric. No plugging, filling, burning-in or welding shall be allowed. All piping shall be subject to inspection and approval by the Engineer upon delivery, and no broken, cracked, misshaped or otherwise damaged or unsatisfactory piping will be accepted.

F. Each piece of pressure ductile iron pipe shall have the weight and class designation conspicuously painted on it as near as possible to flange or bell end of the pipe and these designations shall be clearly legible.

G. Wherever ductile iron pipe is specified or shown as having a spigot end, plain end will be acceptable.

H. Where required or shown, the Contractor shall provide ductile iron specials. Specials shall in general consist of spool pieces, less than standard lengths of flanged, spigot end, or bell end pipe, or combination of ends, and nonstandard fittings. The specials shall conform in material, thickness and finish to the pipe in which they are installed. Taped reinforced bosses shall be provided as an integral part of fittings, when shown or specified.

I. Flanges may be cast integrally with the ductile iron pipe, or screwed on type flanges may be used. Pipe compound of the manufacturer's recommendation shall be used at each threaded joint or flanges.

J. All exposed interior ductile iron or black steel pipe, fittings and exposed cast iron specials, shall be painted. The Contractor shall furnish pipe and fittings with a shop prime coat of paint. In any case, it shall be the Contractor's responsibility to provide a satisfactory final field finish painting job. Details of painting and materials to be used shall be as specified in Division 09900.

K. Where eccentric reducers are indicated to be used, the reducer shall be installed with its straight side at the top of the piping system.

2.05 STEEL PIPE AND FITTINGS

NOT USED

2.06 STAINLESS STEEL PIPE AND FITTINGS

A. All pipe and fittings shall be manufactured and fabricated from sheets and plates of type 304L stainless steel conforming to ASTM A240-72A. The sheet furnish shall be 28 plate finish No. 1. Pipe and fittings shall be designed for a minimum of 10 psi operating pressure. Pipes, fittings and specials shall have the following minimum wall thicknesses.

Diameter (inches)	Schedule or wall thickness
< 2	Sch. 40
2-1/2 to 8	Sch. 5
10 and 12	Sch. 10
14 to 20	Sch. 10
>24	0.375”

Pipes shall be joined using either factory welds, slip-on-flange joints or mechanical couplings of the type specified in this Section.

1. Fittings – elbows 16 inches and smaller will be smooth flow with radius of 1-/2 times pipe diameter except where due to space restrictions. Elbows 18 inches and larger will be fabricated from five mitered sections of 90 degree with radius of 1-1/2 times pipe diameter except due to space restrictions.

2. Slip-on flanges shall be rolled angle face rings of 304L stainless steel. The rolled angle face shall be true and perpendicular to the axis of the pipe or fitting.

3. Backing flanges for the flanged joints shall be stainless steel and drilled to ANSI B16.1 Class 125.

4. All bolt holes shall straddle normal horizontal and vertical centerlines of flanges unless otherwise noted on drawings.

5. Gaskets shall be all graphite, Grafoil as manufactured by Crane Packing Company or equal. Thickness shall be as recommended by the stainless steel pipe manufacturer.

6. All interior bolts and nuts shall be stainless steel.

B. Pipe and fittings shall be manufactured in accordance with ASTM A778-80 and A774-80, respectively.

C. All fabrication and welding shall be performed in the shop by certified welders to ASME approved procedure and ASW Standards. Field welding shall not be permitted. All welding shall be by the shielded arc, inert gas, MIG or TIG method. Filler wire shall be added to all welds to provide a cross section of weld metal equal to, or greater than, the parent metal. Inert gas shielding shall be provided to the interior and exterior of the joint. Interior weld beads shall be smooth, even, and

not have an interior projection more than 1/6 inch beyond the I.D. of the pipe or fitting.

D. After manufacture all pipe, fittings, supports, specials, etc. shall be passivated by immersion in an air agitated pickling tank containing a 25% solution of nitric and hydrofluoric acids for 40 to 50 minutes. The acid shall be neutralized by immersion in a rinse tank containing clean water and tri-sodium phosphate.

E. After fabrication, all shop welds shall be wire brushed and scrubbed with the pickling solution, neutralized and washed clean.

F. All stainless steel components shall be handled, transported, fabricated and installed taking care not to make contact with ferrous material; as the contamination of stainless steel by steel may lead to marks caused by rusting of imbedded steel.

G. Joints for pipe, fittings and specials shall be as shown on the drawings or as directed by the Engineer.

H. Each pipe, fitting and fabrication shall have type, gauge and heat number marked and these designations shall be clearly legible.

I. Certification of all plant tests required under the Standard Specification under which the pipe and fittings are furnished, and certification that such results obtained conform to those specifications, shall be submitted to the OWNER, covering all pipe and fittings delivered to the job.

J. The stainless steel piping shall be as manufactured by Felker Bros. Corp., Douglas Bros., a Division of Robert Mitchell Inc., or equal.

K. Spool type expansion joints shall be suitable for 10 psig air service with a temperature range of 0^{O}F to 300^{O}F, 25 psig 60^{O}F test pressure. The tube shall be seamless Nordel (EPT) extending through the bore to the outside edge of both flanges. Caracass shall be flexible Nordel (EPT). Cover shall be neoprene, ANSI 16.5. All expansion joints which are exposed to the weather shall be coated externally with Hypalon paint for protection against sunlight and ozone. Mercer Rubber Company Style 2502EP RM Holz, General Rubber, Metra Flex, or equal with galvanized steel retaining rings.

2.07 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS (SINGLE WALL)

NOT USED

2.08 POLYETHYLENE (PE) PROCESS PIPE

NOT USED

2.09 FLEXIBLE HOSE

NOT USED

2.10 JOINTS

A. Joints

1. All joints at equipment shall conform to the equipment requirements. No direct welded connections shall be made to valves or other equipment. Right and left couplings, long screws, or caulking of pipe threads or gasket joints will not be permitted. Mitered joints for elbows and matching straight runs of pipe for tees or elbows will not be permitted.

2. Soldered or brazed joints shall be made with solder and a noncorrosive paste flux. The solder mixture shall be of 95-5 (tin-antimony) content. The use of acid core solder shall not be permitted. The application of excess heat shall be avoided to prevent undue softening or burning of the fittings or tubing when making connections. All soldering operations shall be performed in strict accordance with best accepted practices. Tubing shall be square cut and reamed to remove all burrs. The inside of the fittings and the outside of the tubing at each end shall be well cleaned immediately prior to soldering to remove all traces of oxidation, regardless of how clean the surfaces of the pipe and fittings may appear.

3. Threads shall be standard, clean-cut and tapered. All pipe shall be teamed free from burrs and kept free from scale and dirt. Unless otherwise specified, threaded joints shall be made up with “Permatex” type 2, black, nonhardening pipe joint compound applied to the male thread only. The use of red lead or white lead will not be permitted. The complete threaded joint shall not have more than two threads exposed when made tight. Threads shall comply with ANSI B2.1.

4. Except where special couplings are indicated, piping requiring screwed connections shall be connected with screwed, malleable iron, ground joint, brass seat, 150 psi unions; for piping requiring flanged connections, flanged malleable iron unions shall be used. The finish of all unions shall match piping in which they are installed. Unions shall be provided at equipment and where required otherwise to facilitate removal of piping or equipment.

5. All gaskets between flanged connections and fittings shall be rubber ring gaskets 1/8 inch thick.

6. Flanges shall be of the same material as the piping on which installed, and bolts, nuts and washers shall be of mild steel, with good sound well-fitting threads; the nuts shall be cold punched, hexagonal, trimmed and chamfered. Heads, nuts and threads shall be U.S. Standard sizes. Bolts shall be of such length as to project ¼ inch beyond the nut when the flanged joint with gasket is assembled. All hardware shall be galvanized. For exterior, exposed flanged joints, bolts and nuts shall be of 18-8 stainless steel.

7. Welded joints, if required in the project, shall be made by the electric arc or oxyacetylene gas process. Only thoroughly experienced certified pipe welders shall be employed for the work. The welding wire used shall be coated heavily and shall be of material suitable for making the best possible pipe welds. After being welded, the piping, when tested as specified hereinafter, shall show no indication of leakage, weakness, and

other defects. Welding and welders shall be in accordance with the paragraph entitled “Certification of Welders” specified hereinbefore.

B. Flexible Couplings and Flanged Coupling Adapters

1. Unless specified or shown otherwise on the drawings, flexible couplings shall be the Style 38 of the M&H Manufacturing Division, No. 411 or 441 of Rockwell International, or equal. Each shall be so designed and constructed to withstand an internal line pressure equal to that of the pipeline in which it is to be installed. The various flexible couplings shall be suitable for the class and size of ductile iron pipe or steel pipe as required at the various locations, and shall be without pipe stops. The Contractor shall provide and install flexible couplings in addition to those shown, as required, for flexibility in installing the various piping systems. Locations of additional couplings shall be as directed by the Engineer.

2. Flanged Coupling Adapters shall be used for joining plain-end pipe to flanged valves, fittings and pumps. Mechanical Joint, ANSI A21.11.

3. Harnesses shall be provided across all flexible couplings and all flanged adapters.

C. Hose Couplings

1. Cam-locking quick coupler. MPT socket, FPT adapter plug, side levers. Couplers shall be stainless steel with Buna N gaskets and meet MiL-C-27487 specifications.

D. Grooved Joints

1. The grooved joints shall be formed from stainless steel with self contained O-ring seals in the coupling/fitting ends. The couplings and fittings shall be UL/ULC classified to ANSI/NSF 61 for cold +86° F (+30° C) and hot +180° (+82° C) potable water service. This system shall be rated to a maximum working pressure of 300 psi for water, oil, gas, chemical, air, and vacuum services. Grooved joints shall be Victaulic or approved equal.

2.11 WALL PIPE AND WALL SLEEVE CASTINGS THRU WALLS AND FLOORS

A. Wall pipe or sleeve castings shall be provided in walls and floors for the passage of all pipes.

B. Wall and floor sleeves for pipes smaller than 4 inches shall be standard weight galvanized steel, conforming to ASTM A120. Sleeves passing through floors shall extend approximately ½ inch above the finish floor. Chromium plated escutcheon plates, of a suitable pattern, shall be furnished and installed to conceal ends of all exposed pipe sleeves above the floors of finished rooms. Sleeves shall be of sample size to permit passage of pipe and insulation (where required) and allow for expansion. Space between pipe and sleeves shall be sealed or caulked with lamp wicking “oakum” and red lead, link seal, or other method as approved by the Engineer. Low melting point asphaltic materials will not be permitted for caulking.

C. Assembly of synthetic rubber links connected with stainless steel bolts. When the bolts are tightened, Delrin plastic pressure plates compress the rubber links to fill

the annular space between the pipe and the wall sleeve to form a watertight seal. Link seals shall be Thunderline or equal.

D. Generally, except where otherwise noted on the drawings, for pipes four (4) inches and larger passing through walls, wall pipe castings shall be used. The wall pipe castings shall be cast iron. Except where otherwise shown on the drawings the wall pipe casting shall be flanged at one end and shall have a mechanical joint bell at the other and shall be complete with water stop flange. The wall pipe castings shall typically be the width of wall through which the pipe passes, or the length as shown otherwise.

E. Generally, except where otherwise noted on the drawings, for pipes four (4) inches and larger passing through floors, all sleeves shall be standard weight galvanized steel. Except that no escutcheon plates will be required, these sleeves and their arrangement shall be as specified above for sleeves for pipes smaller than four (4) inches. The space between the pipe and the sleeves shall be sealed or caulked as specified above.

F. Generally, the diameter of sleeves for non-insulated pipe shall be one pipe size larger than the pipe passing through the sleeve. The diameter of sleeves for insulated pipe shall be of suitable size to allow the insulation to be continuous and of full thickness. Sleeves for flanged pipe shall be of ample diameter to pass the flanges, if cast-on flanges are used; if screwed-on flanges are used, sleeves may be only one size larger than the pipe. Space between pipe and sleeve shall be caulked as specified above.

G. The Contractor shall not be allowed to box-out the concrete for installation of any wall castings or sleeves, except with the Engineer's permission for each specific location involved. Castings shall be securely fastened in place so that pouring of concrete will not disturb their position in any manner. The Contractor shall correlate with the other trades (particularly concrete work) to assure that all wall castings and wall and floor sleeves are properly set. When boxed-out sections are allowed, the boxed-out section shall be waterstop lined and treated in general as specified for "Construction Joints" in Section 03300.

H. The Contractor shall provide Clow Model F-1984 flange fillers, or equal, where needed for closing up between two flanges which do not meet.

2.12 SPECIALTIES

A. Pressure and Compound Gages

1. Fittings

a. Quick Connect Stems: Shall be Type 316 Stainless Steel, full flow type, ½-inch female NPT stem with protector cap, Swagelok "QF" series or equal. Quick connect stems shall be fully compatible with the quick connect body furnished with the pressure gauges. Both stem and body shall be of the same manufacturer.

b. Ball Valves: Shall be 316 Stainless steel body, stem and ball with Teflon seat and packing, spring return handle to the fully closed position, Marpac, PBM, Flow-Tek or equal.

c. Service Saddles: Shall be bronze or nylon-coated iron with double stainless steel straps for use on pump discharge installations, Smith Blair or equal. Furnish bronze bushings as required for ½-inch NPT connections.

d. Nipple: Shall be Schedule 80, seamless, Type 316 stainless steel conforming to ASTM A312-89 with threaded ends.

PART 3 - EXECUTION

3.01 EXPANSION

A. The installation of all pipes shall be such as to allow for expansion using expansion joints, as shown on the drawings or as may be necessary to prevent undue strain on piping.

B. Expansion joints shall be flanged end, bellows type. Units shall be of neoprene construction and shall be suitable for use in the service intended. The exterior of the expansion joints shall be suitable for outside service. All units to be provided for use in sludge systems shall have a filled arch. Flanges shall be of hot-dipped galvanized steel construction, with flat-face suitable for mating to ductile iron flanges. Retainer rings shall be constructed of hot-dipped galvanized steel. Expansion joints shall be the Model 500N of Mercer Rubber Company, or equal.

3.02 CONNECTION AT DISSIMILAR METALS

A. Wherever pipes of dissimilar metal join, there shall be provided an insulating union, coupling or flange connector for corrosion control. Connectors shall include an approved type dielectric separator. Connectors shall be the product of Dresser Corporation, or equal. Stainless steel nuts, bolts, and washers shall be used at all places at which such dielectric separators are used.

3.03 INTERIOR PROCESS PIPING INSTALLATION

A. Pipe Layout in Building

1. Coordinate work to prevent interference between architectural, structural, electrical and mechanical features; the Contract Drawings are generally diagrammatic due to their small scale.

2. Provide such offsets, fittings and other items as may be required to suit conditions.

3. Do not place joints or fittings over switchboards, panels, motors or other electrical equipment.

4. The completed installation shall present a neat, orderly appearance; do not block openings or passageways; run piping parallel to the walls of buildings or structures.

5. Provide clearance between piping, walls, floors, machinery and equipment to prevent the transmission of noise and vibration.

6. Orient hand wheels, levers, valve operators and other valve actuators for convenience of operation; set gate valves with the stem above the horizontal.

7. Cut pipe to measurements established at the site and install without springing or forcing; make changes in direction with fittings.

B. Equipment Connections

1. Make connections to pumps and other equipment in a manner to eliminate strains on piping and equipment.

2. Install unions or flanges adjacent to equipment and wherever their use will facilitate removal of equipment.

C. Flanged Joints

1. Tighten flange bolts so that the gasket is uniformly compressed and sealed; do not distort flanges; do not exceed manufacturer's recommended maximum torque.

2. Leave flange bolts with ends projected 1/8" to 1/4" beyond the face of the nut after tightening.

D. Flange Adapters and Flange Coupling Adapters

1. Flange Adapters: Tighten flange adapter setscrew with torque wrench to manufacturer's recommended tightening torque.

2. Flange Coupling Adapters: Drill hole in plain-end of process pipe at each anchor stud location. Tighten anchor stud fully so that anchor stud protrudes into drilled hole, thereby preventing lateral movement of the pipe.

E. Threaded Joints: ANSI B2.1, NPT

Cut threads full and clean with sharp dies; ream ends of pipe after threading and before assembly to remove burrs; leave not more than three pipe threads exposed at each connection; use joint compound or thread tape on the male thread only.

F. Solder Joints

1. Ream or file pipe to remove burrs; clean and polish contact surfaces of joints.

2. Apply flux to both male and female end; insert end of tube into fittings full depth of socket.

3. Bring joint to soldering temperature, in as short a time as possible, forming continuous solder bead around entire circumference of joint.

G. Solvent Cemented Joints (PVC): Make joints in pipe and fittings in accordance with the procedures and techniques in ASTM D2855.

H. Fusion Welded Joints (PE): Make joints in pipe and fittings in accordance with the procedures and techniques in ASTM D2657 or ASTM D3261 as applicable.

3.04 PIPE SUPPORTS

A. Support piping from structural construction using pipe hangers, pipe riser clamps and pipe clamp hangers in conjunction with beam clamps, brackets or other equipment as dictated by structure construction.

B. Trapeze hangers approved by the Engineer may be used where several horizontal pipes run closely parallel; secure pipes on trapeze hangers to prevent sideway motion.

C. Vertical Piping

1. Secure at sufficiently close intervals to keep pipe in alignment and to support weight of pipe and its contents.

2. Support vertical iron and steel pipe on maximum 5'-0" centers with steel pipe riser clamps.

3. Support vertical copper tubing at no more than 10'-0" spacing, using plastic coated steel pipe riser clamps or pipe clamp hangers at end of runs and at intermediate points as installation dictates.

4. Support vertical plastic pipe at 4'-0" centers, using plastic coated pipe riser clamps or pipe clamp hangers at end of runs and at intermediate points as installation dictates.

D. Horizontal Piping

1. Support at sufficiently close intervals to prevent sagging, thrust restraint, and vibration.

2. Install hangers or supports at ends of runs or branches and at each change of direction or alignment.

3. Install steel clevis-type pipe hangers for horizontal iron and steel pipe on maximum 10'-0" centers.

4. Install steel clevis-type pipe hangers for copper tubing on 6'-0" centers for 1-1/4" size and smaller, and on 10'-0" centers for copper tubing larger than 1-1/4" size.

5. Install plastic coated ring-type pipe hangers for horizontal plastic pipe on maximum 4'-0" centers, close to every joint, at ends of each branch, and at each change in direction or elevation; hangers shall not compress, distort, cut or abrade plastic piping and shall permit free movement of the pipe.

E. Pipe Bracing: The Contractor is responsible for properly bracing piping against lateral movement or sway. The Engineer shall review with the Contractor and approve method of bracing of piping at each location prior to Contractor proceeding with the installation of the bracing. Bracing shall be installed at all locations where sway is anticipated and as directed by the Engineer.

3.05 CUTTING AND PATCHING

A. Do not cut and patch existing structures without prior permission from the Engineer.

B. Perform cutting and patching where indicated in the contract drawings. Patch to match adjacent finishes.

3.06 IDENTIFICATION OF PIPING SYSTEMS

A. Painting of the various piping system shall be as specified under Section 09900.

B. All piping systems listed shall be stenciled with the name of the service to indicate the use of that particular pipe, and an arrow showing the normal direction of flow. Stencils shall be plain block letters of the size indicated hereinafter. Stenciled names shall be located near each branch connection, near each valve and at least every 50 feet on straight runs of pipe. All stenciled names shall be so located as to be legible from the floor. Generally, letters on light colored pipes shall be either black or red; on dark colored pipes letters shall be white. Stenciled names shall be applied after the piping has been tested, covered (if required) and painted. Color coding and names are as specified herein. Any system inadvertently not listed shall be stenciled as directed by the Engineer. Paint all valves and operators the same color as the piping.

C. All materials shall be applied in accordance with the manufacturer's recommendation.

D. No bright metal parts such as stainless steel, chromeplate, etc., shall be painted. Nor is it intended to paint stainless steel, copper, brass, or aluminum pipes. Pipes of these metals, however, shall be color coded, banded with colors indicated below with 6 inch wide bands not less than 8 feet on centers. PVC piping shall be painted.

E. All valves shall be provided with identification tags. Valve tags shall be 3/32 inch thick engraved plastic, 2-1/2 inches in diameter, with black engraved lettering on a white background. Lettering and/or numbering shall be ¾ inches high, shall be on both sides of the tag and shall correspond to the valve designations required by the Engineer. Valve tags shall be fastened through a small predrilled angular hole through the valve tag and secured with a meter seal. Valve tags shall be as manufactured by the Seton Name Plate Corporation, or equal.

3.06 TESTING OF PIPES

A. The Engineer shall be notified in advance of all tests and all tests shall be conducted to his entire satisfaction. All tests shall be made prior to insulating piping.

B. Repairs to the various systems shall be made with new materials. No caulking of threaded joints, cracks or holes will be acceptable. Where it becomes necessary to replace pieces of pipe, the replacement shall be the same material and thickness as the defective piece. Tests shall be repeated after defects disclosed thereby have been made good or the work replaced.

C. All piping shall be adequately braced and supported during the tests so that no movement, displacement or damage shall result from the application of the test

pressure. Relief devices in the various systems shall be capped or plugged during the tests.

D. All equipment used in testing shall be subject to the approval of the Engineer, and shall be such as to properly develop, maintain and measure test procedures.

E. The test pressure shall be maintained for at least two hours with no pressure drop. All gravity flow piping systems, inside or under the various structures, shall be filled with water and there shall be no drop in level after two hours. Piping systems shall be tested in accordance with the pipe schedule and Section 15190.

3.08 AS-BUILT SHOP DRAWINGS

A. The Contractor shall provide the Engineer with four sets of prints as As-Built Shop Drawings for each interior piping system showing all equipment and valves, together with one set of “mylar” reproducibles. Drawings shall show numbers and/or letters for all equipment and for each valve, as specified herein under Paragraph entitled “IDENTIFICATION OF PIPING SYSTEMS.”

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 15080

VALVES AND PIPING SPECIALTIES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Control valves, check valves, hydrants, gauges, and all other special piping appurtenances

1.02 DESCRIPTION

A. Under this section, the contractor is to provide and install all valves, hose connections, hydrants, valve boxes, and other piping specialties as specified, as indicated on the contract drawings, and as necessary to provide complete piping systems as intended that are not expressly specified in other sections of these specifications.

B. All valves listed within these specifications may or may not be used on each specific project. Refer to project plans for types and locations of valves for each individual project.

1.03 RELATED SECTIONS

A. Submittals: Section 01300

B. Pipe and Pipe Fittings: Section 02535

C. General Building Mechanical Requirements: Section 15010

1.04 QUALITY ASSURANCE

A. Products shall be new, the latest standard product of reputable manufacturers, and shall have replacement parts available.

B. Potable water system materials shall bear the seal of approval of the National Sanitation Foundation (NSF).

C. Materials contaminated with gasoline, lubricating oil, liquid or gaseous fuels will be rejected.

1.05 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Shop Drawings and Product Data

1. Submit manufacturer’s catalog data, literature, illustrations and specifications.

2. Submit shop drawings of valves and valve operators including dimensions, net assembled weight of each size valve furnished, construction details, and materials of components.

3. Submit manufacturer’s installation instructions.

4. Submit manufacturer's maintenance instructions and complete parts lists.

C. Certificates

Submit a Certificate of Compliance, together with supporting data, from the materials supplier(s) attesting that valves, accessories, and specialties meet or exceed specification requirements.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver valves and accessories to the job site in the manufacturer's boxes or crates. Mark each valve as to size, type and installation location.

B. Seal valve ends to prevent entry of foreign matter into valve body.

C. Store valves and accessories in areas protected from weather, moisture and possible damage.

D. Do not store materials directly on the ground.

E. Handle valves and accessories to prevent damage to interior and exterior surfaces.

1.07 JOB CONDITIONS

A. Investigate conditions affecting this work and coordinate with other contractors to prevent interference between architectural, structural, mechanical and electrical features.

B. The contract drawings for small diameter pipe are generally diagrammatic and it is not possible to indicate all fittings, valves, and other items required for a complete operating system. Provide all such valves, fittings and specialties to complete the systems as intended.

C. Provide necessary valve wheels, keys, wrenches, levers and stem extensions. Locate to assure accessibility and operability throughout the operating range without interference. Install valve stem supports, guides and operators. For buried valves, provide valve boxes and stem extensions to grade. Provide valve accessories of the same manufacturer as the valve, unless specified elsewhere.

D. Provide chain operators for valves 4" size and larger that are located 6'-0" or more above finished floor level.

PART 2 – PRODUCTS

2.01 GENERAL

A. Provide valves and piping specialties of the size and type indicated on the contract drawings.

B. Cast iron valve material shall meet or exceed the requirements of ASTM A126, Class B.

C. Valve flanges shall conform to ANSI B16.10, (125# and 250# class) as applicable.

D. Mechanical joint valve ends shall conform to ANSI/AWWA C111/A21.11.

E. Screwed valve ends shall conform to ANSI B2.1; American Standard Taper pipe threads.

F. Valves shall be of a design that requires no more than 50 lbs. pull on the hand wheel or standard valve wrench to provide positive shutoff against rated working pressure.

2.02 GATE VALVES

NOT USED

2.03 CHECK VALVES

A. Flange Joint Swing Disc Check Valves

1. The valve shall have a heavy duty body constructed of high-strength cast iron conforming to ASTM A126 Class B with integral flanges, flat faced and drilled per ANSI B16.1 Class 125 or Class 250 and be suitable for horizontal or vertical installation.

2. The valve body shall be of the full waterway type, designed to provide a net flow area of not less than the nominal inlet pipe size when swung open no more than 25 degrees. The valve shall have a replaceable bronze or stainless steel body seat. The body shall have a bolted steel cover allowing complete access to and removal of all internal components while the valve is in the line.

3. Valve disc shall be cast iron and faced with a renewable resilient seat ring of rubber or other suitable material, held in place by a follower ring and stainless steel screws.

4. The disc arm shall be ductile iron or steel, suspended from and keyed to an austenitic stainless steel shaft which is completely above the waterway and supported at each end by heavy bronze bushings. The shaft shall rotate freely without the need for external lubrication. The shaft shall be sealed where it passes through the body by means of a stuffing box and adjustable packing. Simple O-ring shaft seals are not acceptable.

5. The valve shall be supplied with an outside lever and adjustable counterweight to initiate valve closure. Final closure shall be dampened by means of a single, side-mounted bronze air-cushion assembly directly mounted to the valve body on machined pads. The amount of cushioning shall be easily adjustable without the need for pre-charged air chambers. Commercial air cylinders which pivot and/or are attached with fabricated brackets are not acceptable.

6. The valve shall swing open smoothly at pump start and close quickly and quietly upon pump shutdown to prevent flow reversal. When closed, the valve shall seat drop tight.

7. The valve shall be GA Industries, Inc. Figure 250-D, or approved equal.

B. Threaded and Solder Joint Check Valves for use with copper or steel water piping:

1. Horizontal swing check type

2. Bronze body

3. Renewable bronze disc

4. 200 PSI working pressure

C. Threaded and Solder Joint Check Valves for use with copper or steel compressed air piping:

1. Lift check type

2. Bronze body

3. Renewable disc

4. Union cap

5. 200 PSI working pressure

D. Globe Style Silent Check Valves

1. Semi-steel body with bronze seat, bronze valve plug, and stainless steel spring.

2. Valve plug shall be center-guided at both ends with a through integral shaft; helical or conical spring loaded.
3. Replaceable seat and valve plug.

4. Flow area through body shall be equal to or greater than the cross-sectional area of equivalent pipe size.

5. 200 PSI working pressure

E. PVC Check Valves

1. Use on all plastic piping

2. Double union ball type

3. Viton seals

4. 150 PSI working pressure

F. All check valve shall be designed so that all parts may be removed for inspection or replacement through the top of the valve with the valve in position.

2.04 PLUG VALVES

A. Eccentric plug valves shall be DeZurik model PEF as manufactured by DeZurik Corporation, or approved equal.

B. Plug valves shall be of the non-lubricated eccentric type with resilient faced plugs. All buried force main valves shall be furnished with mechanical joint connections, AWWA C111. All non-buried force main valves shall be furnished with flange joint connections. Port areas of all plug valves shall be at least 100% of full pipe area.

C. Valve bodies shall be of ASTM A126, Class B cast iron in compliance with AWWA Standard C504, Section 5.4. All exposed nuts, bolts, springs, washers, etc. shall be stainless steel. Resilient plug facings shall be of neoprene, suitable for use with sewage.

D. Valves shall be furnished with corrosion resistant seats which comply with AWWA Standard C507, Section 7, paragraph 7.2 and with AWWA Standard C504-74, Section 8, paragraphs 8.4, 8.5, 8.6, 8.6.2, 8.6.3., 8.6.4, 8.6.5, 8.6.6.

E. Valves shall be furnished with replaceable sleeve type bearings in the upper and lower journals. These bearings shall comply with AWWA Standard C507, Section 8, paragraphs 8.1, 8.3, and 8.5 and with AWWA Standard C504, Section 9.

F. Valve shaft seals shall comply with AWWA Standard C507-73, Section 10, and with AWWA C504, Section 10.

G. Valve pressure ratings shall be as follows and shall be established by hydrostatic tests as specified by ANSI Standard B16-1. Pressure rating shall be 175 psi. Valves shall be capable of providing drip-tight shutoff up to the full rating with pressure in each direction.

H. All 4” and smaller non-buried valves shall be furnished with lever actuators. All 6” and larger non-buried valves shall be furnished with gear reduction hand wheel actuators.

I. Valve operators shall be completely enclosed in an air, water, and oil-tight housing mounted directly on the valve and providing access to the valve stem packing. The housing shall comply with AWWA Standard C504, Sections 11.2.3 and 11.3. Both worm gear shafts and gear quadrants shall be furnished with replaceable sleeve type bearings the same as the valve bearings. Shaft seals shall be provided to seal all external shafting. All valves shall be completely sealed including the valve stem packing box. Open and closed stops shall be provided to comply with AWWA C504, Section 11.3.

J. Valves to be direct buried shall be provided with roadway valve boxes. Roadway valve boxes shall be cast iron and inside riser diameter of 5-1/4" and to be of the two-piece sliding adjustable type with drop cover marked for sewer service. Both the inside and outside of the valve box and cover shall be thoroughly cleaned and coated with asphaltum varnish, applied hot, before leaving the foundry. Extension stems with standard 2" square operating nuts shall be provided where depth from finished grade to valve operating nuts exceeds 5 feet. Extension stems shall be securely attached to the valve operating nut and shall be provided with means for centering the operating nut within the roadway valve box.

2.05 GLOBE VALVES

NOT USED

2.06 BALL VALVES

A. Top entry, bronze body, chrome-plated brass ball, double seal TFE seat, TFE stem seal and bonnet O-ring. 200 psi working pressure. Flanged, threaded, or solder joint as applicable.

B. Iron body, (6" through 48" for water) 300 psi pressure, AWWA C507.

C. PVC ball valves: True union, double entry; Viton O-ring seals, self-lubricating Teflon seats. 150 psi working pressure.

2.07 BUTTERFLY VALVES (METAL BODY)

NOT USED

2.08 AIR RELEASE VALVE

A. Air release valve shall be float operated and shall employ a compound lever mechanism to enable the valve to automatically release accumulated air and gases from a sewage pipeline while the system is pressurized and operating.

B. Valve Bodies and Covers: Cast iron, ASTM A 126, Class B.

C. Inlet Size: 2-inches.

D. Outlet Size: ½-inch, NPT.

E. Maximum Working Pressure: 150 psi.

F. Valve Discharge Orifice Seat, Mechanism and Valve Stem: Stainless Steel.

G. Valve Mechanism Lever Pins and Float: High strength stainless steel, ASTM A 240.

H. Valve Float Stem and Guide: Type 304 Stainless Steel.

I. Valve Float: Stainless Steel, ASTM A 240.

J. Valve Orifice Seat: Buna-N, Nitrile Rubber, ASTM SB 800.

K. Back flushing and Cleaning Accessories: Factory assembled to the combination valve and consisting of an inlet shut-off valve, a blow-off valve, a clear water inlet valve, section of rubber hose and quick disconnect couplings.

L. Acceptable Manufacturers:

1. Val-Matic Valve and Manufacturing Corp.; Model No. 48A.

2. Golden Anderson, Short Body, Fig. 929.

2.09 FLOW CONTROL ORIFICES

A. Threaded end inline orifices that maintain a fixed flow rate regardless of varying inlet pressure by means of a flexible orifice that varies its area inversely with pressure.

B. 100 psi minimum working pressure.

2.10 CORPORATION STOPS

NOT USED

2.11 CURB STOP ASSEMBLY

NOT USED

2.12 SURGE RELIEF VALVE

NOT USED

2.13 AIR LINE SHUTOFF VALVES

A. For isolating small air supply branch and signal lines as shown in the contract drawings.

B. Toggle operated

C. Forged brass body

D. Stainless steel trim

E. O-ring stem seal

F. Minimum 200 PSI working pressure rated

2.14 FLOOR TYPE TANK AND FOUNDATION PRESSURE RELIEF VALVES

NOT USED

2.15 WALL TYPE TANK PRESSURE RELIEF VALVES

NOT USED

2.16 SOLENOID VALVES

NOT USED

2.17 PRESSURE REDUCING/REGULATOR VALVES (AIR AND LIQUID)

NOT USED

2.18 LIQUID RELIEF VALVES

NOT USED

2.19 INLINE Y-STRAINERS (AIR AND LIQUID)

NOT USED

2.20 SELF-CLEANING STRAINER ASSEMBLY

NOT USED

2.21 EMERGENCY SHOWER AND EYE WASH

NOT USED

2.22 FIRE HYDRANTS

NOT USED

2.23 YARD HYDRANTS

NOT USED

2.24 WALL HYDRANT (EXTERIOR)

NOT USED

2.25 HOSE BIBBS (INTERIOR)

NOT USED

2.26 VALVE BOXES

A. Three-piece, cast iron, adjustable

B. 5-1/4” diameter

C. Heights as indicated

D. Valve boxes shall be either East Jordan Iron Works, Bingham & Taylor, or approved equal.

2.27 PRESSURE GAUGES (LIQUID SERVICE)

A. Bronze bourdon tube type, brass socket. Stainless steel case. Acrylic window. Liquid filled.

B. 4-1/2" dial size. Stainless steel dial, black lines and numbers.

C. Pressure range as indicated. Graduations and figure intervals proportioned to range.

D. Polypropylene bushed, stainless steel rotary movement, micro-adjustable pointer. Minimum pressure stop, over-pressure protection. Adjustable zero set point adjustment screw which does not require removal of gauge case.

E. Accuracy to 1% of full-scale range.

F. 1/8" NPT bottom connection. Shutoff cock.

G. When indicated on the contract drawings, provide cadmium-plated diaphragm gauge seal; 316 ELC diaphragm, flushing connection, stopcock.

H. Gauges shall be manufactured by either Ashcroft, US Gauge, or approved equal.

2.28 PRESSURE GAUGES (AIR SERVICE)

A. Bronze bourdon tube type, brass socket. Stainless steel case with blowout grommet.

B. 4-1/2" dial, white background, black lines and numbers.

C. Bronze brushed, rotary movement. Micro-adjustable pointer. Accuracy to 1% of full-scale range.

D. 1/8" bottom connection. Shutoff cock.

E. Pressure range as indicated shall cover 150% of operating range. Graduations and figure intervals proportioned to range.

F. Gauges shall be manufactured by either Ashcroft, US Gauge, or approved equal.

2.29 HOSE COUPLINGS

A. Cam-locking quick-coupler

B. MPT coupler socket

C. FPT adapter plug

D. Side levers

E. Stainless steel construction

F. Buna N gaskets

G. Shall meet MIL-C-27487 specifications

2.30 BACKFLOW PREVENTER

NOT USED

2.31 WATER METERS

NOT USED

2.32 TAPPING ACCESSORIES

NOT USED

2.33 FLEXIBLE COUPLINGS AND REDUCERS

NOT USED

2.34 FLOOR BOX

NOT USED

2.35 STEM GUIDES

NOT USED

2.36 EXTENSION STEMS

NOT USED

2.37 CHAIN WHEELS

NOT USED

2.38 SAMPLE VALVES

NOT USED

2.39 ELECTRIC MOTOR OPERATED PINCH VALVES

NOT USED

2.40 FLAP GATES (FLAP VALVES)

NOT USED

2.41 VENTED BALL VALVES (BLEACH BALL VALVES)

NOT USED

2.41 TELESCOPING VALVE

NOT USED

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install valves and accessories in accordance with the manufacturer's instructions.

B. Inspect joint surfaces for structural soundness and thoroughly clean before installation.

C. Flap Gates shall be attached to pipe flanges mounted in the concrete wall. They are **NOT** to be attached directly to the concrete wall.

3.02 FIRE HYDRANTS

NOT USED

3.03 ADJUSTMENT

A. Check and adjust valves and accessories for smooth operation.

END OF SECTION

SECTION 15200

HEATING AND VENTILATING EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

The work of this section includes, but is not limited to: Fans, electric heaters, ductwork, louvers, dampers, heat pumps, air conditioner units, and accessories for heating, ventilating, and air conditioning.

1.02 QUALITY ASSURANCE

A. Design and Performance Criteria:

1. The design capacities and performance criteria are specified herein.

2. All damper, louvers, and actuators shall be provided by one manufacturer to assure system compatibility.

3. All electrical equipment shall be U.L. approved and be labeled as such.

1.03 SUBMITTALS

A. Shop Drawings and Product Data: Submit the required number of copies of detailed certified dimensional shop drawings and manufacturer's product data for materials and equipment; show complete information concerning materials of construction, fabrication, protective coatings, installation and anchoring requirements, fasteners, and other details. Submit electrical wiring diagrams for all electrical equipment.

B. Maintenance Data and Operating Instructions: Submit required number of copies of an Operation and Maintenance Manual including a detailed description of the function of each principal component, procedures for operation, instructions for overhaul and maintenance; include lubrication schedule, safety precautions, test procedures, electrical schematics, and parts lists.

C. Maintenance Manual: (Spare Parts)

1. Provide one complete set of the manufacturer's recommended spare parts to include the following but not limited to:

a. 1 V-belt of each type and size required.

2. Package each part individually or in sets in moisture-proof containers or wrappings, clearly labeled with part name and manufacturer's part/stock number; submit, in writing, storage procedures for spare parts to ensure adequate protection after delivery.

3. Provide any special tools required for equipment maintenance; provide a list of all equipment and tools needed to maintain and calibrate equipment.

PART 2 - PRODUCTS

2.01 SPLIT AC/HEAT PUMP SYSTEM

A. HEAT PUMP

1. Manufacture and Certifications

a. Units shall be manufactured in an ISO 9001 certified facility.

b. Units shall be certified by CSA to UL 1995 / CSA 22.2 and performance certified to ANSI/AHRI Standard 210/240.

c. Units shall be sound tested according to ANSI/AHRI Standard 270.

d. Certified matched system ratings shall be available for download from the AHRI online directory at www.ahridirectory.org.

e. Unit packaging shall be marked, “Assembled in the USA”.

f. System shall be rated for 3-Ton load, 16 SEER, using R-410A refrigerant and operating on 208-230V, 1ϕ, 60 Hz power supply.

g. Heat pump unit shall be York LX Series, model YHM36B21S or engineer approved equal.

2. Unit Application

a. Units shall be approved for heating operation between -20°F and 75°F without modification.

b. Units shall have the following operating modes:

- Defrost
- Cooling Operation
- Heating Operation
- Emergency Heat

c. Units shall be approved for line sets up to 80 feet equivalent length without modification.

d. Units shall be certified to the 5th Edition (2014) of the Florida Building Code for both Ground Mounted and Rooftop Mounted applications up to 200 feet above grade with approved mounting kit.

e. Units shall be designed to 74dBA or less to minimize sound pollution.

3. Unit Access

a. Units shall have a removable fan guard that can be removed independently of the top for interior access through the top of the unit without damaging the coil.

b. Units shall have two removable stamped extruded louver steel coil guards for exterior coil access.

c. Units shall have a separate compartment for electrical controls that can be accessed without disturbing the unit airflow.

d. Units shall have a block-off panel that can be removed to provide interior unit access through the side of the unit.

e. Units shall have a removable block-off panel and a swing away removable electrical

4. Unit Construction

a. Units shall be shipped completely wired, piped and assembled. Wiring pigtails shall be provided for field control wiring connections. Service valves shall be provided for field refrigerant line connections.

b. Units shall be factory leak checked, run tested, and shipped with a holding charge of R-410A refrigerant.

c. Unit cabinet components shall be G90 equivalent steel finished with powder-coat paint rated at a minimum of 750 hours under ASTM B117 testing.

d. Units shall have a single corner post opposite the electrical control box and two independently removable steel coil guard panels to optimize cabinet strength and serviceability.

e. Units shall have L-shaped stamped extruded louver sheet metal coil guards with for maximum panel durability and stiffness.

f. Units shall have a factory installed filter-drier for faster installation and improved system reliability.

g. Unit base valves shall be mounted diagonally on the unit base pan with service ports that provide sufficient clearance for low-loss hose fittings.

h. Units shall provide a service port mounted in the base pan such that panels can be removed without moving the service port.

i. Units shall be constructed with a high-pressure switch and a low-pressure switch for system protection.

j. Units shall be constructed with all badging and labels applied at the factory.

5. Unit Components

a. Units shall be constructed of rotary or scroll compressors paired with an inverter drive.

b. Condenser fan shall be direct drive with vertical air discharge for low sound levels.

c. Condenser fan blades are designed to minimize sound.

d. Condenser fan motor shall be ECM construction with permanently lubricated ball bearing motors approved for vertical shaft applications.

e. Condenser coil shall be air cooled and constructed of enhanced aluminum fins mechanically bonded to internally enhanced Ø 7mm copper tubing.

6. Unit Warranties

a. Unit manufacturer shall provide a 10-Year compressor warranty without a requirement for unit registration.

b. Unit manufacturer shall provide a 5-Year parts warranty without a requirement for unit registration.

7. Accessories

a. Provide the following accessories:

- Support feet kit
- Anchor bracket kit
- Touch-up paint matching color of unit

B. AIR HANDLER

1. Manufacturer and Certifications

a. Units shall be manufactured in an ISO 9001 certified facility.

b. Units shall be tested to UL 1995 / CSA 22.2 standards up to 0.30”wc external static pressure.

c. Air handler shall be load matched to the heat pump unit, operating on same voltage power supply.

d. Air handler shall be York model AHE36C3X or engineer approved equal.

2. Unit Components

a. Insulated Cabinet – Air handler cabinet shall be thermally insulated with ¾” foil faced insulation to prevent sweating.

b. Factory Sealed – Total airflow leakage rate shall be less than 2%.

c. Finish – Air handler casings shall be made of pre-painted galvanized steel which provides a better paint to steel bond that resists corrosion and rust creep. All internal coil sheet metal parts shall be made of G60 galvanized or pre-painted G30 galvanized.

d. Filters – Air handler shall have internal filter racks provided for use with 1" thick standard size filters.

e. Electric Heat Kit – Air handler shall be equipped with a 14.4kW electric heat kit.

f. Blower Motor – Air handler shall use a high efficiency brushless DC motor to provide cooling SSER rating enhancement.

3. Unit Warranties

a. Unit manufacturer shall provide a 10-Year compressor warranty without a requirement for unit registration.

b. Unit manufacturer shall provide a 5-Year parts warranty without a requirement for unit registration.

C. THERMOSTAT

1. Manufacturer and Certifications

a. Thermostat shall comply with Part 15 of the FCC Rules.

b. Thermostat shall be York LX Series or engineer approved equal.

2. Unit Components and Features

a. Thermostat shall have a backlit LCD display that displays the following information:

- Clock with day of the week, which indicates the current time and day. The clock is also used to program the time period schedules.
- Mode indicators, which selects the operational mode of the equipment. Operational modes include heat, cool, heat & cool, and off.
- Program icon indicating that Time Period Programming is running or is enabled to be set.
- Room temperature display, indicating the current room temperature and displays the outdoor temperature when selected.
- Outdoor icon, indicating the temperature displayed is from the optional outdoor sensor.
- Desired set temperature, indicating the desired room temperature(s). Unit shall also display the highest and lowest temperatures for the day.
- Morning, Day, Evening, & Night icons, indicating the day part of the time period program.
- Setup step icon, indicating the step number when the thermostat is in the setup mode.
- 2nd and 3rd stage icons, indicating what stage of cooling or heating is currently energized.
- "Lock" icon, indicating the keypad has been locked.
- "AuxHeat" icon, indicating 2nd stage electric heat is being used when the thermostat is programmed for Heat Pump operation.

Only the “Aux” icon will appear during Cool to Dehumidify to indicate Reheat operation.

- “Lo” icon, indicating the lowest recorded outdoor temperature for the day.
- “Hi” icon, indicating the highest recorded outdoor temperature for the day.
- “Fan On” icon, indicating constant, continuous fan operation. When “Fan On” is not lit – indicates the fan will only operate when necessary to heat or to cool.

b. “Cooler” button

c. “Warmer” button

d. “Mode” button

e. Heat or Cool demand indicator (red = “Heat”; green = “Cool”)

2.02 CORROSION RESISTANT FUME EXHAUSTERS

A. The fans shall be single-width, single-inlet. Fans shall be constructed such that all surfaces in contact with corrosive gas stream are to be made of corrosive-resistant FRP. All nuts, bolts and fasteners in contact with the gas stream shall be type 316 SST and encapsulated in FRP. Fans shall be AMCA Arrangement 1, 8, 9, 9F, or 10. AMCA Arrangement 4, which places the motor shaft in the corrosive gas stream, is unacceptable.

B. Fan ratings shall be based on tests made in accordance with AMCA Standard 210 and licensed to bear the AMCA Certified Ratings Seal of Air Performance. Fans not licensed to bear the AMCA Seal for performance shall be tested, at supplier’s expense, in an accredited AMCA laboratory. Fans shall have a sharply rising pressure characteristic extending throughout the operating range to assure quiet and stable operation. Fan performance shall be as shown on plans.

C. Fan motors and assembled units shall be UL and cUL approved for Class 1, Division 1 and 2, Group C and D; Class II, Divisions 1 and 2, Groups E, F, and G

D. Fan manufactures shall provide sound power level ratings for fans tested and rated in accordance with AMCA Standards 300 and 301. Test shall be performed in an accredited AMCA laboratory. Sound power ratings shall be in decibels (reference 10^{-12} watts) in eight octave bands.

E. Bearings are to be grease lubricated, precision anti-friction ball or spherical roller, self-aligning, pillow block design. Bearings shall be designed for a minimum L-10 life of 30,000 hours (150,000 hours L-50 life) when rated at the fan’s maximum cataloged operating speed. Fan bearings shall be visible and accessible for inspection and maintenance. Bearings enclosed within the fan housing where they can be exposed to the corrosive gas stream are not acceptable.

F. All steel fan surfaces are to be thoroughly cleaned prior to painting using a combination of washing and hand/power tool cleaning per SSPC-SP1, SSPC-SP2 and SSPC-SP3 standards. After cleaning, surfaces of bolted metal components shall be coated and allowed to dry prior to final assembly. After assembly, all fan exterior surfaces are to receive one coat of epoxy enamel finish to a thickness of

2-3 mils d.f.t. All fasteners external to the gas stream shall be platted for extra corrosion protection.

G. Fan shall be constructed in accordance with the ASTM D-4167 standard specification for fiber-reinforced plastic fans and blowers to ensure structural integrity. All parts exposed to the gas stream shall be constructed of, or encapsulated in, an FRP laminate capable of resisting continuous airstream temperatures of 250°F.

All resins shall be clear to allow detection of subsurface imperfections. Use of pigments, gel coats, inhibitors and additives which may disguise flaws in the laminate are prohibited.

Other minimum construction requirements shall consist of the following

1. Housing: Fan housing shall be constructed of a fire-retardant polyester resin with an ASTM E84 Class I rating. Housing laminate construction shall conform to ASTM Standard C-582.

   Airstream surfaces shall be smooth to minimize resistance and prevent build-up of airborne contaminants. Fan shall be furnished with flanged outlet.

   Shaft hole openings shall be fitted with a Teflon® closure having a maximum clearance of 1-32" to minimize leakage. Fan shall be furnished with a lubricatable, double-lip, Teflon or Viton® shaft seal. Inlet assembly shall be bolted to permit wheel removal.

2. Wheel: Wheel shall be of backwardly-inclined, non-overloading design for increased efficiency. Wheel shall be fabricated of a fire-retardant vinyl ester resin with an ASTM E84 Class I rating. Wheel hub shall be permanently bonded to the shaft and completely encapsulated in FRP to insure corrosion-resistant integrity. Steel wheels coated with FRP, or wheels with taper-lock hubs, are not acceptable.

3. Shaft: Shaft shall be ASTM A-108 steel, grade 1040/1045 with an FRP sleeve fixed securely and bonded to the wheel backplate. The sleeve shall extend out through the housing shaft hole for corrosion protection. The shaft first critical speed shall be at least 125% of the fan's maximum operating speed. Shaft shall be countersunk for tachometer readings.

H. The wheel and shaft shall be dynamically balanced as an assembly, and the fan will be balanced in accordance with limits set forth in AMCA 204, Section 6, Table 6-3 for Industrial Process and Power Generation Equipment level BV-3 (.15 insec. Filter-in at both bearings in the horizontal and vertical planes).

I. Fan manufacturer shall warrant that all fan components shall be free from defects in materials and workmanship for a period of one (1) year after shipment from its plant.

J. Accessories shall be provided as called for in the plans and specifications. Required accessories include:

- Explosion Proof
- H/O/A Switch

- Bearings with grease fittings
- Extended lube lines
- Heavy Duty Slide Rails
- Vibration isolators
- Inspection Port
- Flanged Inlet
- Flanged Drilling
- Inlet Box
- Shaft Seal- Viton, Teflon
- Threaded Drain, W/ PVC Plug
- Positive Screw Adjustment
- Belt, shaft, & coupling guards
- V-Belt Drive: Adjustable, Constant
- Spare belt

K. Manufacturer schedule:

FRP Corrosion Resistant Exhaust Fan Manufacturer Schedule		
Mark	Location	Manufacturer / Model
EF-1	Upper level of wet well	New York Blower model GFE or equal as manufactured by Loren Cook Company

L. Design Criteria:

FRP Corrosion Resistant Exhaust Fan Design Requirements								
Mark	Location	Type	Flow (CFM)	Operating Pressure (Inches H20)	Voltage	Phase	HP	Explosion Proof
EF-1	Upper level of wet well	24” backward-inclined FRP fume exhauster, HP	5,200	0.8	480	3	2	Yes

2.03 FIXED LOUVERS

A. Provide stationary, horizontal, drainable storm proof louvers with the following:

1. Depth: 4 inches or 8 inches as shown on the project plans, unless otherwise indicated.

2. Material: 0.081 or 0.125" inch thick, ASTM B 221, 6063-T or T-52 aluminum extrusion frame with integral caulking slot and blades.

3. Blades: Set at fixed angle of 30 degrees, 2-1/2" on centers, unless otherwise indicated.

4. Mullions: Concealed vertical mullions and blade braces.

5. Performance Requirements: As follows, determined by testing 48" wide by 48" high per AMCA Standard 500:

- Free Area: Not less than 6.3 sq. ft.

- Static Pressure Loss: Not more than 0.08 inch w. g. at an air flow of 1000 fpm free area intake velocity.

6. Water Penetration: Not more than 0.20 oz. per sq. ft. of free area at an airflow of 1140 fpm free area intake velocity when tested for 15 minutes.

7. AMCA Seal: Mark units with AMCA certified rating seal.

B. Louver Screen: On inside face of exterior louvers, provide 1" x 1-1/2" mesh anodized expanded aluminum bird screens mounted in removable extruded aluminum frames and having an 80% minimum face open area.

C. Louver Finishes

1. Finish designations prefixed by “AA” conform to the system established by the Aluminum Association for designating aluminum finishes.

2. Baked Enamel Finish: AA-C12C42R1x. Apply baked enamel in compliance with paint manufacturer’s specifications for cleaning, conversion coating, and painting.

- Organic Coating: Thermosetting modified acrylic enamel primer/top coat system complying with AAMA 603.8 except with minimum dry film thickness of 1.5 mils, medium gloss.

- Color: The Owner will select the color from the manufacturer’s standard color schedule at time of submittal review.

- Finishes stated on louver schedules shown on the project drawings govern.

2.04 MOTOR OPERATED DAMPERS (MOD)

A. Provide motor operated dampers to be installed behind the stationary wall louvers. The operable dampers shall conform to the following:

1. Depth: 6" unless otherwise noted.

2. Material: .081" or .125" thick 6063-T5 or T-52 aluminum extruded channel style caulking frame.

3. Blades: 12 gauge aluminum blades mounted on stainless steel pins in nylon sleeve bearings. Blades to have continuous reinforcing bosses on the underside. All fasteners shall be stainless steel or aluminum. Provide bulb nose vinyl gasket on the full length of the blade to seal mating blade surfaces. Also, provide a 2" wide jamb gasket attached to inside of jamb face to seal blades at pivot ends. Pivots shall extend through the jambs and be connected to concealed blade linkage also located in the jamb.

4. Blade Pivot Arms: Shall be aluminum with brass bearings.

5. Performance Requirements: As follows, determined by testing 48" wide by 48" high per AMCA Standard 500:

- Free Area: Not less than 6.15 sq. ft.
- Static Pressure Loss: Not more than 0.15 inch w.g. at an air flow of 1000 fpm free area intake velocity.
- Water Penetration: Not more than 0.02 oz. per sq. ft. of free area at an air flow of 1040 fpm free area intake velocity when tested for 15 minutes.

6. AMCA Seal: Mark units with AMCA certified rating seal.

B. Finish: Chemical etch followed by a .08 mill anodizing. Color shall be as selected by the Engineer.

C. Operators: Provide heavy duty power open/spring closed electric operators. All operators shall be 110 volt, single phase.

Size each motor to operate dampers with sufficient reserve power to provide smooth modulating action or 2-position action as specified.

1. Provide permanent split-capacitor or shaded pole type motors with gear trains completely oil-immersed and sealed. Equip spring-return motors, with integral spiral-spring mechanism. Furnish entire spring mechanism in housings designed for easy removal for service or adjustment.

2. Equip motors for outdoor locations and for outside air intakes with “O-ring” gaskets designed to make motors completely weatherproof, and equip with internal heaters to permit normal operation at -40^{o}F.

3. Furnish non-spring-return motors for running torque rating of 150 inch-pounds and breakaway torque rating of 300 inch-pounds. Size spring-return motors for running torque rating of 150 inch-pounds and breakaway torque rating of 150 inch-pounds.

4. Operators shall be explosion proof.

2.05 EXPLOSION PROOF UNIT HEATERS

A. The explosion proof unit heaters shall be fan-forced type, UL and cUL approved for Class 1, Division 1 and 2, Group C and D; Class II, Divisions 1 and 2, Groups E, F, and G.

B. Housing: Heat exchanger and aluminum fan blade to be enclosed in an industrial grade, corrosion-resistant cabinet fabricated from polyester powder-coated, 14-gauge steel. Adjustable outlet louvers to have minimum opening safety stops.

C. Control Box: Unit heaters shall have manual reset thermal cutout for over-temperature protection, controlling magnetic contactor and 24 Volt control circuit transformer housed in a NEMA 7, 9 cast aluminum enclosure.

D. Fan Motor: Fan motor shall include permanently lubricated ball bearings and built-in thermal overload protection. Motor to operate at line voltage and be prewired to the control enclosure to eliminate the need for separate field wiring to the motor.

E. Heat Exchanger: Heat exchanger shall be liquid-to-air design, utilizing a steel tube

core with integral aluminum fins. Nontoxic, inhibited, propylene glycol heat transfer fluid shall be used that provides freeze protection down to -49°F. A pressure relief plug shall be utilized to provide overpressure protection. The heat exchanger shall include industrial grade electric heating elements.

F. Mounting Kit: The heater shall be provided with an accessory mounting kit designed to bear the weight of heater assembly, chose from either a ceiling mounting kit, wall mounting kit, or a pole mounting kit as shown on the contract drawings.

G. Each individual heater shall be supplied with an integral disconnect switch and remote thermostat.

H. Manufacturer schedule:

Manufacturers		
Mark	Location	Manufacturer / Model
UH-1	Upper level of wet well	Qmark model GUX15004832 or equal as manufactured by Brasch Manufacturing Company, Inc.
UH-2	Upper level of wet well	Qmark model GUX15004832 or equal as manufactured by Brasch Manufacturing Company, Inc.

I. Design Criteria:

Heater Design Requirements					
Mark	Location	kW	Voltage	Phase	Explosion Proof
UH-1	Upper level of wet well	15	480	3	X
UH-2	Upper level of wet well	15	480	3	X

2.06 EXPLOSION PROOF THERMOSTATS

A. Each unit heater shall have its own wall-mounted control thermostat.

B. Electrical heater thermostats shall have a bimetal sensing element that is fast acting, reliable, and unaffected by altitude.

C. Thermostats shall have no exposed copper or brass parts for excellent resistance to corrosion.

D. Feed-through design for easy installation.

E. Thermostat housing shall be constructed of copper-free aluminum.

F. ¾” hub size

G. Thermostats shall be single pole, single throw for heating only applications.

H. Thermostats shall be explosion proof and dust-ignition proof, meeting the following certifications & compliances:

- NEC/CEC

  Class I, Division 1 & 2, Groups C, D
  Class II, Division 1, Groups E, F, G
  Class II, Division 2, Groups F, G
  Class III

- UL Standard: 1203

- CSA Standard: C22.2 No. 30

I. Electrical ratings:

- 480 VAC max.
- ½ HP @ 120 VAC
- 1 HP @ 250 VAC
- 22 amps Res.

J. Temperature range: 36°F to 82°F

K. Install thermostat per both the thermostat and controlled heater manufacturers' instructions and specifications.

L. Thermostats shall be Crouse-Hinds, model HRC1, or engineer approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install the equipment as indicated on the Contract Drawings and in accordance with the manufacturer's instructions.

B. Provide and connect accessories and power as required to ensure a complete operable unit.

3.02 MECHANICAL PERFORMANCE TESTING

Place the equipment into initial operation to demonstrate correct alignment, smooth operation, freedom from noise, vibration, overheating, and all controls and mechanical functions.

3.03 EQUIPMENT ACCEPTANCE

Adjust, repair, modify or replace any components which fail to perform as specified and rerun the tests; make final adjustments to the equipment under the direction of the manufacturer's representative and to the satisfaction of the Engineer.

END OF SECTION

SECTION 15210

DUCTWORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. HVAC ductwork.

1.02 DESCRIPTION

A. Provide materials and installation for complete first class HVAC systems; install ductwork, flexible duct, hangers, supports, sleeves, flashings, vent flues, and all necessary accessories as indicated in the Contract Documents. Provide any supplementary items necessary for proper installation that make the systems operable, code compliant and acceptable to the authorities having jurisdiction.

B. All items mentioned within this specification may not be required for each individual project. Refer to the construction plans for information on materials required for each specific project.

1.03 RELATED SECTIONS

A. Submittals: Section 01300

B. Material and Equipment: Section 01600

C. Heating and Ventilation Equipment: Section 15200

1.04 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. ASHRAE - Handbook of Fundamentals; Duct Design.

2. ASHRAE - Handbook of HVAC Systems and Equipment; Duct Construction.

3. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.

4. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.

5. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

6. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

7. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.

8. ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate.

9. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

10. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.

11. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooling Equipment.

12. NFPA 45 – Laboratory Ventilating Systems and Hood Requirements.

13. SMACNA – HVAC Duct Construction Standards.

14. SMACNA – Rectangular Industrial Duct Construction Standards.

15. SMACNA – Round Industrial Duct Construction Standards.

16. SMACNA – HVAC Air Duct Leakage Test Manual.

17. UL 181 - Factory-Made Air Ducts and Connectors.

18. Engineering Design Manual for Air Handling Systems, United McGill Corporation (UMC).

19. Assembly and Installation of Spiral Ducts and Fittings, UMC.

20. Engineering Report No. 132 (Spacing of Duct Hangers), UMC.

21. AWSD1.1 American Welding Society Structural Welding Code.

1.05 INSTALLER QUALIFICATIONS:

A. Company shall have minimum three years documented experience specializing in performing the work of this section.

B. Installation of HVAC systems shall be performed by qualified Journeyman.

1.06 DEFINITIONS

A. Low Pressure

1. 2 inch W.G. Pressure Class: Ductwork systems up to 2 inch w.g. positive or negative static pressure with velocities less than or equal to 1500 fpm.

B. Medium Pressure

1. 3 inch W.G. Pressure Class: Ductwork systems over 2 inch w.g. and up to 3 inch w.g. positive or negative static pressure with velocities less than or equal to 2500 fpm.

2. 4 inch W.G. Pressure Class: Ductwork systems over 3 inch w.g. and up to 4 inch w.g. positive or negative static pressure with velocities less than or equal to 2500 fpm.

3. 6 inch W.G. Pressure Class: Ductwork systems over 4 inch w.g. and up to 6 inch w.g. positive or negative static pressure with velocities less than or equal to 2500 fpm.

C. High Pressure

1. 10 inch W.G. Pressure Class: Ductwork systems over 6 inch w.g. and up to 10 inch w.g. positive or negative static pressure with velocities greater than 2500 fpm.

1.07 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Product Data:

1. Provide the following information for each duct system furnished on the project (where applicable):

a. Duct system design pressure.

b. Duct material.

c. Duct gage.

d. Transverse joint methods.

e. Longitudinal seam type.

f. Sealant type.

g. SMACNA rectangular reinforcement type.

h. SMACNA intermediate reinforcement type.

i. SMACNA transverse reinforcement type.

C. Record Documents:

1. Submit Shop Drawings on all items of ductwork, plenums, and casings including construction details and accessories specified herein in accordance with Division 01. Ductwork construction details and materials used for duct sealant, flexible connections, etc. shall be submitted and approved prior to the fabrication of any ductwork.

2. Prepare Shop Drawings for the purpose of coordination with other trades including structural, piping, plumbing, electrical, lighting, and architectural. When Shop Drawings are not required to be submitted for the Project, field sketches and shop tickets must be available to the Owner upon request. Changes required during construction to accommodate coordination issues will be performed at no additional cost to the Owner.

3. Draw ductwork Shop Drawings on minimum 1/4 inch equal to one foot scale building floor plans and shall indicate duct sizes, material, insulation type, locations of transverse joints, fittings, ductwork bottom elevation, offsets, ductwork specialties, fire and fire/smoke dampers, and other information required for coordination with other trades. Clearly designate the following on the Shop Drawings:

a. Clearance dimensions between ducts and or location dimensions from walls, floors, columns, beams and large bore piping.

b. Ductwork pressure class ratings of ducts as defined within this specification.

c. Duct materials i.e., stainless steel, galvanized steel, FRP, prefabricated fire rated ductwork.

4. Detail Drawings for mechanical rooms and air handling unit locations shall be submitted at a minimum scale of 1/4 inch equal to one foot shall also be included within the Shop Drawings.

5. Coordinate with all other trades and building construction prior to submitting Shop Drawings for review. Indicate location of all supply, return, exhaust, and light fixtures from approved reflected ceiling plans on Shop Drawings.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver products to the Project Site and store and protect products under provisions of Section 01600.

B. Protect materials from rust both before and after installation.

1.09 WARRANTY

A. All ductwork shown on the Drawings, specified or required for the air conditioning and ventilating systems shall be constructed and erected in a first class workmanlike manner.

B. The Work shall be guaranteed for a period of one (1) year from the Project Substantial Completion date against noise, chatter, whistling, vibration, and free from pulsation under all conditions of operation. After the system is in operation, should these defects occur, they shall be corrected as directed by the Owner at Contractor's expense.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 DUCTWORK MATERIAL AND CONSTRUCTION

A. All ductwork indicated on the Drawings, specified or required for the air conditioning and ventilating systems shall be of materials as hereinafter specified unless indicated otherwise on Drawings. All air distribution ductwork shall be fabricated, erected, supported, etc., in accordance with all applicable standards of SMACNA where such standards do not conflict with NFPA 90A and where class of construction equals or exceeds that noted herein.

B. Ductwork shall be constructed of G-90 coated galvanized steel of ASTM A653 and A924 Standards, unless specified otherwise.

C. Minimum gage of round, oval or rectangular ductwork shall be 26 gage per SMACNA Standards, unless specified otherwise.

D. All duct sizes shown on the Drawings are clear inside dimensions. Allowance shall be made for internal lining, where specified, to provide the required free area.

E. All holes in ducts for damper rods and other necessary devices shall be either drilled or machine punched (not pin punched) and shall not be any larger than necessary. All duct openings shall be provided with sheet metal caps if the openings are to be left unconnected for future connections/phases, otherwise plastic covers are acceptable.

F. Except for specific duct applications specified herein, all sheet metal shall be constructed from prime galvanized steel sheets and/or coils up to 60 inches in width. Each sheet shall be stenciled with manufacturer's name and gage.

G. Sheet metal must conform to SMACNA sheet metal tolerances as outlined in SMACNA's "HVAC Duct Construction Standards."

H. Where ducts are exposed to view (including equipment rooms) and where ducts pass through walls, floors or ceilings; furnish and install sheet metal collars around the duct.

I. Duct Sealing: All ductwork, regardless of system pressure classification, shall be sealed in accordance with Seal Class A, as referenced in SMACNA Standards. All transverse joints, longitudinal seams, and duct wall penetrations shall be sealed.

1. All seams and joints in shop and field fabricated ductwork shall be sealed by applying one layer of sealant, then immediately spanning the joint with a single layer of 3 inches wide open weave fiberglass scrim tape. Sufficient additional sealant shall then be applied to completely embed the cloth.

2. Sealant shall be water based latex UL 181A-M sealant with flame spread of 0 and smoke developed of 0. Sealants shall be Hard Cast Iron Grip 601, Ductmate Pro Seal, Foster 32-19, Childers CP-146 or Design Polymerics DP 1010.

3. Scrim tape shall be fiberglass open weave tape, 3 inches wide, with maximum 20/10 thread count, similar to Hardcast FS-150.

4. Sealer shall be rated by the manufacturer and shall be suitable for use at the system pressure classification of applicable ductwork.

5. Except as noted, oil or solvent-based sealants are specifically prohibited.

6. For exterior applications, “Uni-Weather” (United McGill Corporation), solvent-based sealant, or Foster 32-19 shall be used.

2.03 RECTANGULAR AND ROUND DUCTWORK

A. Metal gages listed in SMACNA HVAC Duct Construction Standards, Metal and Flexible Duct, are the minimum gages which shall be used. Select metal gage heavy enough to withstand the physical abuse of the installation. In no case shall ductwork be less than 26 gage per SMACNA Standards.

B. All longitudinal seams for rectangular duct shall be selected for the specified material and pressure classification. Seams shall be as referenced in SMACNA Standards.

C. Longitudinal seams in laboratory hood exhaust ducts shall be welded.

D. All transverse joints and intermediate reinforcement on rectangular duct shall be as shown in SMACNA Standards. Transverse joints shall be selected consistent with the specified pressure classification, material, and other provisions for proper assembly of ductwork.

E. Spiral round duct and fittings shall be as manufactured by United McGill Sheet Metal Company or approved equivalent. All fittings shall be factory fabricated, machine formed and welded from galvanized sheet metal.

F. Joints in spiral duct and fittings shall be assembled, suspended, sealed, and taped per manufacturer's published assembly and installation instructions.

G. Contractor may use DUCTMATE or Ward Industries coupling system, as an option, on rectangular ductwork. The DUCTMATE or Ward Industries system shall be installed in strict accordance with manufacturer's recommendations.

H. Rectangular ductwork field fabricated offsets shall not exceed 30 degrees.

2.04 FLAT OVAL DUCTWORK AND FITTINGS

A. Oval ducts shall be spiral flat oval or welded flat oval equivalent to those of United McGill Sheet Metal Company with gage and reinforcing as recommended by the manufacturer. Duct may be shop fabricated of completely welded construction in accordance with SMACNA Standards.

B. Oval ducts greater than 24 inch x 72 inch shall be longitudinal seam, flat oval duct, rolled, welded and provided in standard lengths of 5 and 10 feet. Transverse joints shall be factory welded or field connected with flanges or slip couplings. Duct will be fabricated from galvanized steel meeting ASTM A 527 standards.

C. Duct reinforcing angles shall be of sizes specified for same size rectangular duct. Galvanized angles shall be used where standing seams are specified for rectangular duct.

D. Oval fittings shall comply with requirements, sealing, etc., similar to that specified for round ductwork. Manifolding taps may be permitted without increasing the length of run in the branch duct system.

E. Elbows in oval ducts may be smooth long radius or 5-piece 90-degree elbows and 3-piece 45-degree elbows. Joints in sectional elbows shall be sealed as specified for duct sealing.

2.05 CONICAL BELLMOUTH FITTINGS AND TAPS

A. Conical bellmouth fittings shall be made from 26-gage G-90 coated galvanized steel. Two-piece construction with a minimum overall length of 6 inches and factory sealed for high-pressure requirements. Average of loss coefficient for sizes 6, 8 and 10 shall be less than 0.055.

B. Provide each fitting with minimum 24-gage damper plate with locking quadrant operator and sealed end bearings. Damper blade shall be securely attached to shaft to prevent damper form rotating around shaft. Shaft shall be extended to clear insulation.

C. Provide a flange and gasket with adhesive peel-back paper for ease of application. The fittings shall be further secured by sheet metal screws spaced evenly at no more than 4 inches on center with a minimum of four (4) screws per fitting.

D. Conical bellmouth fittings shall be Series 3000G as manufactured by Flexmaster U.S.A., Inc. or Buckley Air Products, Inc., “AIR-TITE”.

2.06 CASINGS AND PLENUMS - 2 INCH W.G. PRESSURE CLASS

A. All 2 inch w.g. pressure class casings and plenums for mixed air plenums shall be constructed in accordance with SMACNA Standards.

B. All casings shall enclose the filter and automatic dampers as shown on the Drawings. Casings shall be fabricated of galvanized sheet metal erected with three-foot center maximum standing seams reinforced with ¼-inch bars. The casing shall be stiffened on three-foot centers maximum with angle irons tack welded in place.

C. All openings to the casing shall be properly sealed to prevent any air leakage. Access doors shall be installed as indicated on the Drawings and shall be air tight, double skin insulated construction with frames welded in place. Doors shall be rubber gasketed with #390 Ventlok gasketing and equipped with fasteners equal to Ventlok #310 latches and #370 hinges that can be operated from both the inside and the outside.

D. Casings shall be anchored by the use of angle irons sealed and bolted to the curb and floor of the apparatus casing. Casings shall be tested and provided tight at a pressure of three inches water column.

E. Insulate per manufacturer’s specifications.

2.07 CASINGS AND PLENUMS – 6 INCH W.G. PRESSURE CLASS

A. Shall enclose filters and automatic dampers at air handling unit systems. Casings shall be constructed of cellular, standing seam panels with 3 inch deep reinforced “hat” sections as manufactured by metal deck manufacturers and as described in SMACNA Standards.

B. All openings to the casing shall be properly sealed to prevent air leakage. Install access doors for easy access to equipment. Access doors shall be air tight, double skin insulated construction with frames welded in place. Doors shall be rubber gasketed with #390 Ventlok gasketing and equipped with fasteners equal to Ventlok #310 latches that can be operated from both the inside and outside. Hinges shall be equivalent to Ventlok #370.

C. Anchor casing by the use of galvanized angle irons sealed and bolted to the curb and floor of the apparatus casing as indicated in SMACNA Standards.

D. A fan discharge diffuser plate shall be located on the fan discharge and shall be constructed of 10 gage steel perforated plate installed in 6 inch channel iron frames (8.2#) rigidly supported to withstand the fan discharge velocity. Perforations shall be 3/8 inch (0.375 inch) staggered on 11/16 inch centers (27 percent open area). One section shall be hinged to provide an access door between the discharge side of the fan and the entering side of the coils. After fabrication of the diffuser plate, coat with rust-resistant paint. After installation, touch up diffuser plate and paint channel iron frames with rust-resistant paint.

E. Provide sufficient access openings to allow access for maintenance of all parts of the apparatus. Access door size shall be as large as feasible for the duty required.

F. Insulate per manufacturer's specifications.

2.08 ELBOWS RECTANGULAR DUCTS

A. Construct elbows as follows in order of preference:

1. Long radius, unvaned elbows.

2. Short radius, single thickness vaned elbows.

3. Rectangular, double thickness vaned elbows.

B. Long radius elbows shall have a centerline radius of not less than one and one-half (1-1/2) times the duct width. Short radius elbows shall have a centerline radius of not less than one times the duct width.

C. Contractor shall have the option to substitute short radius vaned elbows, but shall request the substitution at the time of submittal of Product Data.

D. Provide turning vanes in all rectangular elbows and offsets.

E. Job fabricated turning vanes, if used, shall be fabricated of the same gage and type of material as the duct in which they are installed. Vanes must be fabricated for same angle as duct offset. Submit Shop Drawings on factory fabricated and job fabricated turning vanes.

F. All turning vanes shall be anchored to the cheeks of the elbow in such a way that the cheeks will not breathe at the surfaces where the vanes touch the cheeks. In most cases, this will necessitate the installation of an angle iron support on the outside of the cheek parallel to the line of the turning vanes.

G. In 90-degree turns that are over 12 inches wide in the plane of the turn, provide and install double thickness vanes on integral side rails. For ducts under 12 inches in width, use single thickness vanes. The installation of the turning vanes shall be as described for single thickness vanes. On other types of turns or elbows, single thickness trailing edge vanes shall be used.

2.09 FLEXIBLE DUCT

A. Flexible duct shall be used where flexible duct connections are shown on the Drawings to air distribution devices and terminal units and as scheduled under "Ductwork System Applications.

B. Acoustical Flexible Duct to Diffusers, Grilles, and Terminal Units:

1. Maximum flex duct length 6'-0" (six feet), installed with no more than 90 degrees of bend to diffusers and grilles. Where longer duct runs or more bends are necessary, provide rigid round ductwork.

2. Maximum flex duct length 2'-0" (two feet), installed as a straight run to the inlet of the terminal units.

3. Acoustical flexible duct shall be manufactured with an acoustically rated CPE inner film as the core fabric, mechanically locked by a corrosion-resistant galvanized steel helix.

4. Core shall be factory pre-insulated with a total thermal performance of R-3.5 or greater. Outer jacket shall be a fire retardant polyethylene vapor barrier jacket with a perm rating not greater than 0.10 per ASTM E 96, Procedure A.

5. Duct shall be rated for a minimum positive working pressure of 6 inches w.g. and a negative working pressure of 4 inches w.g. minimum.

6. Temperature range shall be –20 degrees F to 250 degrees F.

7. Duct must comply with the latest NFPA Bulletin 90A and be listed and labeled by Underwriter's Laboratories, Inc., as Class I Air Duct, Standard 181, and meet GSA, FHA and other U. S. Government standards; flame spread less than 25; smoke developed less than 50.

8. Acoustical flexible duct shall be similar to Flexmaster Type 8M for construction and acoustical performance standards.

C. Metal Flexible Duct:

1. May be used for terminal unit connections from sheet metal ductwork where shown on the Drawings.

2. Maximum length 2'-0" (two feet), installed in straight runs only. Where longer duct runs or direction changes are necessary, provide rigid round ductwork.

3. Duct shall be constructed of 0.005 inch thick 3003-H14 aluminum alloy in accordance with ASTM B209. Duct shall be spiral wound into a tube and spiral corrugated to provide strength and flexibility.

4. Core shall be factory pre-insulated with a total thermal performance of R-3.5 or greater. Outer jacket shall be fire retardant metalized vapor barrier jacket of fiberglass reinforced aluminum foil, with a permeance rating not greater then 0.05 per ASTM E96, Procedure A.

5. The duct shall be rated for a minimum positive and negative working pressure of 10 inch w.g.

6. Temperature range shall be –40 degrees F to 250 degrees F.

7. Duct must comply with the latest NFPA Bulletin 90A and be listed and labeled by Underwriter's Laboratories, Inc., as Class I Air Duct, Standard 181, and meet GSA, FHA and other U. S. Government standards; flame spread less than 25; smoke developed less than 50.

8. Metal flexible duct shall be similar to Flexmaster triple lock Type TL-M.

2.10 STAINLESS STEEL DUCTWORK

NOT USED

2.11 ALUMINUM DUCTWORK

NOT USED

2.12 FIBERGLASS REINFORCED PLASTIC DUCTWORK

A. Ductwork shall be single wall and satisfy Class 1 requirements.

B. Ductwork, including fittings, shall be constructed of filament wound fiberglass reinforced plastic, as manufactured by Perry Fiberglass Products, Inc or engineer approved equal.

C. Ductwork shall be manufactured per SMACNA, ASTM D 2996, and industry standard PS 15-69 minimums.

D. Design conditions shall be for minimum 12” WC pressure and 12” WC vacuum. A minimum designed structural safety factor of 5 shall be used.

E. Resins

1. 10 mil liner & 100 mil corrosion barrer

a. Hetron FR 992 w/ 3% antimony trioxide

b. Derakane 510A w/ 5% antimony trioxide

c. Eastman Chemical 755-8590 w/ 3% trioxide

2. Structural

a. Hetron 99P w/ 3% antimony trioxide

b. Derakane 510C w/ 3% antimony trioxide

c. Eastman Chemical 745-4586 w/ 3% antimony trioxide

3. The laminate shall consist of two of the above resins. Resin shall not contain fillers except as required for thixotropic control of fire retardance. The duct and fittings, as a finished composite shall meet the flame requirements (flame spread: less than 25; fuel contributed: less than 10) of a Class 1 duct per UL 181 and UMC 10-1, and ASTM E-84.

F. Wall thickness shall comply with PS 15-69 duct standards. The ductwork shall be furnished with the following minimum wall thickness:

1. 0.125” for ducts up to 20” diameter

2. 0.187” for ducts 21” to 36” in diameter

3. 0.25” for ducts 37” to 60” diameter

****Rectangular ductwork wall thickness shall be determined by substituting the long side for the round diameter.****

G. The inner surface shall contain a 10 mil thick “C” veil saturated with a premium resin from above, (approx. 90% by weight resin). This will be followed by a 100 mil corrosion barrier (2 layers of 1-1/2 oz. chopped mat) with the same resin as used on the 10 mil liner. The structural layer shall be as required for design service and shall be filament wound using resin as detailed above. Duct exterior shall have a relatively smooth surface free of exposed fibers and shall contain an ultra violet inhibiting agent in the gel coat. All resin and joint material is suitable for a 200°F service.

2.13 KITCHEN HOOD EXHAUST

NOT USED

2.14 EMERGENCY GENERATOR EXHAUST SYSTEM

NOT USED

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Cleanliness:

1. Before installing ductwork, wipe ductwork to a visibly clean condition.

2. During construction, provide temporary closures of metal or taped polyethylene on open ductwork and duct taps to prevent construction dust or contaminants from entering ductwork system. Seal ends of ductwork prior to installation to keep ductwork interior clean. Remove closures only for installation of the next duct section.

3. For ductwork supplying Clean Rooms, Operating Rooms and other Critical Care areas, sanitize ductwork with a biocidal agent EPA approved for HVAC systems immediately prior to sealing ductwork.

4. During duration of construction, maintain the integrity of all temporary closures until air systems are activated.

D. Provide openings in ductwork where required to accommodate thermometers, controllers and other devices. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring. Sleeve of pitot tube opening shall be no more than one inch long. Opening shall be one inch wide to accept pitot tube.

E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

F. Slope underground ducts to plenums or low pump out points at 1:500. Provide access doors for inspection.

G. Coat buried, metal ductwork without factory jacket with one coat and seams and joints with additional coat of asphalt base protective coating.

H. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.

I. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for cleanout. Use stainless steel for ductwork exposed to view and stainless steel for ducts where concealed.

J. All visible welds in ductwork between biosafety cabinets, canopy hoods and fume hoods and the ceiling shall be ground and polished.

K. Slope duct toward grilles for moisture-laden ducts. Provide drain and trap at elbow of main moisture exhaust duct system.

L. Project inspector shall be notified to inspect all field fabricated offsets before cover-up or external insulation is applied.

M. FRP Duct:

1. Field joints shall be butt-type wet lay-up method. Flanged connections shall be provided where indicated on the contract drawings. Both of these joining methods are of the same material as the duct, thus forming a continuous FRP component system.

2. Manufacturer's installation instructions to be followed by the installing contractor.

3. Overhead ductwork, when exposed, shall be manufactured incorporating a color selected by the Owner at time of submittal review.

N. Flexible Duct:

1. The terminal ends of the duct core shall be secured by compression coupling or stainless steel worm gear type clamp.

2. Fittings on terminal units and on sheet metal duct shall have flexible duct core slipped over duct and coupling or clamp tightened, then connection sealed with sealant. Insulation of flexible duct shall be slipped over connection to point where insulation abuts terminal unit or insulation on duct.

3. These insulation connections shall be sealed by embedding fiberglass tape in the sealant and coating with more sealant to provide a vapor barrier.

O. Support flexible ducts as per SMACNA standards to prevent sags, kinks and to have 90 degree turns.

P. Hangers and Supports:

1. All ductwork supports shall be in accordance with Table 4-1 (rectangular duct) and Table 4-2 (round duct) of the SMACNA Standards, with all supports directly anchored to the building structure.

2. Rectangular duct shall have at least one pair of supports on minimum 8'-0" (eight feet) centers. All horizontal round and flat oval ducts shall have ducts hangers spaced 10'-0" (ten feet) maximum.

3. Lower attachment of hanger to duct shall be in accordance with Table 4-4 of the SMACNA Standards.

4. Vertical ducts shall be supported where they pass through the floor lines with 1-1/2 inch x 1-1/2 inch x 1/4 inch angles for duct widths up to 60 inches. Above 60 inches in width, the angles must be increased in strength and sized on an individual basis considering space requirements.

5. Hanger straps on duct widths 60 inches and under shall lap under the duct a minimum of 1 inch and have minimum of one fastening screw on the bottom and two on the sides.

6. Hanger straps on duct widths over 60 inches shall be bolted to duct reinforcing with 3/8 inch bolts minimum.

3.02 DUCTWORK SYSTEM CLEANING

A. If the system has been operated without scheduled filters or if the integrity of temporary closures has been compromised, Contractor shall have ductwork cleaned according to National Air Duct Cleaners Association (NADCA) Standards by a Certified Regular Member of the NADCA.

1. For ductwork supplying Clean Rooms or patient care areas, also sanitize the ductwork interior per NADCA standards with a biocidal agent approved by the EPA for use in HVAC Systems.

B. Before turning the installation over to the Owner, Contractor shall certify that the air handling systems have only been operated with scheduled filters in place. Otherwise, Contractor shall present evidence that the ductwork was cleaned as required above.

3.03 TESTING

A. All medium and high pressure duct systems (positive or negative) shall be pressure tested according to SMACNA test procedures (HVAC Air Duct Leakage Test Manual). Notify Owner minimum seven (7) calendar days in advance of leakage testing.

1. Design pressure for testing ductwork shall be determined from the maximum pressure generated by the fan at the nominal motor horsepower selected.

2. Total allowable leakage shall not exceed 1 percent of the total system design airflow rate.

3. When partial sections of the duct system are tested, the summation of the leakage for all sections shall not exceed the total allowable leakage.

4. Leaks identified during leakage testing shall be repaired by:

   a. Complete removal of the sealing materials.

   b. Thorough cleaning of the joint surfaces.

   c. Installation of multiple layers of sealing materials.

5. The entire ductwork system shall be tested, excluding connections upstream of the terminal units (i.e. ductwork shall be capped immediately prior to the terminal units, and tested as described above).

6. After testing has proven that ductwork is installed and performs as specified, the terminal units shall be connected to ductwork and connections sealed with extra care. Contractor shall inform the Owner when joints may be visually inspected for voids, splits, or improper sealing of the joints. If any leakage exists in the terminal unit connections/joints after the systems have been put into service, leaks shall be repaired as specified for other leaks.

7. Fixed flow measurement devices (i.e. orifice tubes, nozzles, etc.) shall have current calibration documentation showing that the device was verified to a National Institute of Standards and Technology (NIST) standard within the previous five years or as recommended by the manufacture and be accurate to at least +/- 2% of reading.

8. Pressure measurement instrumentation (i.e. manometer) shall have current calibration documentation showing that the device was verified to a NIST standard within the previous year or as recommended by the manufacture. Instrumentation shall have an accuracy of at least +/- 2% of reading and have a resolution of 2:1 with respect to the measured pressure (i.e. resolution of 0.01 measured 0.1).

B. All low-pressure duct systems (positive or negative) shall be inspected for visible and audible signs of leakage.

1. Leaks identified by inspection shall be repaired by:

   a. Complete removal of the sealing materials.

   b. Thorough cleaning of the joint surfaces.

   c. Installation of multiple layers of sealing materials.

2. Discrepancies found during testing and balancing between duct traverses and diffuser/grille readings shall result in re-inspection, repair and retest until discrepancies are eliminated.

C. At the option of the Owner, if documented in writing, Contractor may be allowed to eliminate testing of terminal units by capping the supply ductwork prior to the terminal units, then inspecting the connection to the terminal units when complete. This option may only be exercised by the Owner, only if documented in writing prior to testing.

D. Ductwork leakage testing and/or inspection shall be performed prior to installation of external ductwork insulation.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 15950

TESTING PIPING SYSTEMS– PRESSURE TESTING

PART 1 – GENERAL

1.01 DESCRIPTION

A. The work of this section includes, but is not limited to

1. Deflection Testing – Gravity PVC Pipe

2. Gravity Pipe Low-Pressure Air Testing **(See Supplement 15950A following Section 15950)**

3. Pressure Pipe Hydrostatic Testing

4. Disinfection of Potable Water Piping

B. Related Work Specified Elsewhere

1. Section 02315 - Trenching, Backfilling and Compacting

2. Section 15060 - Pipe and Pipe Fittings

3. Section 15080 - Valves and Piping Specialties

4. Section 15960 – Sanitary Sewer Manhole Testing

1.02 QUALITY ASSURANCE

A. Reference Standards

1. American Society for Testing and Materials (ASTM) C828 Low-Pressure Air Test of Vitrified Clay Pipelines

2. American National Standards Institute (ANSI); American Water Works Association (AWWA)

a. ANSI/AWWA C600 Section 4 - Hydrostatic Testing

b. ANSI/AWWA C651 Disinfecting Water Mains

B. Test Acceptance

1. No test will be accepted until leakage rate is below specified maximum limits.

2. The Contractor shall determine and correct the cause of test failures and retest until successful test results are achieved.

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Submit the following prior to start of testing:

1. Test Procedures

2. List of Test Equipment

3. Testing Sequence Schedule

4. Certification of test pressure gauge calibration and accuracy.

5. Certification of composition of chlorination products.

PART 2 - PRODUCTS

2.01 DISINFECTION PRODUCTS

NOT USED

2.02 AIR TESTING EQUIPMENT

A. Air Compressor

B. Air Supply Lines

C. Test Connections

D. Pressure Regulator

E. Pressure Relief Valve

F. Pressure Gauge Calibrated to 0.1 lb/sq. inch.

2.03 HYDROSTATIC TEST EQUIPMENT

A. Hydro Pump

B. Pressure Hose

C. Test Connections

D. Pressure Relief Valve

E. Pressure Gauge Calibrated to 0.1 lb/sq. inch.

PART 3 - EXECUTION

3.01 PREPARATION

A. Backfill trenches in accordance with Section 02315.

B. Provide concrete reaction support blocking, cured a minimum of 7 days, or a minimum of 3 days if high early strength concrete is used, for the pipeline to be tested.

C. Flush pipeline to remove debris; collect and dispose of flushing water and debris in a manner conforming to Regulatory Agency requirements.

3.02 DEFLECTION TESTING – GRAVITY PVC PIPE

NOT USED

3.03 AIR TESTING GRAVITY FLOW PIPELINES

All gravity lines shall be tested by the Contractor in a manner satisfactory to and witnessed by the Engineer. Reference is made to Section 15950 Appendix A – "UNI-B-6-98 – Recommended Practice for Low Pressure Air Testing of Installed Sewer Pipe" for additional details as approved by Engineer.

A. Contractor shall make visual tests as directed by Engineer in order to ascertain if joints are tight and sewer is laid to line and grade. A pressure test, using low-pressure air, shall then by conducted by the Contractor at his own expense.

B. Test each section of gravity flow pipeline between structures; plug all pipeline outlets; brace plugs to offset thrust.

C. Low pressure air shall be introduced into sealed line until internal pressure reaches 4 psig greater than average back pressure of any groundwater that may be over the pipe. At least two minutes shall be allowed for air pressure to stabilize. After stabilization period, pressure in the pipe shall be adjusted to a minimum of 3.5 psig plus average back pressure of any groundwater that may be over the pipe and air supply disconnected. The portion of line being tested shall be termed "acceptable" if the time required for pressure to decrease from 3.5 psig to 2.5 psig (plus average back pressure of any groundwater that may be over the pipe) is not less than the time shown in the Table I found in Section 15950 Appendix A.

D. If groundwater is present, determine its elevation above the springline of the pipe by means of a piezometric tube; for every foot of groundwater above the springline of the pipe, increase the starting test pressure reading by 0.43 psig; do not increase pressure above 10 psig.

E. In no case should the starting test pressure exceed 9.0 psig. If the average vertical height of groundwater above the pipe invert is more than 12.7 feet, the section so submerged may be tested using 9.0 psig as the starting test pressure. The 9 psig limit is intended to further ensure workman safety and falls within the range of the pressure monitoring gauges normally used.

F. Allow air pressure to stabilize for at least five minutes; adjust pressure to 3.5 psig or to the increased test pressure as determined above if groundwater is present; start the test.

G. Table II contains specified minimum times required for a 0.5 psig pressure drop from a starting pressure of at least 3.5 psig greater than the average back pressure of any groundwater above the pipe's invert. Both tables also include easy to use formulas for calculating required test times for various pipe sizes and odd lengths. Also, a zero pressure drop option is shown as a footnote to Table I and Table II. If there has been no leakage (zero psig drop) after one hour, the test section is

accepted and the test is complete. A series of examples are provided in Section 15950a Supplemental to this recommended practice that demonstrates proper use of the tables. "Air Test Data Sheet" shall be completed by Contractor for each test.

H. Record the drop in pressure during the test period; if the air pressure has dropped more than 1.0 psig during the test period, the line is presumed to have failed; if the 1.0 psig air pressure drop has not occurred during the test period, the test shall be discontinued and the line will be accepted.

I. If line fails to meet requirement, Contractor shall, at his own expense, determine source of leakage. Contractor shall then repair or replace all defective material and/or workmanship and retest the line. Since the test must be conducted after backfilling, rectifications shall include re-excavation and backfill after repairs and/or replacement. All testing shall be performed on sewers before any road replacement of surface restoration operations are started.

J. The Contractor has the option to test the section in incremental stages until the leaks are isolated.

K. Testing Pipe Over 36" Diameter: Pipe larger than 36" diameter shall be subjected to a visual interior inspection.

3.04 HYDROSTATIC LEAKAGE TESTING PRESSURE FLOW PIPELINES

A. Hydrostatically test each section of pressure pipeline at the pressure designated on plans or specifications, based on the elevation of the lowest point in the pipeline corrected to the elevation of the test gauge, for a minimum period of two (2) hours or as approved by the Engineer.

B. Slowly fill the section with water, expelling air from pipeline at the high points; install corporation cocks at high points if necessary; after all air is expelled, close air vents and corporation cocks and raise the pressure to the specified test pressure.

C. Observe joints, fittings and valves under test, remove and renew cracked pipe, joints, fittings, and valves showing visible leakage; retest.

D. After visible deficiencies are corrected, continue testing at the same test pressure for an additional two hours to determine leakage rate.

E. Maintain pressure within plus or minus 0.5 psig of test pressure.

F. Leakage is defined as the quantity of water supplied to the pipeline necessary to maintain test pressure during the period of the test and shall not exceed that determined by the following:

$$L = \frac{SD\sqrt{P}}{133{,}222}$$

Where: L = allowable leakage, in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test, in pounds per square inch (gauge).

ALLOWABLE LEAKAGE							
W	P	D (gal/hr/1,000LF)					
(psi)	(psi)	2”	4”	6”	8”	10”	12”
60	100	0.150	0.300	0.450	0.601	0.751	0.901
70	105	0.154	0.308	0.462	0.615	0.769	0.923
80	120	0.164	0.329	0.493	0.658	0.822	0.987
90	135	0.174	0.349	0.523	0.698	0.872	1.047
100	150	0.184	0.368	0.552	0.736	0.919	1.103
110	165	0.193	0.386	0.579	0.771	0.964	1.157
120	180	0.201	0.403	0.604	0.806	1.007	1.209
130	195	0.210	0.419	0.629	0.839	1.048	1.258
140	210	0.218	0.435	0.653	0.870	1.088	1.306
150	225	0.225	0.450	0.676	0.901	1.126	1.351
160	240	0.233	0.465	0.698	0.930	1.163	1.396
170	255	0.240	0.480	0.719	0.959	1.199	1.439
180	270	0.247	0.493	0.740	0.987	1.234	1.480
190	285	0.253	0.507	0.760	1.014	1.267	1.521
200	300	0.260	0.520	0.780	1.040	1.300	1.560
210	315	0.266	0.533	0.799	1.066	1.332	1.599
220	330	0.273	0.546	0.818	1.091	1.364	1.637
230	345	0.279	0.558	0.837	1.116	1.394	1.673
240	360	0.285	0.570	0.855	1.140	1.424	1.709
250	375	0.291	0.582	0.872	1.163	1.454	1.745

W = Maximum Working Pressure within segment of tested pipe
P = Test Pressure = 1.5 x W, but not less than 100 PSI
D = Pipe Diameter (inches)

Example: *2,580 LF of 8” water line with a working pressure of 210 psi is to be tested for leakage.*

Solution: *The test pressure, P, to be used during leakage test is 1.5 x 210 = 315 psi. From the chart above, P = 315, the allowable leakage per 1,000 LF of 8” water main is 1.066 gallons per hour. Since 2,580 LF of pipe is being tested, the allowable leakage is 2,580 / 1,000 x 1.066 = 2.7503 gal/hr.*

For a 2 hour test, the allowable leakage would be 2 x 2.7503 = 5.5066 gallons. If 5.5 (5 ½) gallons or less must be added to the water line at end of 2 hours to bring the test pressure to 315 psi, the line has passed.

G. If the test of the pipeline indicates leakage greater than that allowed, locate the source of the leakage, make connections and retest until leakage is within the allowable limits.

H. Correct visible leaks regardless of the amount of leakage.

3.05 HYDROSTATIC TESTING PRESSURE PIPING SYSTEMS

A. Applicable to chlorine solution piping system, potable water pressure system, chemical feed systems, and all process piping systems within the wastewater treatment plant buildings.

B. Fill entire systems with water and vent air from the system at least 24 hours before the actual test pressure is applied.

C. Apply the required test pressure when the water and average ambient temperatures are approximately equal and constant.

D. Test piping at pressures listed on Yard Piping Plan; avoid excessive pressure on safety devices and mechanical seals.

E. Maintain test pressure for a minimum of 2 hours without drop after the force pump has been disconnected.

F. Visually inspect joints, fittings, and valves while pipe is under test pressure.

G. Correct all visible leaks and retest as often as necessary until satisfactory results are achieved.

3.06 DISINFECTION OF POTABLE WATER PIPING

NOT USED

END OF SECTION

SUPPLEMENT 15950A

GRAVITY PIPE LOW PRESSURE TESTING

UNI-BELL PVC PIPE ASSOCIATION

UNI-B-6-98

RECOMMENDED PRACTICE FOR LOW-PRESSURE AIR TESTING OF INSTALLED SEWER PIPE

July 1998

UNI-BELL PVC PIPE ASSOCIATION

2655 Villa Creek Drive, Suite 155
Dallas, Texas 75234
(972) 243-3902

SECTION 9 - TEST TIMES

9.1 TEST TIME CRITERIA

The Ramseier test time criteria requires that no test section shall be accepted if it loses more than **Q** cubic feet per minute per square foot of internal pipe surface area for any portion containing less than 625 square feet internal pipe surface area. The total leakage from any test section shall not exceed 625 **Q** cubic feet per minute.

9.2 ALLOWABLE AIR LOSS RATE

A **Q** value of 0.0015 cubic feet per minute per square foot shall be utilized to assure the Owner of quality pipe materials, good workmanship and tight joints.

9.3 TEST TIME CALCULATION

All test times shall be calculated using Ramseier's equation:

$$T = 0.085\frac{DK}{Q}$$

Where: **T** = Shortest time, in seconds, allowed for the air pressure to drop 1.0 psig,

K = 0.000419 **DL**, but not less than 1.0,

Q = 0.0015 cubic feet/minute/ square feet of internal surface,

D = Nominal pipe diameter in inches, and

L = Length of pipe being tested in feet.

For more efficient testing of long test sections and/or sections of larger diameter pipes, a timed pressure drop of 0.5 psig may be used in lieu of the 1.0 psig timed pressure drop. If a 0.5 psig pressure drop is used, the appropriate required test times shall be exactly half as long as those obtained using Ramseier's equation for T cited above.

If there has been no leakage (zero psig drop) after one hour of testing, the test section shall be accepted and the test complete. This provides a more efficient test for large diameter sewers that have demonstrated an air loss rate (zero) well within the allowable. If there is any pressure drop, the complete test shall be run to determine whether or not the test section is acceptable.

9.4 TESTING MAIN SEWERS WITH LATERAL SEWERS

It is often convenient to include connected lateral sewers when testing sewer mains having lateral sewers. If lateral sewers are included in the test, their lengths may generally be ignored for computing required test times. This can be done because in practice, ignoring the branch, lateral or house sewers will normally increase the severity of the air test whenever the tested surface area is less than 625 square feet so that the total rate of rejection may only be increased about 2 percent. If the total tested surface area is greater than 625 square feet, ignoring the lateral sewers will only slightly decrease the severity of the test.

In the event a test section, having a total internal surface area less than 625 square feet, fails to pass the air test when lateral sewers have been ignored; the test time shall be recomputed to include all lateral sewers using the following formula:

$$T = 0.085\left[\frac{D_1^2L_1 + D_2^2L_2 + \ldots D_n^2L_n}{D_1L_1 + D_2L_2 + \ldots + D_nL_n}\right]\frac{K}{Q}$$

Where: **T** = Shortest time, in seconds, allowed for the air pressure to drop 1.0 psig.

K = $0.000419 (D_1L_1 + D_2L_2 + ... + D_nL_n)$, but not less than 1.0;

Q = 0.0015 cu.ft./min./sq.ft. of internal surface;

D_1, D_2, etc. = Nominal diameters of the different size pipes being tested;

L_1, L_2, etc. = Respective lengths of the different size pipes being tested.

If the recomputed test time is short enough to allow the section tested to pass, then the section shall be presumed to be free of defects and comply with this specification.

9.5 SPECIFIED TIME TABLES

To facilitate the proper use of this recommended practice for air testing, the following tables are provided. Table I contains the specified minimum times required for a 1.0 psig pressure drop from a starting pressure of at least 3.5 psig greater than the average back pressure of any groundwater above the pipe's invert. Table II contains specified minimum times required for a 0.5 psig pressure drop from a starting pressure of at least 3.5 psig greater than the average back pressure of any groundwater above the pipe's invert. Both tables also include easy to use formulas for calculating required test times for various pipe sizes and odd lengths. Also, a zero pressure drop option is shown as a footnote to Table I and Table II. If there has been no leakage (zero psig drop) after one hour, the test section is accepted and the test is complete. A series of examples are provided in the Appendix to this recommended practice that demonstrates proper use of the tables.

TABLE I

MINIMUM SPECIFIED TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015

1 Pipe Diameter (in.)	2 Minimum Time (min: sec)	3 Length for Minimum Time (ft)	4 Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46
42	39:48	57	41.883 L	69:48	104:42	139:37	174:30	209:24	244:19	279:13	314:07
48	45:34	50	54.705 L	91:10	136:45	182:21	227:55	273:31	319:06	364:42	410:17
54	51:02	44	69.236 L	115:24	173:05	230:47	288:29	346:11	403:53	461:34	519:16
60	56:40	40	85.476 L	142:28	213:41	284:55	356:09	427:23	498:37	569:50	641:04

Note: If there has been no leakage (zero psig drop) after one hour of testing, the test section shall be accepted and the test complete. (See Section 7.5.)

TABLE II

MINIMUM SPECIFIED TIME REQUIRED FOR A 0.5 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015

1 Pipe Diameter (in.)	2 Minimum Time (min: sec)	3 Length for Minimum Time (ft)	4 Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	1:53	597	.190 L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	.427 L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	.760 L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7.05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235 L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6.837 L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653 L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54
30	14:10	80	10.683 L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12.926 L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15.384 L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23
42	19:54	57	20.942 L	34:54	52:21	69:49	87:15	104:42	122:10	139:37	157:04
48	22:47	50	27.352 L	45:35	68:23	91:11	113:58	136:46	159:33	182:21	205:09
54	25:31	44	34.618 L	57:42	86:33	115:24	144:15	173:05	201:56	230:47	259:38
60	28:20	40	42.738 L	71:14	106:51	142:28	178:05	213:41	249:18	284:55	320:32

Note: If there has been no leakage (zero psig drop) after one hour of testing, the test section shall be accepted and the test complete. (See Section 7.5.)

APPENDIX 1

10.1 PURPOSE

The purpose of this Appendix is to illustrate the proper application of this recommended practice with regard to appropriate test time selection. The examples that follow include a variety of conditions that may be encountered in the field.

10.2 EXAMPLE A

A manhole-to-manhole reach of nominal 12 inch pipe is 350 feet long. No lateral connections exist in the reach. What is the required test time for a 0.5 psig pressure drop?

Solution: The required test time can be read directly from Table II. For 350 feet of 12 inch pipe, the required test time is 9:58 (9 minutes and 58 seconds).

10.3 EXAMPLE B

A 350 foot section of nominal 12 inch pipe is ready for testing. A total of 128 feet of 4 inch lateral sewer pipe is connected to the 350 foot section and will be included in the test. What will be the required test time for a 0.5 psig pressure drop?

Solution: Lateral sewers may be disregarded when selecting test times (see Section 9.4). Therefore, the required test time will be the same as for Example A, *i.e.*, 9 minutes and 58 seconds.

Note - If lateral sewers had not been disregarded, the required test time would be 10 minutes and 22 seconds, i.e., only 24 seconds longer.

10.4 EXAMPLE C

What should the required test time be for a 1.0 psig pressure drop in 327 feet of nominal 8 inch diameter pipe between two manholes?

Solution: The exact test time is easily calculated by using Table I. Table I is used because a 1.0 psig pressure drop is specified. Since 327 feet exceeds the 298 foot length associated with the minimum test time for an 8 inch pipeline, the fourth column in Table I shall be used to quickly calculate the required test time as follows:

$$T = 1.520\ L = 1.52 \times 327 = 497 \text{ seconds}$$

Therefore, the required test time for a 1.0 psig pressure drop is 497 seconds or 8 minutes and 17 seconds.

10.5 EXAMPLE D

A manhole-to-manhole reach of nominal 24 inch pipe is 82 feet long. What is the required test time for a 0.5 psig pressure drop?

Solution: Table II must be used because a 0.5 psig pressure drop is specified. Since 82 feet is less than the 99 foot length associated with the minimum test time for a 24 inch pipeline, the minimum test time shall apply. Thus, the required test time for a 0.5 psig pressure drop must be 11:20 (11 minutes and 20 seconds).

10.6 EXAMPLE E

A 412 foot section of nominal 15 inch sewer pipe has been readied for air testing. A total of 375 feet of nominal 6 inch lateral piping and 148 feet of nominal 4 inch lateral piping branch off of the 15 inch sewer line. All laterals have been capped and/or plugged and will be tested together with the 15 inch main line. The specified pressure drop that will be timed is 0.5 psig. What is the appropriate test time for this pipe network?

Solution: All lateral sewer sizes and lengths may be disregarded since their influence is generally not significant enough to warrant computation (refer to Section 9.4). Table II must be used for a 0.5 psig pressure drop. The fourth column in the table provides the appropriate formula for calculating the required test time because 412 feet is longer than the third column value of 159 feet.

$$T = 2.671\ L = 2.671 \times 412 = 1{,}100 \text{ seconds}$$

The required test time is 1,100 seconds or 18 minutes and 20 seconds.

10.7 EXAMPLE F

A manhole-to-manhole reach of nominal 8 inch pipe is only 100 feet long. A total of 300 feet of nominal 4 inch lateral piping is connected to the 100 foot section and will be included in air testing the section. What will be the required test time for a 1.0 psig pressure drop?

Solution: The required test time can be read directly from Table I, since lateral sewers need not be considered. Thus, for 100 feet of 8 inch pipe, the required holding time is 7:34 (7 minutes and 34 seconds). However, should the section fail to meet this test, the required holding time must be recalculated taking into account the connected laterals per Section 9.4. This recalculation is required because the total internal pipe surface area is less than 625 square feet.

Total Area =

$$\pi\left[\frac{D_1L_1 + D_2L_2 + \ldots + D_nL_n}{12}\right]$$

$$= 3.14\left[\frac{(8x100)+(4x300)}{12}\right]$$

= 524 square feet

Thus, using the equation provided in Section 9.4, the required test time should be recomputed as follows:

$$\mathbf{K} = 0.000419\,[(8 \times 100) + (4 \times 300)]$$
$$= 0.838$$

$$0.838 < 1.0 \rightarrow \mathbf{K} = 1.0$$

*Note - **K** will always be 1.0 when the total area is less than 625 square feet.*

$$T = 0.085\left[\frac{(8^2x100)+(4^2x300)}{(8x100)+(4x300)}\right]\frac{1.0}{0.0015}$$

T = 317 seconds

The required test time is actually only 317 seconds or 5 minutes and 17 seconds for a 1.0 psig pressure drop. Therefore, if the section is able to meet this test time, it shall be passed.

Note - For a specified 0.5 psig pressure drop, the test holding time would be only half as long, i.e., 2 minutes and 38 seconds.

APPENDIX 2

AIR TEST DATA SHEET

Owner (Name of city, district, etc.) _____ Test No. _____

Identification of Pipe Installation (Job name, location, contract number, etc.) _____

_____

Field Test Data: (To be filled in by the Inspector)

Date: _____ Specified Maximum Pressure Drop: _____ psig

Identification of Pipe Material Installed _____

Pipe Under Test				Spec. Time	Field Test Operations Data					
Upstream MH sta #	Downstream MH sta #	Dia. D (in.)	Length L (ft.)	Refer to UNI-B-6 (min:sec)	Pressure Initially Raised to (psig)	Time Allowed for Pressure to Stabilize (min)	Start Test Pressure (psig)	Stop Test Pressure (psig)	Elapsed Time (min:sec)	Pass or Fail (P or F)

Inspector's Name and Title: _____

Signature of Inspector: _____

If a section fails, the following items should be completed:

Identify section(s) that failed _____

Leak (was) (was not) located. Method used: _____

Description of leakage found: _____

Description of corrective action taken: _____

_____

For test results after repair refer to Test No. _____. Inspector _____

This data sheet may be used in conjunction with Recommended Practice UNI-B-6. The Uni-Bell PVC Pipe Association is interested in evaluating the testing of sewer pipe installations with low-pressure air. The purpose of this "Air Test Data Sheet" is to assist in obtaining information from field testing of sewer pipes as well as to assist the community in evaluating the sewer's acceptability.

Copies of the above "Air Test Data Sheet" are available free of charge upon request from Uni-Bell. The Uni-Bell PVC Pipe Association suggests that one copy of the completed sheet be retained for your files and requests that one copy be sent to: Uni-Bell PVC Pipe Association, 2655 Villa Creek Drive, Suite 155, Dallas, TX 75234.

THIS PAGE LEFT BLANK

SECTION 15960

SANITARY SEWER MANHOLE TESTING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work of this section includes, but is not limited to:

1. Vacuum Testing Sewer Manholes

2. Exfiltration Testing Sewer Manholes

1.02 QUALITY ASSURANCE

A. Test Acceptance

1. No test will be accepted until the results are below the specified maximum limits.

2. The Contractor shall determine and correct the causes of test failure and retest until successful test results are achieved.

1.03 SUBMITTALS

A. Submit the following prior to start of testing:

1. Testing procedures

2. List of test equipment

3. Testing sequence schedule

4. Provisions for disposal of flushing and test water

5. Certification of test gauge calibration

1.04 JOB CONDITIONS

Do not allow personnel in manholes during vacuum or pressure testing.

PART 2 - PRODUCTS

2.01 VACUUM TESTING EQUIPMENT

A. Vacuum pump

B. Vacuum line

C. Vacuum tester base with compression band seal and outlet port

D. Shut-off valve

E. Stop watch

F. Plugs

G. Vacuum gauge, calibrated to 0.1" Hg

2.02 EXFILTRATION TEST EQUIPMENT

A. Plugs

B. Pump

C. Measuring device

PART 3 - EXECUTION

3.01 TESTING MANHOLES

A. General: Testing using either air or water shall be done whenever possible prior to backfilling to assist in locating leaks. Joint repairs by parging are to be done on both outside and inside of the joint to ensure a permanent seal.

B. Vacuum Test: Vacuum testing of a finished manhole shall be performed with an approved vacuum testing apparatus such as supplied by NPC Systems, Inc. of Milford, NH, and operated according to the recommendations of Peter Glazier and Associates of Worchester, Massachusetts. Apparatus supplied by other manufacturers may also be acceptable but must have the approval of the Engineer before the test is begun.

1. All pipes entering the manhole shall be plugged, taking care to securely brace the plug from being drawn into the manhole.

2. Inflate the compression band to affect a seal between the vacuum base and the structure; connect the vacuum pump to the outlet port with the valve open; draw a vacuum to 10" of Hg; close the valve; start the test.

3. Test: Vacuum testing of a furnished manhole shall be performed with an approved vacuum testing apparatus but must have the approval of the Engineer before the test is begun.

a. Determine the test duration for the manhole from the following table:

VACUUM TEST TABLE	
Manhole Diameter	**Test Period**
48"	60 sec.
60"	75 sec.
72"	90 sec.

b. Record the vacuum drop during the test period; if the vacuum drop is greater than 1.0" of Hg during the test period, the manhole shall be repaired and retested; if a vacuum drop of 1" of Hg does not occur during the test period, the test shall be discontinued, and the manhole will be accepted.

c. If a unit fails to meet a 1" Hg drop in the specified time after repair, the unit shall be subjected to the water exfiltration test and repaired as necessary.

C. Exfiltration Test

1. Plug all pipes in the manhole; remove any water that has accumulated in the manhole; observe plugs over a period of not less than 2 hours to ensure that there is no leakage into the manhole.

2. Fill the manhole with water to within 4" of the top of the cover frame. Prior to test, allow the manhole to soak from a minimum of 4 hours to a maximum of 72 hours; after the soak period, adjust the water level inside the manhole to within 4" of the top of the cover frame.

3. Measure the water level from the top of the manhole frame; at the end of the 4-hour test period, again measure the water level from the top of the manhole frame; compute the drop in the water level during the test period.

4. The exfiltration test of a manhole shall be considered satisfactory if the drop-in water level is less than the values listed in the table below:

Manhole Depth (Feet)	**Allowable Drop in Water Level (Feet) in 24" Diameter Section**	
	4' Dia. MH	**5' Dia. MH**
4	0.11	0.14
6	0.17	0.21
8	0.23	0.28
10	0.28	0.35
12	0.34	0.43
14	0.40	0.50
16	0.45	0.57
18	0.51	0.64
20	0.57	0.71
22	0.62	0.78
24	0.68	0.85
26	0.74	0.92
28	0.79	0.99
30	0.85	1.06

Based on an allowable exfiltration of 4 gallons per day per foot of depth of a 4-foot diameter manhole with a conical top and a 24" diameter opening; for purposes of the tests, the manhole depth shall be the depth from invert to the bottom of the cover frame, or the depth from the ground water surface to the bottom of the cover frame, whichever is less.

6. In case of unsatisfactory test results, the Contractor shall repair the manhole and retest as often as necessary until satisfactory results are achieved; repair visible leaks regardless of the amount of leakage.

END OF SECTION

SECTION 16010

GENERAL REQUIREMENTS - ELECTRICAL

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. All items of labor, materials and equipment, not specified in detail or shown on drawings but necessary for complete installation and proper operation of work described or implied, shall be furnished and installed.

2. Test all electrical conductors, after completion of installation of wiring and apparatus, to insure continuity, proper splicing, freedom from grounds, except "made grounds" and those required for protection and insulation resistance. Use testing instruments, i.e. megger. Activation of each circuit will be required as final test. Testing shall be done at no additional expense to the Owner.

3. Drawings are indicative of work to be installed but do not indicate all bends, fittings, boxes, etc. that will be required in this Contract. The structural and finished conditions of the project shall be investigated prior to construction.

4. Coordinate work with other trades to avoid interference between piping, ducts, equipment, architectural or structural features. In case of interference, the Engineer decides which work is to be relocated, regardless of which is first installed.

5. Visit the site to determine actual conditions. No extra compensation will be allowed by failure to determine existing conditions.

B. Additional Circuits:

1. A sum of money shall be included in the Base Bid for the Contract for five (5) additional circuits. Each additional circuit shall include the following:

a. 50’ of 3/4” rigid aluminum conduit, and associated fasteners and connectors.
b. 150’ of #12 THHN/THWN wire
c. (1) cast outlet box/pull box/junction box
d. 6’ of 3/4" flexible, liquid-tight conduit
e. Final connections to motor, receptacle, lighting control switch, instrument, control or power wiring circuit

1.02 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

ANSI	American National Standards Institute, Inc.
ASTM	American Society for Testing and Materials
IEEE	Institute of Electrical and Electronic Engineers
IPCEA	Insulated Power Cable Engineers Association
NEC	National Electrical Code of National Fire Protection Association
NEMA	National Electrical Manufacturers Association

NESC National Electrical Safety Code
UL Underwriters' Laboratories

1. The installation must comply with all Federal and State, municipal or other authority's laws, rules and/or regulations.

2. Inspections by the required authorities shall be made. Original final wiring certificates with two copies shall be submitted to the Owner.

3. The electrical inspections shall be made by the Middle Department Inspection Agency, or other inspection agency approved by the Owner.

4. All electrical equipment and its components and materials shall meet all applicable UL criteria and bear the appropriate label of the Underwriters' Laboratory.

5. All electrical equipment or apparatus of any one system shall be of the same quality as produced by one or more manufacturers, suitable for use in a unified system. The term "manufacturer" shall be understood as applying to a reputable firm who assumes full responsibility for its products.

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Section 01300.

B. Shop Drawings:

1. All shop drawings shall be submitted to the Engineer for review. All shop drawing submittals shall clearly indicate, using arrows and/or highlighting on all copies, which item(s) are being submitted and that each item being submitted is in compliance with all requirements on the drawings and in these specifications. All pertinent specification and drawing requirements shall be indicated on the shop drawings. If incorrect, they shall be resubmitted in quantity according to Contract conditions until satisfactory. Work shown on shop drawings shall not be executed until such drawings are approved. Electrical items shall not be installed until final approval of the shop drawings has been given by the Engineer.

2. See specific sections for a breakdown of shop drawing items.

3. Submit certification that all equipment is UL listed.

4. Shop drawings shall indicate adequate clearance for operation, maintenance and replacement of operating equipment devices.

5. The Engineer reserves the right to request additional shop drawings.

C. Installation, Operation and Maintenance Manuals:

1. Submit required number of installation, operation and maintenance manuals for all equipment being provided for the electrical system. These manuals shall be submitted in 3-ring loose-leaf binders and shall be complete, neat, orderly and indexed.

2. The installation, operation and maintenance manuals shall include a copy of the approved shop drawings for all electrical items installed on the project.

1.04 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Product Handling:

1. Deliver all materials in good condition. Store in dry place, off ground, and keep dry at all times.

B. Protection of Installation:

1. All unfinished installations, construction materials and equipment shall be protected during construction.

PART 2 - PRODUCTS

2.01 SEE SPECIFIC SECTIONS FOR PRODUCTS

PART 3 - EXECUTION

3.01 INSTALLATION

A. Protection of Installation:

1. All equipment shall be protected during construction. All damaged equipment caused by noncompliance with this requirement shall be repaired at no expense to the Owner.

B. Openings and Chases:

1. Determine locations of chases and openings prior to construction so that same may be provided where required. If openings or chases are made after building construction is accomplished, such cutting and repairing of the building shall be made by this Contractor in complete coordination with other trades on the job site to match original conditions in quality, color and type of materials used, and at no additional expense to the Owner.

C. Position of Outlets:

1. The Engineer shall determine the position of all relocated outlets and equipment if the required location differs from that indicated on the drawings.

D. Moving Outlets:

1. The Owner reserves the right to move any outlet a distance of ten feet before roughing in, at no additional expense.

E. Methods and Materials:

1. All work shall be installed in a first-class, neat and workmanlike manner by skilled mechanics. All materials shall be new. Firmly support all materials and equipment.

F. Cutting, Repairing and Finishing:

1. All cutting, repairing, finishing and painting required for the installation of work under this Contract shall be performed under this Contract.

2. All disturbed surfaces shall be repaired and finished to match adjacent surfaces by skilled mechanics working in their respective fields.

G. Excavation and Backfilling:

1. Excavation and backfilling shall be in accordance with the requirement of Division 2 and as required to complete the work according to details on drawings.

H. Concrete:

1. Concrete work shall be in accordance with the requirements of Division 3 and as required to complete the work according to details on drawings.

I. Cutting and Patching of Concrete Areas:

1. Openings in concrete required for Electrical construction shall be made by taking extreme precautions to prevent excessive damage to existing facilities. Prior to completion, all disturbed areas shall be closed, restored to normal and finished to match surrounding areas.

J. Access:

1. Install all conduit, wire, cable, wiring devices and equipment to preserve access to all equipment installed under this Contract.

K. Layout of Wiring:

1. The layout of wiring as shown on the drawings shall not be considered as absolute. It shall be subject to changes where necessary to overcome obstacles in construction. Where a major deviation from the plans is indicated by practical consideration, shop drawings shall be submitted showing all deviations in detail to clearly indicate the necessity or desirability for the change.

L. Miscellaneous Supports:

1. Furnish and install all necessary angles, beams, channels, hanger rods or other supports for equipment and piping furnished under this Contract requiring support or suspension from building structure.

M. Grounding:

1. Grounding system shall comply with the current edition of the National Electrical Code, the current edition of the National Electrical Safety Code, and as specified herein.

2. All ground conductors shall be copper and sized according to the requirements of the NEC, Table 250-66 and Table 250-122 as applicable.

3. All conduits shall be furnished with a separate ground conductor. Conduits shall not be used as a ground conductor.

4. Ground conductors shall be green, insulated stranded type where installed in conduit.

5. All metallic conduits shall be bonded to the equipment ground terminal, ground wire or ground bus using an insulated ground bushing and jumpers sized as required by the NEC. A bond shall be provided at all conduit terminations.

6. Ground rods shall be 3/4" diameter x 10'-0" long copper clad steel. The exterior shall be electrolytic copper metallically bonded to a round one-piece carbon steel rod. Install a ground rod at each corner of the ground ring. Electrodes shall be driven straight down, perpendicular to the finished grade.

N. Continuity of Service:

1. Uninterrupted electrical service shall be maintained during the entire time required for complete installation of the work contemplated under these specifications and drawings.

2. Temporary equipment, cable and whatever else is necessary shall be provided as required to maintain electrical service. Temporary service facilities, if required at any time, shall not be disconnected or removed until new services are placed in proper operation.

3. If any service or system must be interrupted, the Contractor shall request permission in writing stating the date, time, etc. the service or system will be interrupted and the areas affected. This request shall be made in sufficient time for proper arrangements to be made. Written permission shall be obtained from the Owner before interrupting electrical service.

O. Clean Up:

1. Upon completion of all work under the electrical specifications, furnish labor, materials and incidentals to accomplish the following: remove all dirt, foreign materials, stains, fingerprints, etc. from all lighting fixtures, glassware, panelboards, wall plates, system equipment, floors, walls and ceilings adjacent to the above equipment and leave the electrical work in such a condition that no cleaning will be required by the Owner. The complete system shall be subject to inspection and approval by the Owner.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 16050

BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. All items of labor, materials and equipment, not specified in details on Drawings but necessary for complete installation and proper operation of work described or implied, shall be furnished and installed.

1.02 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

ANSI	American National Standards Institute, Inc.
ASTM	American Society for Testing and Materials
BOCA	Building Officials and Code Administrators
IEEE	Institute of Electrical and Electronic Engineers
IPCEA	Insulated Power Cable Engineers Association
NEC	National Electrical Code of National Fire Protection Association
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
UL	Underwriters' Laboratories

B. Qualification of Manufacturers:

1. Various materials specified herein shall be as supplied by manufacturers listed under PRODUCTS.

C. Quality Control:

1. All equipment shall be new and limited to products regularly produced and recommended for service ratings in accordance with engineering data or other comprehensive literature made available and in effect at time of bidding. In all cases where device, or devices, or part of equipment is herein referred to in singular, reference shall apply to as many items as required to complete installation.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit in accordance with General Requirements. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings, integral controls and types of materials, elevations, and sections.

2. All shop drawing submittals shall clearly indicate, using arrows and/or highlighting on all copies, which item(s) are being submitted and that each item being submitted is in compliance with all requirements on the drawings and in these specifications. All pertinent specification and drawing requirements shall be indicated on the manufacturer's drawings.

3. Submit manufacturer's latest publications for the following items:

   a. Conduit and Fittings
   b. Wire
   c. Instrumentation Cable
   d. Outlet Boxes
   e. Junction Boxes
   f. Explosion-proof Junction Boxes
   g. Pull Boxes
   h. Panelboards
   i. Convenience Receptacles
   j. Local Control Switches
   k. Disconnect Switches
   l. Uni-Strut
   m. Conduit Link Seals
   n. Conduit Labels

PART 2 - PRODUCTS

2.01 MATERIALS

A. Conduit:

1. Rigid steel conduit shall be mild steel piping, zinc coated, and of sufficient weight and toughness to withstand cracking and peeling during bending. Galvanizing to be a coating of zinc of uniform thickness applied by either electrolytic or hot metal dip process.

2. Rigid aluminum conduit shall be 6063-T1 aluminum alloy and shall comply with Federal Specification WW-C-540C.

3. Each piece of rigid conduit to be straight, free from blisters and defects, cut square and taper reamed, finished in 10' lengths and threaded at each end. Couplings shall be supplied at one end and a protective sleeve for the other end. All threads shall be clearly cut. Each length of conduit shall bear Underwriters' Label.

4. PVC coated galvanized rigid steel conduit shall have a permanent plastic coating factory applied to a minimum thickness of 40 mils and a urethane internal coating. PVC coated conduit shall be Plasti-Bond Red H2OT as manufactured by Robroy Industries, Ocal Blue as manufactured by the Occidental Coating Company or Perma-Cote Supreme as manufactured by Perma-Cote Industries.

5. Flexible metallic conduit shall conform to Articles 350 and 351 of the NEC and shall be UL listed. All flexible metallic conduit shall have nonmetallic screw-in type connectors and couplings. All flexible conduit shall be liquid-tight type. Flexible conduit in wet locations and shall be non-metallic.

6. Minimum size of rigid conduit shall be 3/4". Minimum size of flexible conduit shall be 1/2”.

B. Wire:

1. Wire shall be type THHN/THWN, except for underground wiring, which shall be type XHHW. All wiring shall be stranded, copper with 600 volt insulation. Aluminum wire will not be acceptable.

C. Instrumentation Cable:

1. Instrumentation cable for analog signal wiring shall be #18 AWG twisted shielded pairs with tinned copper conductors, 300 volt polyethylene insulation, a continuous foil shield with 100% coverage, and a tinned copper drain wire.

2. The instrumentation cable shall be Beldon #8760, or equal.

D. Conduit Fittings:

1. Conduit fittings for steel conduit shall be made of rust resisting alloy of iron or steel. An iron fitting shall be cast malleable iron thoroughly coated with metallic zinc or cadmium inside and outside after all machine work is completed.

2. Conduit fittings for aluminum conduit shall be made of aluminum.

3. Each conduit fitting shall be provided with heavy threaded hubs to fit the conduit used. Conduit fittings shall be used on all exposed conduit runs except at impractical locations where factory ells may be used.

4. All cast fittings used for PVC coated conduit shall be PVC coated and shall be Form 8 with encapsulated screws.

5. All fittings in wet locations shall be gasketed.

E. Outlet Boxes:

1. Each outlet box shall be sized in accordance with current editions of all Federal, State and local codes.

2. All outlet boxes shall have mounting lugs or ears for mounting wiring devices and covers. Each outlet box shall be equipped with an appropriate cover.

3. Outlet boxes shall be cast type of same construction as fittings described above.

F. Junction Boxes:

1. Junction boxes shall be of same construction as conduit fittings, unless noted otherwise on the Drawings.

2. Junction boxes identified on the Drawings as NEMA 4X aluminum shall be constructed of Type 5052 H-32 aluminum, and shall have gasketed shoe box type covers with stainless steel screws.

3. Label all junction boxes with an engraved nameplate fastened to the junction box. Nameplate shall be black with 1/4” white lettering.

G. Explosion-proof Junction Boxes:

1. Explosion-proof junction boxes shall be provided where indicated on the Drawings, and shall be Crouse-Hinds, Killark or Appleton.

2. Provide conduit sealing hubs for the conduit entering the junction box.

3. Label the junction boxes with an engraved nameplate fastened to the junction box.

H. Pull Boxes:

1. Pull boxes shall be aluminum, constructed of Type 5052 H-32 aluminum, and shall have gasketed shoe box type covers with stainless steel screws.

2. Label all pull boxes with an engraved nameplate fastened to the pull box. Nameplate shall be black with 1/4” white lettering.

I. Panelboards:

1. Panelboards shall be dead front automatic circuit breaker type suitable for connection to the system characteristics and with circuit breakers as called for on the panel schedules. Circuit breakers shall be thermal-magnetic type with quick-make, quick-break operating mechanism and with trip indication. Trip indication shall be clearly indicated by breaker handle taking a position between “ON” and “OFF”. All 2-pole and 3-pole breakers shall be common trip. Breakers shall be plug-in type.

2. Bus bars and lugs shall be plated copper. The ampere rating of the main bus bars and lugs on each panelboard schedule shall be considered a minimum. Larger ampere rating main bus bars and lugs may be required to accommodate the number of poles indicated on the panelboard schedules or to accommodate large wire sizes. Breakers used as switches shall be rated for that purpose.

3. Panelboard box shall be made of code gauge galvanized steel, factory assembled as a complete unit and large enough to provide ample wiring space.

4. Panelboard front shall be complete with door and flush chrome plated pin type cylinder lock and catch. All panelboards shall be keyed alike. Front shall have adjustable indicating trim clamps which are completely concealed when the door is closed. Door shall be mounted with completely concealed hinges.

5. Unless otherwise noted on plan, panelboard shall have all breakers with a minimum interrupting capacity of 30,000 Amps symmetrical and boxes with a minimum width of 14".

6. Panels shall be factory prime coated and finish coated with baked acrylic enamel. Label all panelboards with an engraved nameplate fastened to the front of the panel. Nameplate shall be black with 1/4” white lettering.

7. Panelboards shall be Square D or Eaton.

J. 20 Ampere, 120 Volt, Duplex Receptacles, NEMA 5-20R:

1. Duplex receptacles shall be 3 wire, U-ground, to meet Federal Specification WC-596. Receptacle color shall be ivory.

2. Receptacles shall be Arrow Hart #5362, Bryant #5362, Hubbell #5362, Leviton #5362, Pass &Seymour #5362, or equal.

K. 20 Ampere, 120 Volt, Duplex Receptacles, NEMA 5-20R (G.F.I. Type):

1. All receptacles noted, as G.F.I. receptacles shall be 20 Amp ground fault circuit interrupter receptacles. Receptacles shall be the "Standard" End-of-Line" type, which protects itself only. "Feed-Thru" installation will not be permitted. Devices shall be Class A, UL listed.

2. Provide a weatherproof cover for G.F.I. receptacles where indicated on the Drawings. Cover shall be self-closing and UL listed.

L. Switches:

1. Local control switches, other than those mounted on a panelboard, shall be 20 ampere, 120-277 volt, AC, meeting Federal Specification WS-896E. Switch color shall be ivory.

2. Switches shall be single pole, double pole, three-way, four-way or type as noted. Switches shall be Arrow Hart #1221, Bryant #4901, Hubbell #1221, Leviton #1221, Pass & Seymour #20AC, or equal.

M. Wall Plates:

1. Local control switches, receptacles and similar wiring devices shall be provided with stainless steel wall plates with beveled edges. Plates shall be same manufacturer as wiring device used.

2. At locations where FS condulets are used for switches or receptacle outlets, an FS condulet plate shall be used. Plates shall have beveled or rounded edges and shall fit flush with all sides of the FS condulet.

N. Manual Starter Switches:

1. Manual starter switches shall consist of a single pole snap switch and a thermal overload device. Size of overload element shall be based on the nameplate rating of the motor it is to protect. Switches shall be furnished with a red pilot light and an H/O/A switch. Switches shall be mounted in an outlet box where wiring is concealed and in a condulet box where wiring is exposed.

2. Manual starter switches shall be rated for 1 hp at 120V AC and shall be manufactured by Square D or Allen-Bradley.

O. Disconnect Switches:

1. Disconnect switches shall be non-fusible, size and NEMA enclosure as indicated on the Drawings, quick-make, quick-break, heavy-duty. Provide a ground lug in each disconnect switch.

2. NEMA 4X disconnect switches shall be 316 stainless steel.

3. Label all disconnect switches with an engraved nameplate fastened to the disconnect switch.

4. Disconnect switches shall be Square D or Eaton.

P. Uni-strut:

1. Uni-strut shall be used where indicated on the drawings to support conduit and electrical equipment. All uni-strut shall be 316 stainless steel unless noted otherwise.

Q. Conduit Link Seals:

1. Conduit link seals shall be installed in all core-drilled holes for sealing around the conduit. All link seal bolts shall be stainless steel.

R. Conduit Labels:

1. Conduit labels shall be PVC sleeves that wrap around conduit. Labels shall indicate the voltage of the wiring inside the conduit.

S. Fire Resistant Foam Sealant:

1. All penetrations through floors and walls shall be sealed with Nelson Firestop Products CLK, Cat. #AA492, silicon based sealant, or equal.

2. All wall or floor penetration openings shall be as small as possible.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Conduit:

1. All conduit inside the pump station, and all exterior exposed conduit, shall be rigid aluminum, unless noted otherwise on the Drawings.

2. All conduit in the Pump Station Wet Well, Meter Pit, and Comminutor Area shall be PVC coated galvanized rigid steel.

3. All wiring shall be run in conduit.

4. Install conduit so wires may be removed and replaced at a later date.

5. Short runs of flexible nonmetallic conduit with separate ground wire shall be used for connection of motors and instrumentation. Approximately 18" runs of flexible nonmetallic conduit shall be used for connection of all HVAC equipment. No rigid connection to HVAC equipment will be permitted.

6. Running threads will not be permitted. Use an approved threaded coupling or a suitable union where required. Setscrew couplings will not be permitted.

7. Space supports for conduit not more than 5' apart. Support conduit by one-hole malleable iron pipe straps or beam clamps. Where it is impractical to use beam clamps and where conduit is installed on building surfaces, use back straps and approved fastening devices with malleable iron pipe straps.

8. Where it is necessary to cross building expansion joints, provide conduit runs with suitable expansion fittings.

9. Provide conduit expansion fittings in aluminum conduit at 30'-0" intervals.

10. All conduit penetrations into electrical equipment enclosures shall be made using conduit hubs. PVC coated rigid steel conduit systems shall use PVC coated conduit hubs.

11. Bend conduit only by use of an approved pipe bending machine or hickey so the conduit will always retain its cylindrical shape. PVC coated conduit shall be bent and threaded only with tools manufactured for that purpose.

12. If the PVC coating on conduit and fittings is damaged during installation, the damaged conduit or fitting shall be replaced in its entirety by the contractor. Repairing damaged conduit with touch-up paint will not be acceptable.

13. Install metallic electrical warning tape above all underground duct banks and conduit. Tape shall be 6" wide with yellow background and black letters. Letters shall read "CAUTION ELECTRICAL LINE BURIED BELOW". Install tape 6" below finished grade.

14. Label all exposed conduits at each end of the conduit run.

B. Outlet Boxes:

1. An outlet box shall be furnished and installed at each outlet, firmly in place, and set true and square.

2. All outlet boxes shall be supported from the building structure, independent of the entering conduit. All unused knockouts must remain closed.

C. Wiring:

1. The voltage drop at the end of any circuit shall not exceed 3% of the normal line voltage under full load. No wires smaller than #12 AWG shall be used for branch circuits; pilot and control circuits shall not be smaller than #14 AWG.

2. Care shall be exercised in pulling wire into conduit so as not to injure insulation. Use pulling compound as required.

3. Conductors to be continuous from outlet to outlet. Splice only within outlet or junction boxes.

4. Balance circuits across the phase wires of the branch and distribution panels. Run separate neutral wires for all circuits.

5. Switches shall not be connected to the neutral conductor.

6. Power and control wiring shall be run in separate conduits. AC and DC circuits shall be run in separate conduits.

7. All wiring shall conform to the following color code:

208 Volt, 3 Phase:	Black, Red, Blue - Phase Wires White - Neutral Wire
208 Volt, 1 Phase:	Black, Red - Phase Wires White - Neutral Wire
120 Volt, 1 Phase:	Black - Phase Wire White - Neutral Wire
Control Wires:	120V AC - Red 24V dc - Blue
Ground Wires:	Green

8. AC control wires energized from a source external to the control panel power source shall be yellow.

9. All control wiring shall be identified at each end with a legible permanent coded wire-marking sleeve. Sleeves shall be heat-shrink white PVC tubing with machine printed black marking, as manufactured by Brady Markings shall be in accordance with the wire numbers and terminal numbers shown on the control panel wiring diagrams.

D. Splices:

1. Make all splices using solderless connectors. Use wire nut connectors composed of expandable spring steel shell and PVC insulator for size #14 through #8. Temperature rating shall be 105°C. For size #6 and larger, use bolted-type tinned copper pressure connectors, either the straight coupling type or the split bolt type. All connectors #6 and larger shall be wrapped with UL approved linerless rubber splicing tape rated to 69 KV and vinyl plastic electrical tape to the same thickness as the insulation of the wire. Electrical tape shall be Scotch 33+, or equal.

E. Lugs:

1. All lugs used with copper wire and cable shall be tinned copper. Aluminum will not be accepted.

F. Panels:

1. Furnish a typed list identifying all circuits and insert in frames provided inside of panel doors.

G. Mounting Heights:

1. Mounting heights and exact locations of all outlets to be verified by the Owner before roughing in.

2. Unless otherwise instructed, outlets shall be located as follows:

   a. Local Lighting Control Switches: Locate all outlets for single or gang switches 3'-4" above finished floor on strike side of door. If this location places the switch group partly in tile or other finishes, the outlet shall be lowered or raised to place the plate entirely on a flat surface.

   b. Duplex Receptacles: 36” above finished floor, unless noted otherwise on the Drawings.

   c. Panelboards: 6'-0" above finished floor to top of panel.

   d. Disconnect Switches: 4-6" above finished floor to top of switch, unless noted otherwise on the Drawings.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 16400

ELECTRIC SERVICE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Furnish all labor and materials to install a complete electric service to the Oak Ridge Pump Station, including termination, metering, conduit, and all equipment and labor required, as indicated on the drawings and specified herein. Power Company is Potomac Edison.

2. Service characteristics of the electric service are 277/480 volt, 3 phase, 4 wire wye.

1.02 QUALITY ASSURANCE

A. Contact Power Company for specific instructions regarding service requirements before beginning work. Complete system must meet with power company approval.

B. Power company representative is Keith Artice. Phone No. 301-533-3309.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Primary Service Conduits:

1. Primary service conduits shall be PVC Schedule 80 minimum of 30” below finished grade.

B. Secondary Service Conduits:

1. Secondary service conduits shall be PVC Schedule 80.

PART 3 - EXECUTION

3.01 INSTALLATION OF ELECTRIC SERVICE

A. Primary Service Conductors and Pad Mounted Transformer:

1. Primary service conductors and pad mounted transformer will be furnished by the power company, paid for by the owner, and installed in the primary service conduits by the contractor.

B. Secondary Service Conductors:

1. Secondary service conductors shall be furnished and installed by the Contractor in the secondary service conduits by the contractor.

C. Current Transformers (CTs):

1. Current transformers shall be furnished and installed by the power company in the pad mounted transformer.

D. Metering:

1. Metering will be furnished and installed by the power company on the power company pad mounted transformer.

E. Costs:

1. Power company costs for the furnishing of the electric service upgrade shall be paid by the owner, installed by the Contractor.

END OF SECTION

SECTION 16500

LIGHTING FIXTURES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Furnish all labor and materials to complete lighting fixture installation and associated items indicated, specified herein or both. Fixtures of size and type specified herein shall be supplied, installed and connected for each outlet indicated on the Drawings. Furnish and install lamps in each fixture.

1.02 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

1. Fixtures shall be U.L. listed.

2. All fixtures shall meet all Federal, State and local required criteria.

3. All light fixtures shall be mounted in accordance with manufacturer's recommendations.

4. Ballasts shall be Electrical Testing Laboratories, Inc. (E.T.L.) - Certified Ballast Manufacturers Association (C.B.M.) certified.

5. The installation must comply with the amended National Electrical Code of the National Fire Protection Association.

B. Qualification:

1. When more than one name of manufacturer of fixture is listed in these specifications, the first manufacturer and number determine the style and quality.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit manufacturer's latest publication of each fixture including ballast information, construction details, light distribution details and/or coefficients.

PART 2 - PRODUCTS

2.01 MATERIALS

A. LED Drivers:

1. LED light driver shall be of high efficiency.

2. LED light driver shall allow operation of all other LEDs in the event of an LED failure.

B. Light Fixture Schedule:

1. CA: Ceiling mounted, 120 volt, high efficiency LED, nominal 8" x 4', totally enclosed gasketed fixture suitable for wet locations. Fixture shall be provided with an electronic driver. Fixture shall produce a minimum of 4,000 initial lumens and have a color temperature of less than or equal to 4,100K. Housing shall be one-piece high impact plastic to provide durability and corrosion resistance. The lens shall be one-piece deep clear polycarbonate, resistant to damage. Fixture shall have plastic latches to apply positive, uniform pressure on the gaskets to seal against dust and moisture. Provide gasketed conduit hubs. Fixture shall be Holophane #EMSL48-4000LM-IMACD-MD-MVOLT-GZ10-40K-80CRI-WLFEND2, Lithonia #FEM4LED-4L-IMACD-WLFEND-PLCL-WLFEND, or Columbia #LXEM-4-40-HL-DCA-E-U-DWH.

2. CB: Ceiling mounted, 120 volt, high efficiency LED, nominal 4' linear, totally enclosed gasketed fixture. Fixture shall be designed for a Class 1, Division 1 hazardous environment where flammable gases or vapors, flammable liquids, combustible dust and/or ignitable fibers may exist. The fixture housing shall be baked-on powder epoxy for added corrosion protection. Fixture shall be AZZ Lighting #XML-07-L-C-4-U-MB, or equal.

3. WA: Wall mounted, 120 volt, high efficiency LED fixture. Fixture shall be designed for a Class 1, Division 1 hazardous environment where flammable gases or vapors, flammable liquids, combustible dust and/or ignitable fibers may exist. The fixture housing shall be baked-on powder epoxy for added corrosion protection. Fixture shall have a prismatic glass globe and stainless steel wire guard. Fixture shall be Holophane #HRLL-8L-AS-GG-WL, or equal.

4. WB: Wall mounted, multi-volt, high efficiency LED fixture. The fixture shall have a color temperature of less than or equal to 4,000. The fixture housing shall be constructed of die-cast copper-free aluminum with epoxy powder finish. Fixture shall have a prismatic glass reflector. Fixture shall be NEMA 4X rated and UL listed as suitable for wet locations. Fixture shall be furnished with a SPAS20K surge suppressor. Fixture shall be Holophane #HPLED-56-700-4K-AS-US-G-L5H, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation:

1. Contractor shall furnish supports for the light fixtures.

2. The fixture manufacturer's catalog numbers describing the various types of fixtures shall be used as a guide only and do not include all the required accessories or hardware that may be required for a complete installation.

The Contractor shall be responsible for furnishing, at no additional cost to the Owner, all required accessories and hardware for a complete installation.

3. All inoperable lamps shall be replaced with new lamps during the course of construction, up to and including the date of final acceptance by the Owner and Engineer.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 16530

BATTERY EMERGENCY LIGHTING UNITS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Furnish, install and connect a complete system of conduits, conductors, unit type battery emergency lighting units and all other materials and equipment necessary for the installation of an emergency lighting system.

1.02 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

NEC National Electrical Code of National Fire Protection Association
UL Underwriters' Laboratories
FM Factory Mutual Engineering Corp.

B. Qualification:

1. The complete system shall be of a type, which has been in satisfactory service for at least one year under automatic emergency lighting conditions.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit the manufacturer's latest data sheets on the following:

a. Battery Units
b. Battery Exit Fixtures

PART 2 - PRODUCTS

2.01 MATERIALS

A. Battery Units:

1. EA: Exit fixtures shall be back mounted, single faced with red high intensity LED lamps and a sealed nickel cadmium battery. The fixture housing shall be white polycarbonate. The exit fixtures shall operate on 120 VAC power and shall be Sure-Lites #LPX7, or equal.

2. EB: Explosion-proof battery emergency lighting units shall have a nickel cadmium battery and aluminum housing with a gray powder epoxy finish. Fixture shall operate on 120 volts and shall be furnished with (2) 14-watt tungsten halogen lighting fixtures. Wattage rating shall be 30 watts for 1½ hours. Fixture shall be suitable for Class 1, Division 1, Groups C and D area and shall be Crouse-Hinds Light-Pak #ELPS502, or equal.

3. EC: Combination exit fixture/battery emergency light fixtures shall be back mounted, single faced with red high intensity LED lamps and sealed nickel cadmium battery. The fixture housing shall be white polycarbonate. The exit fixtures shall operate on 120 VAC power. Fixture shall be Sure-Lites #LPX7DHNC, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Battery Units:

1. Battery units shall be firmly fastened to walls. Mounting height to be determined in field.

B. Wiring:

1. Wiring on low voltage side of unit shall be no smaller than #10.

2. Connect combination exit fixture/battery emergency light fixture to lighting circuit for area being protected ahead of all local control switches.

END OF SECTION

SECTION 16612

EMERGENCY GENERATOR SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Furnish a complete diesel emergency Caterpillar generator system for the Oak Ridge Pump Station, including generator, prime mover, muffler, exhaust system, cranking battery, battery charger, control panel, sub-base fuel tank, water jacket heater, generator mounted circuit breaker, sound attenuated weatherproof enclosure, and all other necessary material required to complete the system.

2. Furnish and install an automatic transfer switch for the emergency generator.

B. Generator Requirements:

1. The emergency generator shall be rated for continuous standby service at 250 KW, 313 KVA, 60 Hz, 0.8 power factor, 277/480 volts, 3 phase, 4 wire.

1.02 QUALITY ASSURANCE

A. Standards: The engine generator set, and all accessories, shall meet the requirements of:

UL	Underwriters' Laboratory
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association (Pamphlets 30, 31, 37, 110)
MIL-STD	705 B

B. Quality Control:

1. All components of the emergency generator system shall be new and of the most current and proven design.

2. The complete system shall be of a type, which has been in satisfactory service for at least one year under automatic emergency system conditions.

3. This generator set system shall be assembled, tested and shipped by one supplier so that there is one source of supply and responsibility.

4. The Kohler Supplier shall be a factory trained and certified manufacturer's representative and shall maintain a complete service facility. The service facility shall be capable of making delivery to the generator set site all generator set parts within 48 hours of placing the order. The Supplier shall employ a manufacturer trained and certified technician on a full-time basis at the service facility capable of making repairs and responding to service

calls within 24 hours of notice. Certified proof of this requirement shall be available from the Supplier.

C. Testing:

1. Prototype tests performed on a generator set of the same size and type, required by these specifications, shall be submitted and approved with the shop drawings, required below. The test procedures and results shall be certified by an independent testing laboratory. The tests shall be performed in accordance with NFPA 110 and shall document the following:

   a. Maximum power level
   b. Maximum motor starting capacity
   c. Voltage dip
   d. Fuel consumption
   e. Engine-generator cooling air flow
   f. Governor response time
   g. Alternator temperature rise per NEMA MG1-22.40
   h. Harmonic analysis and voltage Wave Form Deviation per MIL-STD-705 B, method 601.4
   i. Three (3) phase short circuit test for mechanical and electrical strength

2. Factory tests of the generator set to be supplied shall be conducted in accordance with procedures certified by an independent testing laboratory. The manufacturer shall successfully test the generator set to be supplied, document items 1 a-i above and submit the test results for approval before shipping the generator set to the job site. A two-hour load bank test shall be performed and the results submitted before shipping the generator set.

D. Acceptance Tests:

1. Acceptance testing of the installed generator set shall be conducted by a factory-trained representative of the generator set manufacturer. An authorized representative of the Owner shall witness the acceptance tests. The test results shall be submitted to and approved by the Owner before the generator set is accepted. The Supplier shall furnish all testing equipment, materials, etc., including fuel needed to demonstrate the set is in compliance with the specification. Any deficiencies brought to the attention of the Supplier shall be corrected and, if warranted or requested by the Owner, the test shall be reperformed prior to acceptance. Final O&M Manuals shall be submitted before the acceptance tests commence.

2. The acceptance tests shall be performed during an eight-hour field test during which the manufacturer's representative shall demonstrate that the system performs in complete compliance with the specifications. As a minimum, a load bank test, performed in accordance with NFPA 110 section 5-13.2 shall be conducted. The load tests shall use dry type load banks specifically utilized for this purpose. The load bank will be capable of definite and precise incremental loading and shall not be dependent on the generator control instrumentation to read voltage and amperage of each phase. The test instrumentation will serve as a check of the generator set meters. Load bank testing shall be performed for a period of four (4) hours at the full rated load of the generator.

1.03 SUBMITTALS

A. Shop Drawings:

1. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings, integral controls and types of materials, elevations, and sections. Shop drawings shall include manufacturer's literature and complete information including the following:

a. Engine generator system plan, elevation and dimensional drawings clearly indicating all aspects of the system including points for each of the inter-connections required.

b. Engine generator/exciter control cubicle layout and component descriptions.

c. Sub-base fuel tank, piping schematic and fuel line connection information.

d. Fuel consumption rate curve at various loads, ventilation and combustion CFM requirements.

e. Exhaust muffler and vibration isolator.

f. Schematic ladder and control wiring diagrams for the generator system.

g. Printed literature and brochures describing the system including all sizing requirements and components specified.

h. The weight of the engine, generator and complete system.

i. Points of measurement and maximum vibration readings (measured as velocity) for the installed system recommended by the manufacturer.

j. Battery, battery rack and battery charger literature and description.

k. Sound attenuated weatherproof housing.

l. The specified standby KW of the generator shall be for continuous electrical service during interruption of the normal utility power source and this shall be certified to this effect by the manufacturer for the actual unit supplied.

m. Factory prototype test results performed on a unit of this size and type documenting items (a) through (I) listed in 1.02 C above.

n. Automatic Transfer Switch

B. Operation and Maintenance Manuals:

1. Submit required number of copies of an operation and maintenance manual for the complete emergency generator system. The manual shall be submitted in 3-ring loose-leaf binders, and shall be complete, neat, orderly and indexed. The manual shall include, at the least, all data bearing on the specific generator system necessary for maintenance, operation, parts repair and replacement including all accessories and electrical controls, fire-code safety and operator safety measures, and lubrication schedule. A copy of the approved shop drawings shall be included in the manual. Manual shall be submitted and approved before system will be accepted.

C. Installation Certificate:

1. A factory technician shall inspect the installed generator system and certify in writing to the installer that it is installed in accordance with the manufacturer's recommendations before the system is initially started. The technician shall be present for the initial start-up and make recommendations to resolve any defects experienced. A copy of the installation certificate must be submitted to the Owner before the generator set is conditionally accepted.

1.04 MANUFACTURER

A. The manufacturer of the generator set shall be Caterpillar or Cummins Onan.

PART 2 - PRODUCTS

2.01 GENERATOR EQUIPMENT

A. Engine:

1. The engine shall be the water-cooled in-line or V-type, compression ignition diesel. It shall meet specifications when operating on No. 2 diesel fuel. The engine shall be equipped with filters for fuel, lube oil, intake air, lube oil cooler, fuel transfer pump, fuel priming pump, one foot of flexible fuel line between engine and rigid supply, and gear-driven water pump.

2. The engine shall be controlled by an electronic governor. The governor shall maintain isochronous frequency regulation from no load to full load.

3. The engine shall be equipped with automatic safety controls, which will shut down the engine in the event of low oil pressure, high water temperature, overspeed and overcrank.

4. The engine shall be remote starting with a 2 wire, solenoid shift electric starter.

B. Generator:

1. The generator shall be a three phase, single-bearing, synchronous-type built to NEMA standards, rated for continuous standby at service. Class F insulation shall be used on the stator and rotor, and both shall be further protected with 100% epoxy impregnation and an overcoat of resilient

insulating material on end coils to reduce possible fungus and/or abrasion deterioration. The generator shall incorporate a resettable thermal protector for exciter/regulator protection against extended low power factor loads. The generator shall be capable of accepting full nameplate load in one step.

2. A generator-mounted, volts-per-hertz type exciter/regulator shall be provided to match the characteristics of the generator and engine. Voltage regulation shall be ±1% from no load to full rated load. Voltage level adjustment shall be a minimum of ±5%. The solid-state regulator module shall be shock-mounted and epoxy-encapsulated for protection against vibration and atmospheric deterioration. Voltage dip due to motor starting current shall not exceed 20% under the maximum load conditions.

3. A permanent magnet generator (PMG) shall provide excitation power to the automatic voltage regulator for immunity from voltage distortion caused by non-linear SCR controlled loads on the generator. The PMG shall sustain main field excitation power for optimum motor starting and to sustain short circuit current for selective operation and coordination of system over current devices.

4. The alternator shall be 105°C rise at standby rating.

C. Cooling System:

1. The engine shall be furnished with a cooling system having sufficient capacity for cooling the engine when the generator set is delivering full rated load at an ambient temperature of 125°F.

2. The engine cooling system shall be filled with a solution of 50% ethylene glycol. Cooling system shall be pretreated by supplier for inhibition of internal corrosion.

3. The engine shall be equipped with a radiator having a blower type fan. The radiator shall have a duct adapter flange, and shall be equipped with a fan guard and core guards.

D. Starting System:

1. The engine shall be equipped with a DC electric starting system of sufficient capacity to crank the engine at a speed, which will allow full diesel starting of the engine. The motor voltage shall be as recommended by the engine manufacturer.

2. Fully automatic generator start/stop controls shall be provided in the generator control panel to start the generator automatically from a contact in the automatic transfer switch.

3. When the engine starts, the starting control shall automatically disconnect the cranking controls. The cranking disconnect means shall be electrically self-regulating to prevent recranking for a definite time after source voltage has reduced to a low value. If engine fails to start, or any safety device operates while engine is running, engine shall be stopped immediately and starting control locked out, requiring manual resetting.

4. Controls shall provide shutdown for low oil pressure, high water temperature, overspeed and overcrank. Controls shall include a 10-second cranking cycle limited to 3-5 attempts before lockout.

5. The automatic engine starting control shall incorporate industrial control type elements throughout, which must operate at 80% battery voltage. Relays shall be equipped with silver-gold contacts of the wiping type and shall have adequate pressure to insure reliable performance at battery voltage.

6. Batteries:

   a. A lead/acid storage battery set of the heavy-duty starting type shall be provided. Battery voltage shall be compatible with the starting system. The battery set shall be rated for a minimum of 172 hours and shall be of sufficient capacity to provide for 1½ minutes total cranking time without recharging. It shall be sized for the cold cranking amps as recommended by the battery manufacturer. A wood bottom, fiberglass treated, battery rack and necessary cables and clamps shall be provided. The battery rack shall be isolated from the engine to protect it from excessive vibration, and shall be readily accessible for service and/or removal.

7. Battery Charger:

   a. A 10-amp current limiting battery charger shall be furnished to automatically recharge the batteries. The charger shall include overload protection, silicon diode-full wave rectifiers, voltage surge suppressors, DC ammeter, and AC over current protection. AC input voltages shall be the same as the generator output voltage.

   b. The battery charger shall be mounted inside the generator housing.

E. Jacket Water Heater:

1. Provide an engine mounted thermostatically controlled water heater to maintain the engine jacket water temperature at a temperature recommended by the engine manufacturer. Heater shall be sized as recommended by the manufacturer.

2. The heater for the generator shall operate on 120 volts, 1 phase.

F. Sub-base Fuel Tank:

1. Furnish and install a sub-base fuel tank under the generator. The fuel tank shall be sized to run the generator for 24 hours at 100% load. The minimum size of the fuel tank shall be 500 gallons.

2. Tank shall be UL listed double wall construction, with a float switch between walls. Float switch shall be wired to an alarm light on the generator control panel.

3. Tank shall have a fuel level gage mounted next to fill pipe.

4. Tank shall have a low fuel level float switch, which shall be wired to an alarm light on the generator control panel.

5. Fill and vent pipes shall be as recommended by manufacturer, and installed by the Contractor.

6. Exact location of fill pipe and vent shall be coordinated with Owner.

7. All fuel connections at the engine shall be made using wire reinforced flexible hose.

G. Exhaust System:

1. Provide a critical type exhaust silencer, including stainless steel flexible exhaust fitting, properly sized according to the manufacturer's recommendation. Exhaust pipe size shall be sufficient to ensure that exhaust backpressure does not exceed the maximum limitations specified by the generator set manufacturer. The silencer shall be manufactured by Maxim, or equal.

2. Provide taps for drainage with petcock drain valves, drip cap, rain cap, wall thimble and accessories.

3. The exhaust silencer shall be installed inside the generator housing.

4. The exhaust piping and muffler shall be insulated with insulating blankets.

H. Engine Generator Set Mounting:

1. The engine generator shall be mounted in perfect alignment on an all welded preformed structural steel I-beam or C channel skid type sub-base which shall provide for attachment of all specified engine and generator accessories.

2. Provide spring-type vibration isolators for mounting between the engine generator set mounting rails and the sub-base fuel tank. The size and quantity of isolators shall be as recommended by the manufacturer.

I. Generator Control Panel:

1. Provide a generator-mounted NEMA 12 control panel. The control panel shall be mounted on the generator terminal box and shall be vibration isolated. The generator control panel shall contain, but not be limited to, the following equipment:

a. Digital AC Voltmeter
b. Digital AC Ammeter
c. Digital AC Frequency Meter
d. Ammeter - Voltmeter Phase Selector Switch
e. Automatic Starting Controls
f. Voltage Level Adjustment Potentiometer
g. Run-stop-remote switch and remote start-stop terminals

h. Alarm lights for low oil pressure, low engine temperature, high water temperature, overspeed, overcrank, low fuel tank level and fuel tank leak
i. Engine Temperature and Pressure Gauges
j. DC Charging Volts and Ampere Gauges
k. Running Time Meter
l. Dry Contacts for run indication, low fuel tank level and common alarm wired to terminal strips
m. Panel illumination lights and switch

J. Generator Circuit Breaker:

1. A main line molded case 3-pole circuit breaker shall be installed as a load circuit interrupting and protection device. It shall operate both manually as an isolation switch and automatically during overload and short circuit conditions.

2. The trip unit for each pole shall have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short circuit protection. The circuit breaker shall meet standards established by Underwriters' Laboratories, National Electrical Manufacturer's Association, and National Electrical Code.

3. The circuit breaker shall be mounted in a NEMA 12 type enclosure, adjacent to the generator control panel.

K. Weatherproof Enclosure:

1. Provide a weatherproof, sound attenuated 16 gauge painted galvanized steel enclosure for the generator. The enclosure shall be drip-proof to prevent water from entering enclosure and shall be provided with heavy-duty “lockable” latches to ensure tamper-proof security and safety. Sound shield shall be provided with lifting eyes for ease of installation.

2. The enclosure shall have solid access doors with door handles keyed alike. Doors shall have 3-point latches, stainless steel butt hinges, stainless steel door holders, and rain gutters above doors.

The enclosure shall have an advanced sound-attenuation design. The noise at 7 meters shall be 72 dBA or less, at full load.

L. Painting:

1. The complete generator set shall be painted with the manufacturer's standard prime and finish paint system. Observed nicks, damage, rust, etc. to the paint system of the installed generator set shall be prepared, primed and finish coated in the field prior to conditional acceptance.

PART 3 - FIELD SERVICES

3.01 TECHNICAL SERVICES

A. The manufacturer of the emergency generator shall furnish a qualified technician, whose qualifications are acceptable to the Owner, to provide the following services:

1. Inspection of the installation of the emergency generator system
2. Start-up
3. Performance testing
4. Operating adjustments
5. Instruction of Owner's personnel
6. Assistance at final inspection.

B. These services shall include not less than two 8-hour workdays on-site comprising a minimum of two trips.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 17010
PUMP CONTROL SYSTEM GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. The Contractor shall obtain the services of a subcontractor who shall provide a complete integrated Pump Control System (PCS) for the pump station consisting of variable frequency drives, control panels, instrumentation, programmable controller system hardware and software, and software programming as shown on the Drawings and as specified in Division 17. This subcontractor will hereafter be referred to as the Pump Control System Supplier. The System Supplier shall have total responsibility for the design, programming, testing, start-up and implementation of the Pump Control System.

2. The Pump Control System Supplier shall be the following System Integrator. No other suppliers will be accepted without approval prior to the bid:

Allied Control Services, Inc.
611 Garfield Ave.
West Point, PA 19486
215-699-2855
Contact: Matt Mamzic

1.02 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

ANSI	American National Standards Institute
IEEE	Institute of Electrical and Electronic Engineers
ISA	International Society of Automation
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
UL	Underwriters' Laboratories, Inc.

B. Quality Control:

1. All components of the Pump Control System shall be new and of the most current and proven design. All components shall be suitable for the intended application and shall be installed and wired in strict accordance with the manufacturer's requirements. The System Supplier shall provide all necessary transformers, power supplies, fusing, and grounding required to meet the manufacturer's requirements.

2. The complete system must comply with all Federal, State, Municipal, or other authority's laws, rules, or regulations.

3. All control panels, and their components and materials, shall bear the label of the Underwriters’ Laboratory. All control panels shall be UL listed as a complete assembly.

C. Equipment Manufacturers:

1. The Pump Control System Supplier shall base his bid on providing the manufacturers specified under Division 17 for all equipment furnished for the System. No substitutes will be allowed without prior approval.

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Section 01300.

B. Shop Drawings:

1. Submit required number of detailed shop drawings for all equipment being provided for the Pump Control System. Shop drawings shall be submitted within 60 days of the date of Notice to Proceed.

2. Shop drawings shall be submitted in 3-ring loose-leaf binders and shall be complete, neat, orderly, and indexed. Separate shop drawing submittals shall be made for each of the following:

a. Motor Control Center
b. Variable Frequency Drives
c. Control Panels
d. Instrumentation
e. Programmable Controller System Hardware and Software
f. Operator Interface Terminal Graphic Screens

3. Refer to specification sections for specific shop drawing requirements.

4. The System Supplier shall submit a complete set of engineered drawings for the Motor Control Center, Variable Frequency Drives, Control Panels, and Programmable Controller System hardware. These engineered drawings shall be similar to the Contract Drawings, and shall be done by the System Supplier using AUTOCAD. The drawing size shall be 11"x17". These drawings shall include, but not be limited to, the following:

a. Motor Control Center elevations showing all unit locations, door mounted devices and dimensions.

b. A chart for the Motor Control Center indicating nameplate engraving, starter size and type, circuit breaker size and type, transformer size, special controls, motor horsepower, and overload heater size, for each Motor Control Center unit.

c. Three line wiring diagrams for each motor control center unit showing power and control wiring, unit devices, terminal numbers, and interconnecting wiring.

d. VFD elevations and details showing door mounted devices and dimensions. Three line wiring diagrams for each VFD showing power and control wiring, VFD components and devices, terminal numbers, and interconnecting wiring.

e. Control panel elevation, details, front and back panel layout, and wiring diagrams showing terminal numbers and interconnecting wiring. The control panel layout drawings shall include dimensions for the location of all panel-mounted devices.

f. Programmable controller system power wiring diagrams and I/O wiring diagrams showing terminal numbers and interconnecting wiring.

C. Installation, Operation and Maintenance Manuals:

1. Submit required number of copies of installation, operation and maintenance manuals for all equipment being provided for the Pump Control System.

2. Installation, operation and maintenance manuals shall be submitted in 3-ring loose-leaf binders, and shall be complete, neat, orderly and indexed. Separate binders shall be submitted for each of the following:

a. Motor Control Center
b. Variable Frequency Drives
c. Control Panels
d. Instrumentation
e. Programmable Controller System Hardware
f. Programmable Controller System Software
g. Operator Interface Terminal Graphic Screens

PART 2 - PRODUCTS

2.01 SEE SPECIFIC SECTIONS FOR PRODUCTS

PART 3 - EXECUTION

3.01 COORDINATION

A. The Pump Control System Supplier shall attend an initial coordination meeting with the Engineer, the Contractor and the Owner to review the scope of the project and the project schedule.

3.02 FACTORY ACCEPTANCE TEST

A. The System Supplier shall conduct a factory acceptance test for the Pump Control System prior to shipment of the equipment. The factory test shall be conducted at the supplier's facility and shall demonstrate the control system was designed and performs in accordance with the Specifications and Drawings. All equipment furnished for the Pump Control System shall be assembled and inter-wired so that it functions as a complete system for the factory acceptance test.

B. The System Supplier shall provide all necessary equipment and hardware required to conduct the factory test.

C. The factory acceptance test shall demonstrate the proper operation of all control logic described in the Description of Operation, and all system hardware and software. The factory test shall be witnessed by the Engineer and the Owner.

D. Submit an itemized test procedure and schedule for the factory acceptance test to the Engineer for his review prior to the actual test.

3.03 RECORD DRAWINGS

A. Submit required number of record or as-built drawings for the Pump Control System prior to the delivery of any equipment to the site. Provide an as-built drawing in the control panel.

B. Following start-up and commissioning of the system, the System Supplier shall make all necessary changes to the as-built drawings and re-submit required number of final as-built drawings. A final as-built drawing shall also be provided in the control panel.

3.04 SYSTEM INSTALLATION, START-UP AND COMMISSIONING

A. System Installation:

1. The System Supplier shall provide on-site supervision and advice to the installing contractor to insure the system is installed in accordance with the specifications and the manufacturer's requirements.

2. All field wiring to the equipment furnished by the System Supplier shall be performed under the electrical portion of the Contract unless noted otherwise on the Drawings.

B. System Start-Up:

1. Start-up the control system by energizing the system equipment and testing the operation of all hardware, software, process control logic, and all customized software programs.

2. All start-up and testing shall be scheduled, performed in an orderly sequence, and conducted in the presence of and to the satisfaction of the Engineer and the Owner.

C. System Commissioning:

1. Calibrate all instrumentation, and place the complete control system into operation. The commissioning of the system shall include the overall calibration and tuning of all control loops and sequences to provide stable control of the pumps. The validity of all inputs and outputs for the system shall be checked and corrected during the system commissioning.

2. The System Supplier shall provide someone on-site for the length of time necessary for system installation, start-up and commissioning.

3.05 FINAL ACCEPTANCE TEST

A. Following the commissioning of the Pump Control System, and the issuance of the Certificate of Substantial Completion to the Contractor by the Engineer, a final acceptance test shall be conducted for a period of 30 consecutive days. This test shall be scheduled with the Owner and the Engineer and shall not begin until the System Supplier receives written approval to start. During that time period, the system shall operate satisfactorily and in compliance with the Specifications.

The System Supplier shall promptly correct any problems that occur during the final acceptance test.

B. Following the successful completion of the final acceptance test, a certificate of final acceptance will be issued to the System Supplier.

3.06 EXPANSION OF SYSTEM I/O

A. The System Supplier shall include in his cost for this Contract the addition of ten (10) I/O points to the system as directed by the Engineer. These additional I/O points will originate from the spare I/O. The Supplier's allowance shall include all costs to add these points to the system including drawing changes, software programming, and field verification.

3.07 ADDITIONAL SOFTWARE CONFIGURATION AND PROGRAMMING

A. The System Supplier shall include in his cost for this Contract, sixteen (16) additional man-hours of on-site time for software configuration and programming. This time shall be utilized for changes and/or additions that may be required after the commissioning of the system. The Supplier's cost for these additional man-hours shall include software documentation changes.

3.08 TRAINING

A. During the final acceptance test, the System Supplier shall arrange for the instruction and training of the Owner in the operational procedures of the system. At the end of the training, the Owner shall have, as determined by the Engineer, sufficient knowledge to operate the system. This training shall be for four people for four (4) hours, and shall be conducted at the pump station. This training shall be in addition to the training specified in the other Division 17 sections.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 17100

MOTOR CONTROL CENTER

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Furnish and install a motor control center in the Oak Ridge Pump Station as shown on the Drawings. The motor control center shall include required number of vertical sections, main lugs, circuit breakers, combination type motor starters, control transformers, relays, selector switches, push buttons, pilot lights, elapsed time meters, and special controls as shown on the Drawings and specified herein.

B. Special Requirements:

1. The Motor Control Center shall be provided by the Pump Control System Supplier.

1.02 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

ANSI	American National Standards Institute
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
UL	Underwriters' Laboratories, Inc.

1. All internal conductors are to be of sufficient cross-sectional area copper to carry the rated ampere load and not exceed the maximum heat rise above ambient temperature specified by UL and NEMA.

B. Quality Control:

1. The motor control center shall be new and limited to products regularly produced and recommended for service ratings in accordance with engineering data or other comprehensive literature. In all cases where device, or devices, or part of equipment is herein referred to in singular, reference shall apply to as many items as required to complete installation.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit in accordance with the requirements of Section 17010. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings, integral controls and types of materials, elevations, and sections. Shop drawings shall include manufacturer's literature and complete information on the following:

a. Freestanding Vertical Sections
b. Main Lugs
c. Thermal-Magnetic Type Circuit Breakers
d. Motor Circuit Protector Type Circuit Breakers
e. Automatic Transfer Switch
f. Magnetic Across-the-Line Motor Starters
g. Control Transformers
h. Relays
i. Selector Switches
j. Push Buttons
k. Pilot Lights
l. Elapsed Time Meters
m. Special Controls
n. Engineered Control Diagrams and Connection Diagrams
o. Nameplate Schedules

1.04 MANUFACTURER

A. The motor control center shall be Allen-Bradley Bulletin 2100.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Motor Control Center Structure and Configuration:

1. The Motor Control Center shall be NEMA Type 1, gasketed. Wiring shall be NEMA Class 1, Type B. The motor control center shall have main lugs as indicated on the Drawings to feed the horizontal bus. Provide lugs of adequate size to terminate incoming cables. The motor control center shall be furnished with a ground bus, and a neutral bus as indicated on the Drawings.

2. The motor control center shall be rated at 208 volts, 3 phase, 4 wire, 60 Hz and shall be braced to withstand a short circuit current of 65,000 rms symmetrical amperes.

3. Motor starter units shall be combination type with a molded case circuit breaker. Control voltage for units shall be 120 volts.

4. The motor control center shall consist of vertical sections bolted together to form a rigid, freestanding assembly.

5. Vertical sections shall be formed of 13 gauge hot rolled steel with uniform blemish-free surfaces. Top and bottom structural parts shall be 10 gauge. End closing plates shall be 12 gauge, and unit parts and doors shall be 14 gauge. Base channels shall be provided constructed of rugged steel to easily withstand the stress of transit and moving the control center into position. Bolt holes in the base channels shall be provided in all sections for the purpose of bolting the control center to the floor. Steel removable lifting angles shall be provided on the top of the sections for convenience in handling the control center.

6. Each section, to comply with standards of NEMA, shall be approximately 90" high excluding lifting angles and base channels. It shall be approximately 20" deep by 20" to 35" wide, as indicated on the Drawings.

7. End sections shall have end-closing plates, which can be removed for the addition of future sections. The top plate shall be of a removable one-piece construction for added convenience in cutting conduit holes. Removable blank plates flanged on all 4 sides and having captive screws shall cover all unused unit spaces.

B. Main Lugs:

1. Main circuit breaker shall be thermal magnetic molded case type, service entrance rated, individually mounted and identified. Main circuit breaker shall have quick-make, quick-break mechanism and shall visually indicate whether the breaker is closed, open or tripped. The main breaker shall have sufficient interrupting capacity to properly close against and interrupt instantaneously, without damage, the maximum short circuit current available at the breaker. Minimum interrupting capacity shall be 65,000 amperes symmetrical at 480 volts.

C. Horizontal Wireways:

1. Adequate conduit entrance space and wire entry room shall be provided at both the top and bottom of each section. The bottom horizontal wireway shall be 12" and the top horizontal wireway shall be 6" and both shall extend through the length and depth of the control center section with openings between sections. Covers over these wireways shall be equipped with captive type screws to prevent loss of hardware during installation. These wireways shall be isolated from the bus bars.

D. Vertical Wireways:

1. A vertical wire trough located on the right-hand side of each standard section and having a cross-sectional area of not less than 28 sq.in. shall extend from the top horizontal wire trough to the bottom horizontal wire trough for the purpose of routing user's motor and control wires to the control units. The wire trough shall be isolated from the bus bars to guard against accidental contact. A separately hinged door having captive type screws shall cover the vertical wire trough for safe and easy access to wiring without disturbing control units.

2. Wire ties shall be furnished in the vertical wire trough to group and securely hold wires in place for a neat, orderly installation.

3. Where wire access ports between unit spaces and vertical wire trough are open, shutters shall be provided to prevent items, such as a fish tape, from accidentally entering the unit space. Snap-in wire grommets shall be provided in wire access ports for size 2 units and smaller for isolation and added protection of small wires. For larger units, snap-in wire guards shall be provided for added protection of larger wires.

E. Automatic Transfer Switch:

1. Furnish an 600 amp, 480 volt, 3-pole, 4-wire automatic transfer switch in Motor Control Center-P for utility and generator service. The transfer

switch shall be suitable for continuous operation and shall consist of a double throw power transfer mechanism and a microprocessor controller.

2. The transfer switch shall be arranged to close a contact for remote starting of the diesel generator, after a time delay of 0-6 seconds, after power failure or drop in any phase voltage to 70 percent of line voltage. During the delay period, the load circuits shall not be disconnected from the normal service lines.

3. When the generator is delivering not less than 95 percent of rated voltage and frequency, the load circuits shall be transferred. Retransfer to normal service shall be automatic when full line voltage and phase are restored after a time delay of 0 to 5 minutes, set for 3 minutes. Provisions shall also be made for manual transfer to the generator. After transfer to normal source, the generator shall continue to run for 5 minutes (adjustable 0 to 25 minutes) unloaded, shall shut down and shall be ready to start upon the next failure of the normal source or for manual start-up. If the generator should fail while carrying the load, retransfer to the normal source after a short delay shall be made upon restoration of the normal power. The pick-up and drop-out settings of the phase voltage-sensing relays shall be completely adjustable in the field from 70 percent to 100 percent pick-up and drop-out.

4. The transfer switch shall be double-throw switch operated by a single coil mechanism momentarily and electrically. Operating current for transfer shall be obtained from the source to which the load is to be transferred. Failure of any coil or disarrangement of any parts shall not permit a neutral position. The switch shall be positively locked mechanically on either source without the use of hooks, latches, semi-permanent magnets, or contacts. All contacts and coils shall be readily accessible for replacement from the front of the panel without major disassembly of associated parts.

5. The transfer switch shall be equipped with a test button, and auxiliary contacts as required to show that the switch is in the normal or emergency position. Provide pilot lights on the enclosure door to indicate the switch position.

6. Auxiliary contacts shall be provided for remote indication of the transfer switch position. The contacts shall be wired to a terminal block in the transfer switch enclosure.

7. The transfer switch shall have a load test switch to simulate normal power failure.

8. The transfer switch shall be furnished with an inphase monitor.

9. Provide a 7-day solid-state exercise clock to set the day, time and duration of the generator exercise period. Furnish a selector switch to enable the generator to be exercised with or without load.

10. Minimum withstand and closing ratings shall be in accordance with UL 1008.

11. The automatic transfer switch shall be the same as the generator manufacturer.

12. The automatic transfer switch shall be furnished with all software, programs and cables necessary for maintenance and adjustment of the transfer switch.

F. Vertical Sections:

1. Each vertical section shall be divided into compartments, each containing a combination starter or other control assembly as indicated on the Drawings. Power shall be provided to these compartments from the main bus by bus bars extending the full height of the unit. Sections shall also be provided with horizontal spaces at the top and at the bottom, which shall line up with adjacent section to form horizontal wiring raceways along the entire length of the control center.

G. Compartments:

1. Compartments shall be built in interchangeable combinations of modular heights. A full vertical section shall contain six equal NEMA size l modular compartments exclusive of top and bottom wiring spaces. Starter compartments shall not be less than 12" high. Only l/2 and integral multiples of the basic module will be allowed. Compartments for NEMA size 4 and smaller starters shall be draw out type.

2. Guide rails shall be provided in the structure for supporting and aligning a unit during its removal or replacement. Draw out units shall have pressure type, line disconnecting stabs of high strength alloy and shall be held in place by means of quick acting, captive machine screw fasteners arranged so the units can be removed or remounted readily without access to the rear of the structure. Each compartment whether draw out or stationary, shall be enclosed and effectively baffled to isolate any fault which may occur and shall be covered by an individual door fixed to the structure with a continuous full length piano hinge or two (three for doors over 36" high) semi-concealed, heavy-duty, pin type hinges. Doors shall be secured with captive, quick acting fasteners and shall be arranged to completely cover all live parts whether the draw out unit is present or not.

H. Bus Bars:

1. Main horizontal bus bars rated as indicated on Drawings but not less than 1,200 amperes shall be provided at the top or center of the control center and extend its entire length, except when cut and supplied with splice bars to divide the control center for ease in handling or when section is indicated on Drawings to be furnished without bus.

2. Horizontal bus bars of copper shall be mounted edge-to-edge to provide greater mechanical strength.

3. Vertical copper bus bars shall be rated not less than 300 amperes for adequate current carrying capacity in a variety of plug-in applications.

4. Horizontal and vertical bus bars shall be electrolytically tin plated copper. Connections between horizontal and vertical busses shall be joined by bolts, conical spring washers for constant pressure joints and self-clinching nuts to allow joint maintenance from the front.

5. High strength glass reinforced alkyd insulators shall be used as bus supports and as unit plug-in insulators. Bus and plug-in insulators shall be red to indicate the proximity of energized bus parts.

6. The temperature rise, above ambient temperature outside the enclosure, of bus bars and connections shall not exceed 50°C and that of connections to insulated cable shall not exceed 45°C when operated continuously at rated current. Bus work, wiring and equipment shall be rated to withstand short circuits of 65,000 rms symmetrical amperes at 208 volts or as noted on the Drawings.

7. A copper ground lug shall be provided in each incoming line vertical section capable of accepting a #8 to 250 MCM cable. A horizontal and vertical copper ground bus shall be provided in each section of the motor control center. Horizontal ground bus shall run continuously throughout the control center except where splits are necessary for ease of shipment and handling; in which case, splice bars shall be provided. Ground bus shall be tin plated copper and have a cross-sectional area of equal to 28% of the main horizontal bus cross-sectional area. Horizontal ground bus shall be located at the bottom of the motor control center.

I. Bus Barriers:

1. Insulated horizontal and vertical bus barriers shall be furnished to reduce the hazard of accidental contact. These barriers shall have a red color to indicate proximity to energized busses. Vertical bus barriers shall have interlocking front and back pieces to give added protection on all sides and shall segregate the phases from each other. Small, separate openings in the vertical bus barriers shall permit unit plug-in contacts to pass through and engage the vertical bus bars.

2. Bottom bus covers shall be provided below the vertical bus to protect the ends of this bus from contact with fish tapes or other items entering the bottom of the enclosure. Unused plug-in openings shall have plastic snap-in closing plates.

J. Unit Plug-In:

1. Unit plug-in contacts shall be provided for size l through size 5 motor starters and for branch circuit breakers.

2. The plug-in connection shall be 2-point connection for each phase designed to tighten during heavy current surge. The plug-in fingers shall be tin plated to yield a low resistance connection and shall be backed by spring steel clips to provide high-pressure connection points. Contact fingers shall be mounted in their support so these fingers become floating and self-aligning to allow solid seating onto the vertical bus bars.

K. Unit Doors:

1. Each unit shall have a door securely mounted with hinges, which allow the door to swing open a minimum of 112 degrees. Unit doors shall be fastened to the stationary structure so they can be closed to cover the unit space when the units have been temporarily removed. Unit doors shall be held closed with captive type screws, which engage self-aligning cage

nuts. These screws shall provide at least 2 threads of engagement to help hold unit doors closed under fault conditions. Removable door panels held captive type screws shall be provided on starter unit doors for mounting push buttons, selector switches or pilot lights. Blank door panels capable of accepting future push button devices shall be furnished when push button devices are not originally specified for starter units. Starter units shall have an external low profile overload reset button.

2. Pilot devices and instruments, including push buttons, reset buttons, and indicating lights, shall be flush mounted in the compartment doors. Equipment shall not be mounted on the rear of draw out units. All equipment within the unit shall be arranged to provide ample electrical clearances and easy access for maintenance. Draw out combination starter unit of a given type and size shall be made interchangeable. Only those items, which are common to all starters, shall be mounted in the unit.

3. Where a spare unit is indicated on the Drawings, it shall be a complete combination starter of the type and size shown.

L. Unit Support Pan:

1. Each plug-in unit shall be supported and guided by a tilt and lift-out removable pan so unit rearrangement is easily accomplished. For easy unit installation and rearrangement, transfer of this unit support pan from one location to another shall be accomplished without the use of tools after the unit and door have been removed.

M. Unit Saddles:

1. Each plug-in unit shall have a sheet steel saddle designed to physically isolate the unit from the bus compartment and adjacent units. Saddles shall be equipped with captive, self-aligning mounting screws, which hold the unit securely in place during shipment and maintain the unit and structure at the same potential. Handholds shall be provided on each plug-in unit to facilitate unit removal.

N. Disconnect Operator:

1. A flange mounted operator handle shall be supplied for each switch or breaker. To prevent false circuit indication, this mechanism shall be engaged with the switch or breaker at all times regardless of unit door position. The operator handle shall have a conventional up-down motion with the down position as "OFF." It shall be possible to lock this handle in the "OFF" position with up to three 3/8" diameter shackle padlocks. The operator handle shall be color coded to display red in the "ON" position and black in the "OFF" position.

2. The operator handle shall be interlocked with the unit door so the disconnect cannot be switched to the "ON" position unless the unit door is closed. It shall be possible to defeat this interlock by a deliberate act of an electrician should he desire to observe the operation of the operator handle assembly. This interlock shall also prevent opening the unit door, unless the disconnect is in the "OFF" position. A defeater for this action shall also be provided in the event an electrician must gain access to the unit without interrupting the service.

O. Starter Units:

1. Starter units shall be completely draw out Type B, sizes as indicated on the Drawings, so units may be withdrawn without disconnecting any wiring. Units over three space units high may be bolt-in type. A positive guidance system shall be provided to assure proper alignment of wedge-shaped power stabs in dead-front openings in vertical power bus. The screw racking mechanism shall serve as a mechanical advantage to the operator during unit insertion or removal. Stab-in power terminals shall be of a type that will increase contact pressure on short circuits.

2. All starter units shall be rated to withstand short circuits of 65,000 rms symmetrical amperes at 208 volts or as noted on the Drawings.

P. Thermal Magnetic Type Circuit Breakers:

1. Thermal magnetic circuit breakers shall have quick-make, quick-break mechanisms and shall visually indicate whether the breaker is closed, open or tripped.

2. All breakers shall have sufficient interrupting capacity to properly close against and interrupt instantaneously, without damage, the maximum short circuit current available at the breaker. Minimum interrupting capacity of breakers shall be 65,000 amps rms symmetrical at 208 volts.

3. Provide auxiliary contacts on the circuit breakers where indicated on the Drawings.

Q. Motor Circuit Protector Type Circuit Breakers:

1. Motor circuit protector type circuit breakers shall be used for all branch circuit breakers for motor circuits. Breakers shall be instantaneous trip, magnetic only type. Each breaker shall be furnished with a single magnetic trip adjustment, which simultaneously sets the magnetic trip level of all poles. Adjustment shall be continuous throughout the trip range. Minimum interrupting capacity of breakers shall be 65,000 amps rms symmetrical at 208 volts.

2. Provide auxiliary contacts on the circuit breakers where indicated on the Drawings.

R. AC Magnetic Starters - Line Voltage Type:

1. Motor starters shall be across-the-line magnetic type, rated in accordance with NEMA standards, sizes and horsepower ratings. Starter sizes shall be as indicated on the Drawings.

2. Across-the-line magnetic starters shall be equipped with double-break, silver alloy contacts. All contacts shall be replaceable without removing power wiring or removing starter from panel.

3. Coils shall be of molded construction and shall operate on 120 volts AC. All coils shall be replaceable from the front without removing the starter from the panel.

4. Overload relays shall be solid state electronic type. Thermal units shall be one-piece construction and interchangeable. The starter shall be inoperative if the thermal unit is removed.

S. Control Transformers:

1. Provide a control transformer for each motor starter control circuit as indicated on the Drawings. Control transformers for individual control circuits shall be 208 volts to 120 volts and shall be protected according to code. Size shall be as required plus 50VA spare capacity. Primary fuses shall be Class "CC".

T. Relays:

1. Relays shall be heavy-duty general-purpose type with 10 amp contacts. Relays shall have terminals, which plug-in to a socket, mounted to the inside of the MCC bucket. Contact configuration shall be 3PDT.

2. Relay coils shall operate on 120 volts AC, unless indicated otherwise on the Drawings. Relays shall have an indicator light to indicate the relay coil is energized.

U. Selector Switches:

1. Selector switches shall be non-illuminated. Switches shall be 30.5 mm, heavy-duty, oil tight. Switches shall have double-break silver contacts. All switches shall be maintained contact type unless otherwise indicated on Drawings.

2. Provide auxiliary contact blocks as indicated on the Drawings, or in the Description of Operation.

V. Push Buttons:

1. Push buttons shall be non-illuminated. They shall be 30.5 mm, heavy-duty, oil tight. Contacts rated for 10 amps minimum. Push buttons shall be momentary contact type unless noted otherwise on the Drawings.

W. Pilot Lights:

1. Pilot lights shall be LED, push to test, transformer type. They shall be 30.5 mm, heavy-duty, oil tight. Voltage rating shall be 120 volts. Color caps shall be green for "run", and red for "alarm".

X. Elapsed Time Meters:

1. Elapsed time meters shall be time totalizer, non-resettable. They shall have a synchronous motor, which shall drive a set of digit readout wheels to indicate the total time the unit is energized. Readout shall be five-digit including 1/10 digit. Range shall be 0 to 9999.9 hours. Voltage rating shall be 120 volts. Elapsed time meters shall be ENM Company Series T50.

Y. Legend Plates:

1. Provide an engraved legend plate for each pilot device. Engraving shall be as indicated on the Drawings.

Z. Identification:

1. A control center identification number nameplate describing section catalog numbers and characteristics shall be fastened on the vertical wire trough door of every section. Each control center unit shall have its own identification number nameplate giving unit catalog number fastened to the unit saddle near the upper left-hand corner. These nameplates shall also have suitable references to factory records for efficient communication with supplier.

2. Each control center unit shall also have an engraved Bakelite nameplate fastened to the outside of each unit door. Nameplates shall be black with white engraving.

AA. Wiring:

1. The motor control center shall be wired in accordance with NEMA class and type previously specified and shall be furnished to be interconnected with a programmable controller system.

2. All 120 VAC control wiring shall be red. All 24vdc control wiring, and wiring for 24vdc PLC inputs shall be blue. All wiring in each MCC cubicle shall be labeled.

3. Quick separating, pull apart terminals shall be mounted on lift-out brackets in the units. All terminals shall be labeled.

BB. Finish:

1. All painted parts shall undergo a phosphatizing pre-painting treatment for rust resistance and good paint bond. All painting shall be with enamel, which shall be baked for a durable, hard finish. Unit saddles shall be painted white for easy interior visibility. Removable push button plates, flange mounted operator handles and trim plates, and top horizontal wire trough cover plates shall be painted a contrasting charcoal gray. Other painted parts shall be painted ANSI-49 medium light gray.

2. All unpainted parts shall be plated for resistance to corrosion.

2.02 SPARE PARTS

A. Provide the following spare parts for the motor control centers:

1. Two (2) Relays for each type utilized
2. Six (6) Fuses for each size and type utilized
3. Six (6) pilot light bulbs with special tool to remove bulb

B. Spare parts shall be packaged individually in boxes that are clearly labeled with part name and manufacturer's part/stock number.

PART 3 - EXECUTION

3.01 FIELD SERVICES

A. Start-up and Testing:

1. Test the operation of each motor starter and all MCC controls.
2. All start-up and testing shall be performed in the presence of the Owner and the Engineer.

B. Training:

1. Provide two (2) hours of training on the motor control center. Training shall include theory of operation, maintenance and troubleshooting procedures.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 17110

VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Furnish and install the following variable frequency AC drives as shown on the Drawings and specified herein:

   a. Three (3) Sewage Pump VFDs

2. The variable frequency drives shall be free-standing drives, as shown on the Drawings.

B. Special Requirements:

1. The variable frequency drives shall be furnished by the Process Control System Supplier, who shall be responsible for coordinating the drive start/stop and speed controls.

1.02 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

ANSI	American National Standards Institute
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
UL	Underwriters Laboratories, Inc.

B. Quality Control:

1. All variable frequency drives shall be new and limited to products regularly produced and recommended for service ratings in accordance with engineering data or other comprehensive literature. In all cases where device, or devices, or part of equipment is herein referred to in singular, reference shall apply to as many items as required to complete installation.

2. The drives shall be built to applicable NEMA standards and be suitable for use as a component to meet NEC requirements. Drives shall be listed by Underwriters Laboratories (UL).

3. All incoming material shall be inspected and/or tested for conformance to quality assurance specifications. All chips (CMOS, TTL, LINEAR, etc.) shall be functionally tested.

4. All subassemblies shall be inspected and/or tested for conformance to vendor's engineering and quality assurance specifications.

5. All drives shall be burned-in at the factory, cycling load to simulate no load/full load and exercise drive power components.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit in accordance with the requirements of Section 17010. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings, integral controls, elevations, and sections. Shop drawings shall include manufacturer's literature and complete information on the following:

a. Variable Frequency Drives
b. Drive Enclosure
c. Drive Disconnect Switch
d. Line Reactors
e. Passive Harmonic Filters
f. Control Transformers
g. Selector Switches
h. Pilot Lights
i. Elapsed Time Meters
j. Relays
k. Panel Layout Drawings
l. Wiring Diagrams

2. The VFD wiring diagrams shall be customized for this project. Standard drawings will not be accepted.

1.04 MANUFACTURER

A. The Variable Frequency Drives shall be Allen-Bradley Power Flex 755.

1.05 WARRANTY

A. Provide a two (2) year warranty on each variable frequency drive. The warranty shall include parts and labor, and shall start on the date that the drive is started up by an authorized field service representative from the VFD manufacturer.

PART 2 - PRODUCTS

2.01 VARIABLE FREQUENCY DRIVES

A. General:

1. The variable frequency drives shall convert a fixed frequency, three phase input power to an adjustable AC frequency and voltage source for controlling the speed of a standard, NEMA Design B, AC induction motor.

2. The drives shall be fully digital, microprocessor controlled and shall incorporate a diode bridge rectifier and a transistorized inverter section. IGBT type power transistor modules shall be utilized in the inverter section to invert a fixed DC bus voltage to a symmetrical three-phase pulse-width modulated (PWM) output voltage.

3. The drives shall accept incoming 208 VAC, 60 Hz line power, and shall not be affected by voltage fluctuations of ± 10% or frequency fluctuations of ± 2%. The drive shall include phase-to-phase and phase-to-ground protection, and transient voltage surge protection.

4. Each variable frequency drive shall be designed to operate a 208 volt, 3 phase, AC induction motor in an ambient temperature of 32 to 104°F. The drive output amp rating shall exceed the motor nameplate FLA rating. Refer to the Drawings for the motor hp and the specifications for the motor RPM.

B. Drive Enclosure:

1. The variable frequency drives shall be free-standing enclosures as shown on the Drawings. Provide ventilation fans and louvers as required to dissipate the heat generated by the drive.

C. Drive Operating Characteristics:

1. The drive operation shall be fully digital with microprocessor control of frequency, voltage and current. All drive set-up operations and adjustment shall be digital and stored in a non-volatile memory (EEPROM).

2. To control the rate of change of output frequency for a step change in input reference, the drive shall have two independently adjustable acceleration and deceleration rates.

3. The drive shall have a foldback current limiting circuit. During acceleration, the circuit shall automatically reduce the acceleration rate to a slower rate should the load inertia cause excessive currents.

4. The drive shall have a selectable deceleration voltage limiting circuit. The circuit shall extend the set deceleration ramp should the bus voltage approach high limits due to regeneration.

5. The drive output frequency shall be adjustable from 0-60 Hz.

6. The drive shall have a fully programmable volts per hertz ratio.

7. The drive shall maintain set frequency to within 0.6 Hz during power line fluctuations.

8. The drive speed reference signal shall be a 4-20mA analog signal output from the PLC, or a signal received from the VFD keypad module.

9. The drive shall be capable of maintaining 100% of rated output current continuously, and shall be capable of delivering 110% of rated output current for up to one minute.

10. The drive shall be capable of restoring motor operation after a 0.5 second line loss without shutting down on a fault.

11. The drive input circuitry shall not generate line notches or large voltage transients on the incoming line.

12. The drive shall present a displacement power factor of 0.95 or better to the AC line at any speed or load.

13. The drive efficiency at rated load and frequency shall be 96% or better.

D. Drive Controls:

1. Each variable frequency drive shall be furnished with start/stop controls and speed controls as indicated on the Drawings and in the Description of Operation.

E. VFD Keypad Module:

1. A keypad module shall be mounted on the VFD enclosure door for digital set-up of the drive, drive parameter review and drive fault annunciation. The module shall have an LCD display and a digital speed pot for local control of the drive speed.

F. Drive Protection and Diagnostics:

1. Each variable frequency drive shall incorporate internal diagnostic and fault sensing circuits as an integral part of the drive. The following drive protection functions shall be monitored:

   a. Momentary Overload Protection - Adjustable from 20 to 110% of Drive Rating
   b. Motor Overload Protection
   c. Undervoltage Sensing
   d. Overvoltage Sensing
   e. Phase Protection
   f. Drive Overtemperature
   g. Ground Fault Detection

2. Each of the above fault conditions shall be annunciated on the VFD keypad, and shall shut down the drive.

2.02 DRIVE CONTROL COMPONENTS

A. Line Reactors:

1. Provide line reactors where indicated on the Drawings to eliminate nuisance overvoltage tripping and to reduce harmonic distortion. The line reactors shall be iron core, 5% impedence, Class H insulation, 115ºC rise, copper wound. The line reactors shall be sized for the motor horsepower and shall be manufactured by TCI.

B. Passive Harmonic Filters:

1. Provide a passive harmonic filter for each high service pump VFD. The harmonic filters and all associated components shall be designed, manufactured and tested in accordance with the latest applicable NEMA, IEEE, and ANSI standards.

2. The passive harmonic filter shall be designed to filter all characteristically low harmonics (5^{th}, 7^{th}, 11^{th}, 13^{th}, etc.) generated from three phase diode loads such as variable frequency drives (VFDs), while improving power factor.

3. The filter shall consist of inductive elements in series with the load and an inductive-capacitive network in parallel with the load (shunt). The shunt load shall be tuned to 4.7 times the fundamental frequency.

4. The filter shall not adversely react with or resonate with the power system or attract harmonics from other sources.

5. The filter shunt circuit shall be protected by field replaceable fuses on each phase to ensure the VFD remains operational in the event of a capacitor over current or other condition causing the fuses to open.

6. The filter shall have a fuse monitor to provide status of the fuse via a NO or NC dry contact.

7. The Total Demand Distortion (TDD) of the current at the input terminals of the filter, in combination with the variable frequency drive, shall not exceed 5% THID at full rated load.

8. The Total Harmonic Voltage Distortion (THVD) at the input terminals of the filter in combination with the variable frequency drive shall not exceed the limits defined in Table 10-2 of IEEE-519.

9. The full load efficiency of the filter shall be not less than 98.5%.

10. The filter shall be compatible with engine generators.

11. The filter shall have a SCCR rating of 100kA per UL-508A.

12. The voltage regulation at the VFD terminals and attributable to the filter shall not exceed 5%.

13. The filter shall suppress characteristic harmonics without the requirement to phase shift against other harmonic sources or without the need for individual tuning.

14. The passive harmonic filter shall be sized for the motor horsepower and shall be manufactured by TCI.

C. Control Transformers:

1. Provide a control power transformer for each drive control circuit. Control transformers shall be 208 volts to 120 volts and shall be protected with primary and secondary fuses.

D. Selector Switches:

1. Selector switches shall be non-illuminated. Switches shall be 30.5 mm, heavy-duty, oil tight. Switches shall have double-break silver contacts. All switches shall be maintained contact type unless otherwise indicated on the Drawings. Provide auxiliary contact blocks as indicated on the Drawings or in the Description of Operation. Provide a legend plate for each switch with white engraving as indicated on the Drawings. Selector switches shall be Allen-Bradley Bulletin 800T, NEMA Type 4/13, or equal by Square D.

E. Pilot Lights:

1. Pilot lights shall be 30.5mm, heavy-duty, push to test, transformer type with LED lamps. Voltage rating shall be 120 volts. Color cap shall be green

for "run" and red for “VFD fault". Provide a legend plate for each pilot light with white engraving as indicated on the Drawings. Pilot lights shall be Allen-Bradley Bulletin 800T, NEMA Type 4/13, or equal by Square D.

F. Relays:

1. Relays shall be heavy-duty general-purpose type with 10 amp contacts. Relays shall have terminals, which plug-in to a socket, mounted to the inside of the drive enclosure. Contact configuration shall be 3PDT. Relay coils shall operate on 120 volts AC, unless indicated otherwise on the Drawings. Relays shall have an indicator light to indicate the relay coil is energized.

G. Elapsed Time Meters:

1. Elapsed time meters shall be time totalizer, non-resettable. They shall have a synchronous motor, which shall drive a set of digit readout wheels to indicate the total time the unit is energized. Readout shall be five-digit including 1/10 digit. Range shall be 0 to 9999.9 hours. Voltage rating shall be 120 volts. Elapsed time meters shall be ENM Company Series T50, or equal.

H. Control Wiring:

1. All 120 VAC control wiring shall be red. All 24vdc control wiring, and wiring for 24vdc PLC inputs, shall be blue. All wiring in the VFD shall be labeled.

I. Control Terminal Block:

1. Provide a control terminal block in the VFD enclosure, to terminate all control wiring from the field. All terminals shall be labeled.

2.03 SPARE PARTS

A. Provide the following spare parts for the variable frequency drives furnished:

1. One (1) VFD for each size furnished
2. One (1) ventilation fan for each size furnished
3. Four (4) sets of fan filters for each type utilized
4. Six (6) Fuses for each size and type utilized

B. Spare parts shall be packaged individually in boxes that are clearly labeled with part name and manufacturer's part number.

PART 3 - EXECUTION

3.01 FIELD SERVICES

A. Start-up and Testing:

1. Provide the services of a manufacturer's representative to start-up, adjust and test each variable frequency drive. Demonstrate start/stop control, fault diagnostics and variation of motor speeds in response to both the manual and automatic variable speed controls.

2. All start-up and testing shall be performed in the presence of the Owner and the Engineer.

B. Training:

1. Provide two (2) hours of on-site training for the Owner on the variable frequency drives. Training shall be specific for the VFDs provided and shall include theory of operation, maintenance and troubleshooting procedures. All training shall be performed by a qualified training specialist from the VFD manufacturer.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 17200

CONTROL PANELS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Furnish and install a Pump Station Control Panel for control of the sewage pumps and pump station equipment.

2. The control panel shall be provided by the Pump Control System Supplier and shall be complete, and include all components and wiring as shown on the Drawings and specified herein.

1.02 QUALITY ASSURANCE

A. Regulations and Standards:

ANSI	American National Standards Institute
IEEE	Institute of Electrical and Electronic Engineers
ISA	International Society of Automation
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
UL	Underwriters' Laboratories

B. The control panel components shall be of the most current and proven design. Specifications and Drawings call attention to certain features but do not purport to cover all details entering into the design of the control panels. The components provided by the System Supplier shall be compatible with the functions required and shall form a complete working system.

C. The control panels shall be UL listed as a complete assembly in accordance with UL-508.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings on the control panels in accordance with the requirements of Section 17010. Shop drawings shall be complete in all respects and shall include a complete bill of material, catalog information, descriptive literature of all components, UPS load study, wiring diagrams, and panel layout drawings showing dimensions to all devices.

PART 2 - PRODUCTS

2.01 CONTROL PANEL COMPONENTS

A. Control Panel Enclosure:

1. The control panel enclosure shall be designed and sized in accordance with the requirements of the Drawings and as specified herein. Control panel enclosures shall be manufactured by Hoffman, or equal.

2. Steel control panel enclosures shall be NEMA 12, constructed of 10 gauge steel with continuously welded seams. Panel shall have piano type hinged, overlapping doors with neoprene gasket. Enclosure doors shall be equipped with a heavy-duty 3-point latching mechanism operated by a padlocking handle. Following fabrication, the control panel shall be degreased, cleaned and treated with a phosphatizing process, then primed and painted inside and out with an industrial grade enamel. The inside of the control panel shall be painted white. The exterior color shall be gray.

3. The control panel components shall be properly identified with an engraved nameplate mounted on the inside of the panel. All components not mounted on the front of the panel shall be mounted to a subpanel. All wiring shall be installed in a neat, workmanlike manner and shall be grouped, bundled, supported and routed horizontally and vertically to provide a neat appearance. All wires leaving the panel shall be terminated at the terminal strips inside the enclosure. Terminals and wires shall be identified in accordance with the Supplier's panel wiring diagrams.

4. Provide a copper grounding plate inside the control panel for terminating all ground wires.

5. Provide a plastic data pocket inside each control panel.

B. Enclosure Light Fixture:

1. Provide an LED light fixture in control panels where indicated on the Drawings to illuminate the enclosure. The light fixture shall have a low profile design with a non-yellowing lens cover and a manual switch. The light fixture shall be Hoffman, or Phoenix Contact.

C. Control Circuit Breakers:

1. Circuit breakers shall be quick-make, quick-break thermal magnetic molded case type, individually mounted and identified. Circuit breakers shall be Allen-Bradley Bulletin 1492-CB, or equal.

D. Surge Protection Devices:

1. Provide a 120 volt, 1 phase transient voltage surge suppressor in control panels where indicated on the Drawings to protect the panel components from damage which may occur from transient overvoltages caused by lightning or surges on the incoming power line.

2. The surge protection device shall have an indication light and an alarm contact to indicate if the unit has failed.

3. Surge protection devices shall be Phoenix Contact PLT-SEC-T3-120-FM.

E. Uninterruptible Power Supply (UPS):

1. Provide a UPS in control panels where indicated on the Drawings to power the equipment in the panel. The UPS shall provide lightning and surge protection, spike attenuation, galvanic isolation, noise isolation, and a regulated 120 volt, 1-phase power supply. The power output shall be continuous with no interruptions.

2. The UPS shall be sized by the System Supplier based on the maximum power requirements of the control panel and for a minimum run time of 10 minutes. The UPS shall be furnished with two (2) alarm contacts to indicate when the UPS is operating on battery power and when the UPS battery needs replaced.

3. The UPS shall be APC, Eaton, or equal.

F. 24 Volt DC Power Supplies:

1. 24 volt DC power supplies shall be mounted in control panels, where indicated on the Drawings, to supply 24 volt DC power for the PLC inputs, Ethernet switch, and for the 2-wire instrumentation.

2. The power supplies shall be wired in parallel with a redundancy module. The power supplies shall be sized as required for the load being powered.

3. Each power supply shall be furnished with a normally open contact that closes when the power supply is operating and the DC power is ok. This contact shall be wired to the PLC System.

4. The 24 volt DC power supplies shall be Phoenix Contact Quint4 with a Quint-Oring redundancy module.

G. Selector Switches:

1. Selector switches shall be 30.5mm, heavy-duty, non-illuminated. Switches shall have double-break silver contacts. Switches shall be maintained contact type unless otherwise indicated on the Drawings. Provide auxiliary contact blocks on switches where indicated on the Drawings or in the Description of Operation. Provide a legend plate for each switch with white marking as indicated on the Drawings. Selector switches shall be Allen-Bradley Bulletin 800H, NEMA 4X.

H. Push Buttons:

1. Push buttons shall be 30.5mm, heavy-duty, non-illuminated. Push buttons shall have double-break silver contacts. Push buttons shall be momentary contact type, color-coded as indicated on the Drawings. Push buttons shall have flush heads. Provide a gray legend plate for

each push button with white marking as indicated on the Drawings. Push buttons shall be Allen-Bradley Bulletin 800H, NEMA 4X.

I. Pilot Lights:

1. Pilot lights shall be 30.5mm, heavy-duty, push to test, transformer type with LED lamps. Voltage rating shall be 120 volts. Lens color shall be as indicated on the Drawings. Provide a gray legend plate for each pilot light with white engraving as indicated on the Drawings. Pilot lights shall be Allen-Bradley Bulletin 800H, NEMA 4X.

J. Relays:

1. Relays shall be heavy-duty general-purpose type with 10 amp contacts. Relays shall have terminals, which plug-in to a socket, mounted to the inside of the panel enclosure. Terminals for relays having AC coils shall be pin type, and terminals for relays having DC coils shall be blade type. Contact configuration shall be 3PDT.

2. Relay coils shall operate on 120 volts AC, unless indicated otherwise on the Drawings. Relays shall have an indicator light to indicate the relay coil is energized. Relays shall be Idec RR Series, or equal.

K. Intrinsically Safe Relays:

1. Provide an intrinsically safe relays in control panels where indicated on the Drawings.

2. The intrinsically safe relays shall be a single channel repeater with a DPDT set of output contacts and shall operate on 120 volts AC.

3. The intrinsically safe relays shall be Stahl I.S. Isolators Type 9170, or equal.

L. Intrinsically Safe Barriers:

1. Provide an intrinsically safe barrier in the control panel for the signal cable from the wet well level transducer. The intrinsically safe barrier shall be Stahl, or equal.

M. Fuses:

1. All fuses shall be sized as required for the circuit they are protecting. Fuses shall be Bussmann, touch-safe type, or equal.

N. Terminal Blocks:

1. Terminal blocks shall be provided in each control panel for terminating field wiring. All terminal blocks shall be rated for 600 volts AC, and shall be identified with a permanent machine printed marking in accordance with the terminal numbers shown on the panel wiring diagrams.

2. Terminal blocks for 24vdc inputs shall be blue.

3. Provide 20% spare terminal blocks in the control panel.

4. Terminal blocks shall be Allen-Bradley Bulletin 1492-W4, or equal.

O. Wiring:

1. All wiring shall be stranded copper. Control wiring shall be 16 gauge, 600 volt, Type MTW. Power wiring shall be 600 volt, Type MTW, sized as required.

2. All analog signal wiring shall be 18 gauge twisted pairs with foil shield and drain wire, with 300 volt, 90°C insulation. Drain wires shall be grounded at one end only.

3. All wiring and terminal strips shall be isolated by voltage levels to the greatest extent possible.

4. All wiring shall conform to the following color code:

a. 120 volt, 1 phase: Black, White

b. 24vdc: Blue

c. 120 VAC Control Wires: Red

d. Ground Wires: Green

5. 120 VAC control wires energized from a source external to the control panel power source shall be yellow.

6. Wiring for intrinsically safe circuits shall be purple.

7. All control wiring shall be tagged at each end with a legible permanent coded wire-marking sleeve. Sleeves shall be white PVC tubing with machine printed black marking. Markings shall be in accordance with the wire numbers shown on the control wiring diagrams, and shall match terminal strip numbers.

P. Nameplates:

1. Provide laminated phenolic nameplates on the front of the control panel. Nameplates shall be black with white engraved letters. Engraving shall be as indicated on the Drawings. Minimum size of engraving shall be 1/4".

2.02 SPARE PARTS

A. Provide the following spare parts for the control panel:

1. One (1) 24 volt DC power supply for each size utilized
2. Two (2) general purpose relays for each type utilized
3. Six (6) fuses for each type and size utilized

B. Spare parts shall be packaged individually in boxes that are clearly labeled with part name and manufacturer's part/stock number.

PART 3 - EXECUTION

3.01 FIELD SERVICES

A. Start-up and Testing:

1. Test the operation of the control panel and all controls.

2. Start-up each control panel and place the control panel into operation.

3. All start-up and testing shall be performed in the presence of the Owner and the Engineer.

END OF SECTION

SECTION 17300

INSTRUMENTATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Furnish and install all instrumentation and provide services as specified herein or as indicated on the Drawings. Instrumentation shall be provided by the Pump Control System Supplier.

1.02 QUALITY ASSURANCE

A. Regulations and Standards:

UL	Underwriters' Laboratories
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
ANSI	American National Standards Institute
IEEE	Institute of Electrical and Electronic Engineers
ISA	International Society of Automation

B. All instrumentation equipment supplied shall be of the most current and proven design. Specifications and drawings call attention to certain features but do not purport to cover all details entering into the design of the instrumentation equipment. The equipment provided by the System Supplier shall be compatible with the functions required for the Pump Control System.

C. All necessary fuses and cables required for instrumentation equipment shall be provided with the equipment.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings on all instrumentation in accordance with the requirements of Section 17010. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings, integral controls and types of materials, elevations, and sections. Submittals shall include a complete bill of material, catalog information, descriptive literature of all components and wiring diagrams.

PART 2 - PRODUCTS

2.01 INSTRUMENTATION

A. Wet Well Submersible Level Transducer:

1. The wet well submersible level transducer shall be an industrial submersible pressure transducer, submerged in the wet well to sense the sewage level in the wet well. The transducer shall be furnished with an integral signal cable with a molded cable seal.

2. The transducer shall have a weatherproof housing constructed of 316 stainless steel. The transducer shall have a 2.75" sensing area and an integral diaphragm protector.

3. The transducer shall be designed for installation in a Class 1, Division 1, Group C and D hazardous location.

4. The transducer cable shall be a polyethylene jacketed shielded cable. Length of cable shall be as required for transducer installation. Provide a stainless steel cable hanger to support the cable.

5. The pressure transducer shall be a 2-wire device with dc power being provided from the Pump Station Control Panel. The transducer shall output a 4-20mA dc signal, which is proportional to the wet well level.

6. The level transducer shall be factory calibrated for the range indicated on the schedule below. Provide an aneroid bellows and lightning arrestor for each transducer.

7. The transducer shall operate in a temperature range of -20°C to +60°C.

8. The transducer accuracy shall be ±0.25% of the full-scale range.

9. The wet well level transducers shall be KPSI Series 750.

SCHEDULE OF SUBMERSIBLE LEVEL TRANSDUCERS

Location	Range	Service
Wet Well	0 - 12 feet	Wet Well Level

B. Magnetic Flow Meters:

1. Magnetic flow meters shall be of the low frequency and short form characterized coil design. The characterized field principle of electro-magnetic induction shall produce a positive DC pulsed signal directly and linearly proportional to the flow rate.

2. The metering tube shall be constructed of Type 304 stainless steel. The meter body shall be carbon steel. The flow meter shall have a flanged body to fit between ANSI Class 150 pipe flanges. The flow meter shall have a polyurethane liner and Type 316 stainless steel electrodes. The electrodes shall be bullet nose type. Liners and electrodes shall be suitable for municipal sewage. Provide all required mounting hardware, stainless steel grounding rings and grounding straps for the installation of the magnetic flow meter.

3. The coils, which generate the field, shall be inside the pipe wall and shall be encapsulated in epoxy resin and encased behind the meter lining material. The ratio of flow velocity to reference voltage signals generated shall be compatible with the readout instrument without the necessity of circuit modifications. The meter shall have an average power consumption of 60 watts. Accuracy of the meter shall be ±0.5% of rate.

4. The meter housing shall be splash-proof and weather resistant design. The meter shall be capable of accidental submergence in up to 30 feet of water for up to 48 hours without damage to the electronics.

5. Complete zero stability shall be inherent characteristic of the meter system. This shall eliminate the requirement for valving downstream of the meter for creating a full pipe zero flow condition for calibration purposes. Meter systems requiring field zero adjustment will not be acceptable.

6. The magnetic flow meters shall be factory calibrated on an approved test stand with certified accuracy traceable to NIST, compliant with the ISO 17025 standard, and third party accreditation by a national verification agency such as A2LA. Calibration curves shall be submitted for each flow meter for 3 points within the specified flow range.

7. The flow meter shall have a remote mounted microprocessor based, NEMA 4X flow transmitter. The flow transmitter shall have an LCD display to indicate the flow rate. The transmitter shall convert the meter's DC pulsed signal to a linear 4-20mA dc signal which is proportional to the flow rate.

8. The flow transmitter shall operate on a 120 volt AC, 60 Hz power source and shall have RFI protection. Provide signal cables to connect the flow transmitter to the flow meter. Length of cable shall be as required for the installation (See Electrical Drawings).

9. The Magnetic Flow Meters shall be Endress & Hauser Promag 400, or Rosemount Model 8750WA.

SCHEDULE OF MAGNETIC FLOW METERS

Size	Flow Range	Location	Service
12"	0 – 3000 GPM	Meter Pit	Pump Station Flow

C. Float Switches:

1. Each float switch shall consist of a single pole, mercury switch in a smooth, chemical resistant polypropylene casing with integral 2-wire cable. The mercury switch shall be furnished in a normally open configuration and shall be permanently molded to the signal cable at the factory.

2. Signal cable shall be minimum #18 AWG. Length of cable shall be as indicated on schedule below.

3. Specific gravity of sensors shall be 0.95-1.10. Sensors shall remain operable at temperature down to 0°C and up to 90°C. Mercury switch contacts shall operate on 24 volts DC.

4. Provide a 316 stainless steel mounting bracket for the wet well float switches.

5. The float switches shall be Anchor Scientific Roto-Float.

SCHEDULE OF FLOAT SWITCHES

Qty.	Type	Cable Length	Mounting Bracket	Service
5	S	40 feet	WMS-5	Wet Well Level

2.02 INSTRUMENT NAMEPLATES

A. Provide a laminated phenolic nameplate for each instrument. The nameplates shall be black with white engraved letters, and they shall be mounted on the front of each instrument or instrument enclosure, or where applicable attached to the instrument with a plastic wire tie. An instrument nameplate schedule shall be submitted to the Engineer for approval prior to performing any engraving.

PART 3 - EXECUTION

3.01 INSTALLATION ASSISTANCE AND INSPECTION

A. Provide the services of manufacturer's service representatives to assist in installation for all instrumentation specified herein.

B. Each manufacturer's representative shall inspect the installation of each of their instruments, and shall issue an installation certificate to the Owner and the Engineer for each instrument certifying that the instrument has been installed in accordance with the manufacturer's recommendations.

3.02 CALIBRATION

A. Provide the services of manufacturer's service representatives to calibrate all instrumentation provided. All calibration shall be performed in the presence of the Owner and the Engineer. The calibration of each instrument shall be performed after the instrument installation certificate has been issued.

B. Each manufacturer's representative shall issue a calibration certificate to the Owner and the Engineer for each instrument certifying that the instrument has been calibrated and is ready to be placed into service. The calibration certificates shall indicate the calibrated range or setpoint for each instrument.

3.03 PROGRAMMING

A. Program the automatic telephone dialer to provide alarm notification for the pump station alarms.

B. Test all pump station alarms to demonstrate that the dialer calls out when each alarm occurs.

3.04 TRAINING

A. Provide four (4) hours of training on the instrumentation provided.

B. All training shall be performed by a representative from the manufacturer and shall be specific to the instruments provided. Training shall include theory of operation, maintenance requirements, calibration methods and function of instrument in the Pump Control System.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 17400

PROGRAMMABLE CONTROLLER SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Furnish all labor and materials required for a complete programmable controller system consisting of a programmable controller, I/O modules, operator interface terminal, power supplies, Ethernet switch, power and communication cables, software packages, software programming, and all other associated equipment as specified herein and as indicated on the Drawings.

B. System Configuration:

1. The system shall be configured as shown on the Pump Control System Drawings and as described in the Description of Operation.

C. Description of Operation:

1. The Description of Operation for this project is contained in Section 17500. All system configuration and programming shall be performed to meet the requirements of this description.

1.02 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

ANSI	American National Standards Institute
IEEE	Institute of Electrical and Electronic Engineers
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association

B. Quality Control:

1. All equipment and software supplied shall be of the most current and proven design. The Specifications and Drawings call attention to certain features but do not purport to cover all details entering into the design of the programmable controller system. The completed system and the equipment provided shall be compatible with the functions required and shall be a complete working system.

C. Manufacturer:

1. The programmable controller system shall be manufactured by Allen-Bradley. All model numbers shown on the Drawings are Allen-Bradley numbers.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings on each of the items listed below in accordance with the requirements of Section 17010. Shop drawings shall be complete in all respects, and shall include a complete bill of material, catalog information, descriptive literature of all components, and applicable wiring diagrams.

a. Programmable Controller
b. Programmable Controller Power Supply
c. Input and Output Modules
d. Operator Interface Terminal
e. Ethernet Switch
f. Power and Communication Cables
g. Programming Software
h. System Programming
i. Operator Interface Screens

1.04 MEETINGS

A. Operator Interface Meeting:

1. The System Supplier shall attend and participate in one (1) meeting with the Engineer and the Owner to discuss the layout, color conventions, and control strategies for the operator interface screens. This meeting will be held at Washington County.

PART 2 - PRODUCTS

2.01 SYSTEM HARDWARE

A. Programmable Controller:

1. Provide an Allen-Bradley CompactLogix 1769-L33ER programmable controller in the Pump Station Control Panel as indicated on the Drawings. The programmable controller shall be mounted with input and output (I/O) modules as shown on the Drawings.

2. The programmable controller shall be furnished with 2MB of user memory, and a Secure Digital (SD) flash memory card. The PLC program shall be stored on the Secure Digital card.

B. Programmable Controller Power Supply:

1. Provide an Allen-Bradley power supply for the programmable controller. The power supply shall be sized as required for the power consumption of the system.

C. Operator Interface Terminal:

1. A programmable operator interface terminal shall be flush mounted in the Pump Station Control Panel to display graphic displays, alarm messages and process values, and to provide an interface for the operator to change process setpoints.

2. The operator interface shall have a 12.1" TFT color touch screen and shall have a NEMA 4X rating.

3. The operator interface shall be networked to the PLC via Ethernet. The operator interface shall be furnished with enough memory to meet the requirements of the Description of Operation plus 20 percent spare memory.

4. The operator interface terminal shall operate on 120 VAC power.

5. The operator interface terminal shall be Allen-Bradley PanelView Plus 7 1250 Touch.

D. Ethernet Switch:

1. Provide an industrial Ethernet switch in the Pump Station Control Panel to network the PLC and the operator interface terminal.

2. The Ethernet switch shall be a stand-alone unit operating on 24vdc power.

3. The Ethernet switch shall be Stratix, Moxa or N-tron.

2.02 COMMUNICATIONS CABLES

A. Ethernet Cable:

1. Provide Cat 6 Ethernet cable to network the PLC and operator interface terminal to the Ethernet switch.

2.03 PROGRAMMING SOFTWARE

A. Programmable Controller Programming and Documentation Software:

1. Provide a windows based programming and documentation software package for programming the Allen-Bradley programmable controller using a personal computer as a programming terminal. This software package shall be utilized by the System Supplier to program the programmable controller.

2. The programming and documentation software shall be Rockwell Software RSLogix Studio 5000, Professional Edition.

3. At the completion of the project, the PLC firmware and software shall be upgraded to the latest version.

4. The programming software, and all licenses, shall be turned over to the Owner at the completion of the project.

B. Operator Interface Programming Software:

1. Provide a windows based programming software package to program the operator interface using a personal computer. The operator interface shall be programmed by the System Supplier in accordance with the requirements of the Description of Operation.

2. The programming software shall be Rockwell Software Factory Talk View Machine Edition.

3. At the completion of the project, the operator interface software shall be upgraded to the latest version.

4. The programming software, and all licenses, shall be turned over to the Owner at the completion of the project.

2.04 SPARE PARTS

A. Provide the following spare parts for the programmable controller system:

1. One (1) Programmable Controller
2. One (1) Programmable Controller Power Supply
3. One (1) 16 Point 24vdc Input Module
4. One (1) 8 Point 24vdc Output Module
5. One (1) 8 Point Analog Input Module
6. One (1) 8 Point Analog Output Module
7. Six (6) fuses for each type and size utilized

B. Spare parts shall be packaged individually in boxes that are clearly labeled with part name and manufacturer's part/stock number.

PART 3 - EXECUTION

3.01 SOFTWARE PROGRAMMING

A. PLC Programming:

1. Program the PLC to meet the requirements of the Description of Operation.

2. All programming shall be annotated and documented with rung numbers, descriptive comments and I/O identification comments. The beginning of each major sub-system shall be identified in the PLC program.

B. Operator Interface Programming:

1. General:

a. Program each operator interface terminal to meet the requirements of the Description of Operation. All programming and graphic screen development shall be performed as required for a complete and operational system.

2. Graphic Displays:

a. Dynamic graphic displays shall be programmed in each operator interface for the process equipment and its associated control strategies. The graphic displays shall be interactive with live data from the PLC.

b. The graphic displays shall include all digital and analog points being monitored by the PLC system.

c. The graphic displays shall indicate the auto/manual status, run status and alarms for all system equipment.

d. The graphic displays shall allow the pump station operator to set and adjust all process setpoints, and timer settings for control of the system equipment.

e. The configuration of each graphic screen shall be reviewed with and approved by the Owner and the Engineer.

3. Alarms:

a. All alarms shall be displayed on the alarm display screen on the operator interface.

4. Monitoring of Process Variables:

a. All process variables being monitored by the PLC System shall be displayed by the operator interface.

3.02 TESTING

A. Field Testing:

1. Test the operation of each PLC I/O point after the PLC System is installed.

2. Analog points shall be tested using a signal generator. Each point shall be tested at 0, 25, 50, 75 and 100% of its full scale range.

3. Test the operation of each graphic screen programmed in the operator interface to verify the digital and analog points display correctly on the screen.

4. Test all control strategies to verify that they function correctly.

5. Test all alarms in the system to verify that they display correctly.

6. All testing shall be conducted in the presence of, and to the satisfaction of, the Owner and the Engineer.

3.03 TRAINING

A. On-Site Training:

1. Provide four (4) hours of training for the Owner on the operation of the PLC System and the operator interface terminal. Training shall be conducted at the pump station.

END OF SECTION

THIS PAGE LEFT BLANK

SECTION 17500

DESCRIPTION OF OPERATION

A. PUMP CONTROL SYSTEM CONFIGURATION

1. General Description

a. The Pump Control System for the Oak Ridge Pump Station consists of a motor control center, variable frequency drives, a pump station control panel, instrumentation, a programmable controller system, which will all be integrated to form a complete control system for the pump station.

2. Variable Frequency Drives

a. A free-standing variable frequency drive (VFD) will be provided for each sewage pump.

3. Pump Station Control Panel

a. A control panel will be provided in pump station to control the sewage pumps. The control panel will house the following:

(1) Circuit Breakers
(2) Surge Protection Device
(3) Uninterruptable Power Supply (UPS)
(4) Programmable Logic Controller (PLC)
(5) Operator Interface Terminal
(6) Ethernet Switch
(7) 24vdc Power Supplies
(8) Selector Switches
(9) Control Relays
(10) Intrinsically Safe Relays

b. The operator interface terminal will be networked to the PLC via Ethernet.

c. The operator interface terminal will be programmed to perform the following functions:

(1) Display Graphic Screens of the Pump Station
(2) Display Process Variables
(3) Display Alarm Messages
(4) Display Setpoint Screens

B. SEWAGE PUMPS

1. General Description

a. Three rail-mounted submersible sewage pumps will be installed in the pump station wet well to pump the influent wastewater from the wet well to the wastewater collection system. The three pumps will operate in the lead/lag/standby mode, and they will be designated as Sewage Pumps No. 1, No. 2 and No. 3.

b. A variable frequency drive (VFD) will be provided for each sewage pump to provide for variable speed control of the pump. The VFDs will be located in the Operations Area of the pump station.

c. A submersible level transducer will be installed in the wet well to monitor the sewage level in the wet well. The level transducer will output a 4-20mA level signal proportional to the wet well level to the PLC for level monitoring by the programmable controller. The wet well level shall be displayed on the operator interface located on the Pump Station Control Panel.

d. Five float switches will be mounted in the wet well for back-up control of the sewage pumps should the transducer or PLC fail, and for alarm indication. Each float switch will be wired to an intrinsically safe relay located in the Pump Station Control Panel. The float switches will be designated as follows:

(1) Wet Well Low Level
(2) Pump Off Level
(3) Lead Pump Start Level
(4) Lag Pump Start Level
(5) Wet Well High Level

2. Sewage Pump Motor Controls

a. A free-standing variable frequency drive (VFD) will be provided for each sewage pump. Each VFD will house the following:

(1) Main Disconnect Switch
(2) Line Reactors
(3) Variable Frequency Drive
(4) Control Transformer
(5) H/O/A Selector Switch
(6) VFD Run Indication Light
(7) VFD Run Relay
(8) VFD Fault Alarm Light
(9) VFD Fault Relay
(10) Elapsed Time Meter
(11) Seal Leak Relay
(12) Motor Overtemp Alarm Light
(13) Motor Overtemp Alarm Relay
(14) Seal Failure Alarm Light
(15) Seal Failure Alarm Relay

b. Each variable frequency drive (VFD) will incorporate the following:

(1) Diode Rectifier to Convert the AC Input Voltage to a Fixed DC Voltage

(2) Transistorized Inverter to Invert the Fixed DC Voltage into a Sine Coded Pulse Width Modulated Output to the Pump Motor

(3) Control Logic Boards to Control and Monitor Electronic Functions within the VFD

(4) VFD Keypad Mounted on the VFD Enclosure

c. Each pump H/O/A switch will have two auxiliary normally open contacts that will close when the switch is placed in the "auto" position. One contact will be wired to the drive for selecting automatic speed control, and the other contact will be wired to the PLC for switch position monitoring by the programmable controller.

d. Each variable frequency drive will have a run contact that will close when the drive is energized and outputting a frequency to the pump motor. This contact will be wired to a run relay located in the VFD enclosure, and to a run indication light located on the VFD. The run relay will have two normally open contacts that will close when the relay is energized. One contact will be wired to the elapsed time meter on the VFD, and the other contact will be wired to the PLC for pump run status monitoring by the programmable controller.

e. Each variable frequency drive will have a normally open VFD fault contact that will be wired to a VFD fault relay located in the VFD enclosure, and to a VFD fault alarm light on the VFD. The fault relay will have a normally open contact that will close when the relay is energized. This contact will be wired to PLC for VFD fault monitoring by the programmable controller.

f. Each variable frequency drive will output a 4-20mA analog speed signal proportional to the drive speed to the PLC.

3. Programmable Controller Inputs and Outputs

a. The programmable controller inputs and outputs for the Sewage Pumps will be wired to and from the PLC located in the Pump Station Control Panel.

b. Digital Inputs (24vdc):

	Description	Origination Point
(1)	Sewage Pump No. 1 H/O/A Switch "Auto" Position	H/O/A Switch on Pump VFD
(2)	Sewage Pump No. 1 Running	Run Relay in Pump VFD
(3)	Sewage Pump No. 1 VFD Fault	VFD Fault Relay in Pump VFD
(4)	Sewage Pump No. 1 Motor Overtemp	Motor Overtemp Alarm Relay in Pump VFD
(5)	Sewage Pump No. 1 Seal Leak	Seal Leak Alarm Relay in Pump VFD

(6)	Sewage Pump No. 2 H/O/A Switch "Auto" Position	H/O/A Switch on Pump VFD
(7)	Sewage Pump No. 2 Running	Run Relay in Pump VFD
(8)	Sewage Pump No. 2 VFD Fault	VFD Fault Relay in Pump VFD
(9)	Sewage Pump No. 2 Motor Overtemp	Motor Overtemp Alarm Relay in Pump VFD
(10)	Sewage Pump No. 2 Seal Leak	Seal Leak Alarm Relay in Pump VFD
(11)	Sewage Pump No. 3 H/O/A Switch "Auto" Position	H/O/A Switch on Pump VFD
(12)	Sewage Pump No. 3 Running	Run Relay in Pump VFD
(13)	Sewage Pump No. 3 VFD Fault	VFD Fault Relay in Pump VFD
(14)	Sewage Pump No. 3 Motor Overtemp	Motor Overtemp Alarm Relay in Pump VFD
(15)	Sewage Pump No. 3 Seal Leak	Seal Leak Alarm Relay in Pump VFD
(16)	Wet Well Low Level	Intrinsically Safe Relay in Pump Station Control Panel
(17)	Wet Well Pump Off Level	Intrinsically Safe Relay in Pump Station Control Panel
(18)	Wet Well Lead Pump Start Level	Intrinsically Safe Relay in Pump Station Control Panel
(19)	Wet Well Lag Pump Start Level	Intrinsically Safe Relay in Pump Station Control Panel
(20)	Wet Well High Level	Intrinsically Safe Relay in Pump Station Control Panel

c. Digital Outputs (24vdc):

	Description	Destination Point
(1)	Sewage Pump No. 1 Start/Stop	Pump Start Relay in Pump Station Control Panel
(2)	Sewage Pump No. 2 Start/Stop	Pump Start Relay in Pump Station Control Panel
(3)	Sewage Pump No. 3 Start/Stop	Pump Start Relay in Pump Station Control Panel

d. Analog Inputs (4-20mA):

	Description	Origination Point
(1)	Pump Station Wet Well Level	Submersible Level Transducer in Wet Well
(2)	Sewage Pump No. 1 Speed	Pump VFD
(3)	Sewage Pump No. 2 Speed	Pump VFD
(4)	Sewage Pump No. 3 Speed	Pump VFD

e. Analog Outputs (4-20mA):

	Description	Destination Point
(1)	Sewage Pump No. 1 Speed Reference Signal	Pump VFD
(2)	Sewage Pump No. 2 Speed Reference Signal	Pump VFD
(3)	Sewage Pump No. 3 Speed Reference Signal	Pump VFD

4. Description of Operation

a. The three sewage pumps will be controlled by the individual H/O/A selector switches located on the pump VFDs. The "hand" and "off" positions of the H/O/A selector switches provide for manual start/stop control of the pumps. When the pump H/O/A switches are in the "auto" position, the sewage pumps will be automatically controlled by the pump station PLC in response to the pump station wet well level as follows:

b. When the pump H/O/A switches are in the "auto" position, the influent pumps will be automatically controlled by the PLC in response to the wet well level as follows:

(1) Level setpoints will be programmed in the PLC for the following wet well levels:

(a) Wet Well Low Level
(b) Lead Pump Stop
(c) Lag Pump Stop
(d) Wet Well Level Setpoint
(e) Lead Pump Start
(f) Lag Pump Start
(g) Wet Well High Level

(2) The level setpoints shall be adjustable via the operator interface located on the Pump Station Control Panel.

(3) The operator interface shall be programmed to allow the operator to select the lead and lag sewage pumps, or to select automatic alternation of the pumps. When automatic alternation is selected, the PLC will alternate the lead/lag/standby status of the pumps after each pumping cycle.

(4) A PID level controller will be configured in the programmable controller to control the sewage level in the wet well. The level controller will vary the speed of the sewage pumps as required to match the pump discharge flow rate to the pump station influent flow rate. The desired level to be maintained in the wet well will be programmed in the PLC as the setpoint for the level controller. The level controller will compare the actual wet well level measured by the wet well level transducer, to the level setpoint and will output a 4-20mA speed reference signal to the pump VFDs to increase or decrease the speed of the pumps as required to maintain the level setpoint.

(5) When the sewage level in the wet well rises to the elevation of the "lead pump start" level setpoint, the PLC will start the lead sewage pump. When the lead pump is started, it will run with its speed being varied by the programmable controller to maintain the setpoint level in the wet well. As long as the influent flow rate into the wet well is sufficient to maintain the sewage level in the wet well above the lead pump stop level, the lead pump will run continuously with its speed varied to match the pump discharge rate to the wet well influent flow rate as the influent flow rate varies from the minimum pumping rate to the maximum capacity of the lead pump. When the sewage level in the wet well is drawn down to the "lead pump stop" level setpoint, the PLC will shut down the lead pump.

(6) If the lead sewage pump is unable to keep up with the influent flow, the sewage level in the wet well will rise to the "lag pump start" level setpoint. When this level is reached, a start delay timer in the programmable controller will be started. When this timer times out, the PLC will start the lag pump and will output equivalent speed reference signals to both the lead and lag pumps so that both pumps match speeds. As long as the sewage level is above the lag pump stop level, both pumps will run continuously with the speed of the lead and lag pumps being varied by the PLC as required to match the combined pump discharge rates to the influent flow rate. When the sewage level in the wet well is pumped down to the "lag pump stop" level setpoint, the PLC will shut down the lag pump.

c. If the sewage level in the wet well is drawn down to the "wet well low level" setpoint, a timer in the programmable controller will be started. If this timer times out and the low level condition still exists, the PLC will shut down the sewage pumps. When this occurs, a "Wet Well Low Level" alarm message shall be displayed on the operator interface.

d. If the sewage level in the wet well rises to the elevation of the "wet well high level" setpoint, a timer in the programmable controller will be started. If this timer times out and the high level condition still exists, a "Wet Well High Level" alarm message shall be displayed on the operator interface.

e. The PLC will continuously monitor the analog signal received from the wet well level transducer. If an error is detected with the level transducer signal (less than 4mA or greater than 20mA), a "Wet Well Level Transducer Failure, Pumps on Float Switch Control" alarm message shall be displayed on the operator interface. When this occurs, the PLC will automatically switch the wet well level control to the float switches. The float switches will remain in control until the alarm condition for the level transducer is corrected. The float switches and the PLC will provide automatic start/stop control of the pumps as follows:

(1) The "pump off", "lead pump start", and "lag pump start" float switches will be wired to individual intrinsically safe relays located in the Pump Station Control Panel. These relays will each have a normally open contact that will be wired to the back-up relay logic in the control panel and a normally open contact that will be wired to the PLC for pump control.

(2) When the sewage level in the wet well rises to the level of the "lead pump start" float switch, the PLC will start the lead pump. When the lead pump is started, it will continue to run until the sewage level in the wet well is drawn down to the level of the "pump off" float switch. When this occurs, the PLC will shut down the lead pump.

(3) If the sewage level in the wet well rises to the level of the "lag pump start" float switch, the PLC will start the lag pump. When the lag pump is started, it will continue to run until the sewage level in the pumping station is drawn down to the level of the "pump off" float switch. When this occurs, the PLC will shut down the lag pump.

(4) When the pumps are operating under float switch control, the PLC will output an adjustable 4-20mA speed reference signal to the pump VFD. This speed reference signal will be entered by the operator via the operator interface.

f. The "wet well low level" float switch will be wired to an intrinsically safe relay located in the Pump Station Control Panel. This relay will have a normally open contact that will be wired to the back-up relay logic in the control panel and a normally open contact that will be wired to the PLC for wet well low level monitoring. If the sewage level in the wet well is drawn down to the elevation of the low level float switch, the low level relay will be energized and the PLC will shut down the sewage pumps. When this occurs, a "Wet Well Low Level Detected by Low Level Float" alarm message shall be displayed on the operator interface.

g. The "wet well high level" float switch will be wired to an intrinsically safe relay located in the Pump Station Control Panel. This relay will have a normally open contact will be wired to the PLC for wet well high level monitoring. If the water level in the wet well rises to the elevation of the high level float switch, the high level relay will be energized, and a "Wet Well High Level Detected by High Level Float" alarm message shall be displayed on the operator interface.

h. Relays and timers will be provided in the Pump Station Control Panel to enable the sewage pumps to be controlled by the float switches if the programmable controller fails. This relay logic will serve as a back-up to the control logic programmed in the PLC and will be initiated as follows:

(1) A control relay will be wired to an output from the PLC so that it is always energized

whenever the programmable controller is operating. A normally closed contact on this relay will be wired in series with the wet well float switch relay logic control of the sewage pumps. If the programmable controller fails, the relay will be de-energized and the relay contact will close. When this occurs, the wet well float switches will provide automatic start/stop control of the pumps.

i. The PLC will provide failure monitoring for each sewage pump as follows:

(1) When a pump H/O/A switch is in the "auto" position and the pump gets a signal to start, a failure timer in the programmable controller will be started. If this timer times out and the pump run relay is not energized, a "Sewage Pump Failure" alarm message shall be displayed on the operator interface.

j. The PLC will provide VFD fault monitoring for each sewage pump as follows:

(1) If a VFD fault occurs, the pump will shut down and the VFD fault relay will be energized. When this occurs, a "Sewage Pump VFD Fault" alarm message shall be displayed on the operator interface.

k. Each sewage pump motor will be furnished with normally closed motor thermal switches in the motor windings. The thermal switches will be wired to a motor overtemp alarm relay located in the starter enclosure. The overtemp relay will have two normally open contacts and a normally closed contact, which will change state when the relay is energized. One of the normally open contacts will be wired to a motor overtemp alarm light on the starter enclosure, and the other normally open contact will be wired in series with the motor starter control circuit. The normally closed contact will be wired to the PLC. If a motor high temperature occurs, one or more of the thermal switches will open, and the motor overtemp alarm relay will be de-energized. When this occurs, a "Sewage Pump Motor Overtemp" alarm message shall be displayed on the operator interface.

l. Each sewage pump will be furnished with a seal leak sensor in the pump casing to detect a leakage of water into the oil chamber. The seal leak sensor will be wired to a seal leak monitor relay located in the SSRV starter enclosure. A normally open contact on the monitor relay will be wired to a seal leak alarm relay in the starter enclosure, and to a seal leak alarm light on the enclosure. The seal leak alarm relay will have a normally open contact that will close when the relay is energized, which will be wired to the PLC. If a seal leak occurs, a "Sewage Pump Seal Leak" alarm message shall be displayed on the operator interface.

m. If a sewage pump experiences a failure, VFD fault, motor overtemp, or seal leak, the PLC will index the lead/lag/standby assignments of the three pumps so that this pump now becomes the standby pump. The remaining two pumps will become the lead and lag pumps.

5. Sewage Pump Alarms

a. The following alarms for the Sewage Pumps shall be displayed on the operator interface located on the Pump Station Control Panel:

(1) Sewage Pump No. 1 Failure
(2) Sewage Pump No. 1 VFD Fault
(3) Sewage Pump No. 1 Motor Overtemp
(4) Sewage Pump No. 1 Seal Leak
(5) Sewage Pump No. 2 Failure
(6) Sewage Pump No. 2 VFD Fault
(7) Sewage Pump No. 2 Motor Overtemp

(8) Sewage Pump No. 2 Seal Leak
(9) Sewage Pump No. 3 Failure
(10) Sewage Pump No. 3 VFD Fault
(11) Sewage Pump No. 3 Motor Overtemp
(12) Sewage Pump No. 3 Seal Leak
(13) Wet Well Low Level
(14) Wet Well Low Level Detected by Low Level Float
(15) Wet Well High Level
(16) Wet Well High Level Detected by High Level Float
(17) Wet Well Level Transducer Failure, Pumps on Float Control

C. PUMP STATION FLOW METERING

1. General Description

a. A magnetic flow meter will be provided on the common sewage pump discharge line to meter the pump station flow. The flow meter will be located in the meter pit.

b. The magnetic flow meter will output a voltage signal proportional to the flow rate to a flow transmitter mounted in the Operations Room. The flow transmitter will convert the voltage signal to a 4-20mA analog signal proportional to the flow rate and output this flow signal to the PLC. The pump station flow shall be displayed on the operator interface located on the Pump Station Control Panel.

2. Programmable Controller Inputs

a. The programmable controller input for the Pump Station Flow signal will be wired to the PLC located in the Pump Station Control Panel.

b. Analog Inputs (4-20mA):

	Description	Origination Point
(1)	Pump Station Flow	Magnetic Flow Meter Flow Transmitter

D. EMERGENCY GENERATOR

1. General Description

a. A new 250 KW diesel emergency generator, provided by the owner, located outside of the pump station will provide standby power for the pump station loads.

b. The automatic transfer switch located in the pump station will sense a failure of the normal utility power and transfer the pump station loads to the emergency generator.

c. The transfer switch has position indication contacts to indicate when the transfer switch is in the "normal" and "emergency" positions. The "emergency" position contact will be wired to the PLC in the Pump Station Control Panel for switch position monitoring by the PLC.

2. Programmable Controller Inputs

a. The programmable controller inputs for the Emergency Generator will be wired to the PLC located in the Pump Station Control Panel.

b. Digital Inputs (24vdc):

	Description	Origination Point
(1)	Automatic Transfer Switch Emergency Position	Automatic Transfer Switch
(2)	Emergency Generator Running	Run Relay in Generator Control Panel
(3)	Emergency Generator Common Alarm	Alarm Relay in Generator Control Panel

3. Description of Operation

a. The automatic transfer switch will continuously monitor the incoming power source. When a failure of the utility power source occurs, control logic in the transfer switch will start the emergency generator. When the generator is putting out the required voltage and frequency, the transfer switch will transfer the pump station loads to the generator. When the transfer switch transfers to the emergency position, a normally open contact on the switch will close. This contact will be wired to the PLC for monitoring of the transfer switch position by the programmable controller.

b. A generator run relay is located in the generator control panel. A normally open contact on this relay will be wired to the PLC for generator run status monitoring by the programmable controller. If the generator is running, an "Emergency Generator Running" alarm message shall be displayed on the operator interface.

c. A common alarm relay is located in the generator control panel to indicate a generator alarm. A normally open contact on this relay will be wired to the PLC. If a generator alarm occurs, an "Emergency Generator Common Alarm" message shall be displayed on the operator interface.

4. Emergency Generator Alarms

a. The following alarms for the Emergency Generator shall be displayed on the operator interface located on the Pump Station Control Panel:

(1) Emergency Generator Running
(2) Emergency Generator Common Alarm

E. CONTROL PANEL POWER MONITORING

1. General Description

a. A power failure relay and a surge protective device (SPD) will be provided in each Pump Station Control Panel to monitor the incoming power to the panel and to protect the PLC from transient voltages that may occur due to lightning or surges on the incoming power line.

2. Programmable Controller Inputs

a. The programmable controller inputs for Power Monitoring will be wired to the PLC in the control panel.

b. Digital Inputs (24vdc):

	Description	Origination Point
(1)	Control Panel Power Failure	Power Failure Relay in Control Panel
(2)	Control Panel SPD Failure	Failure Contact in SPD

3. Description of Operation

a. A power failure relay will be provided in the control panel. The relay will be energized continuously by the main incoming power to the panel. The programmable controller will provide power failure monitoring for the control panel as follows:

(1) A normally closed contact on the power failure relay will be wired to the PLC. Under normal circumstances, the relay will be energized and this contact will be open. If the main incoming power supply fails, the relay contact will close, and a "Control Panel Power Failure" alarm message shall be displayed on the operator interface.

b. The surge protective device located in the control panel will each be furnished with a normally open failure contact. This contact will be wired to the PLC in the panel. If an SPD failure occurs, this contact will close, and a “Control Panel SPD Failure” alarm message shall be displayed on the operator interface.

4. Control Panel Power Monitoring Alarms

a. The following alarms for Control Panel Power Monitoring shall be displayed on the operator interface located on the Pump Station Control Panel:

(1) Control Panel Power Failure
(2) Control Panel SPD Failure

F. 24 VDC POWER SUPPLIES

1. General Description

a. Two 24vdc power supplies will be provided in the Pump Station Control Panel to provide power for the Ethernet switch, 24vdc programmable controller inputs, and the 2-wire instruments. The power supplies will be wired in parallel through a redundancy module so that if one power supply fails, the other power supply will continue providing 24vdc power.

2. Programmable Controller Inputs

a. The programmable controller inputs for the 24vdc power supplies will be wired to the PLC located in the control panel.

b. Digital Inputs (24vdc):

	Description	Origination Point
(1)	24vdc Power Supply No. 1 Failure	Alarm Contact in Power Supply
(2)	24vdc Power Supply No. 2 Failure	Alarm Contact in Power Supply

3. Description of Operation

a. The PLC will provide failure monitoring for the 24vdc power supplies in the control panel as follows:

(1) A normally closed contact on each power supply will be wired to the PLC in the control panel. When the power supply is operating, this contact will be open. If a power supply fails, this contact will close, and a "24vdc Power Supply Failure" alarm message shall be displayed on the operator interface.

4. 24vdc Power Supply Alarms

a. The following alarms for the 24vdc Power Supplies shall be displayed on the operator interface located on the Pump Station Control Panel:

(1) 24vdc Power Supply No. 1 Failure
(2) 24vdc Power Supply No. 2 Failure

G. UNINTERRUPTIBLE POWER SUPPLY

1. General Description

a. An uninterruptible power supply (UPS) will be provided in the Pump Station Control Panel to provide continuous power for the equipment in the control panel.

2. Programmable Controller Inputs

a. The programmable controller inputs for the UPS will be wired to the PLC located in the Pump Station Control Panel.

b. Digital Inputs (24vdc):

	Description	Origination Point
(1)	UPS on Battery Power	UPS in Control Panel
(2)	UPS Battery Low	UPS in Control Panel
(3)	UPS Failure	UPS Failure Relay In Control Panel

3. Description of Operation

a. The UPS will be furnished with a normally open contact that will close when the UPS is operating on battery power. This contact will be wired to the PLC in the corresponding panel. When normal power fails and the UPS is operating on battery power, a timer in the programmable controller will be started. If this timer times out and the UPS is still on battery power, a “UPS on Battery Power” alarm message shall be displayed on the operator interface.

b. The UPS will be furnished with a normally open contact that will close when the UPS battery is low. This contact will be wired to the PLC. If the UPS battery is low, a timer in the programmable controller will be started. If this timer times out and the UPS battery low alarm is still present, a “UPS Battery Low” alarm message shall be displayed on the operator interface.

c. A UPS failure relay will be provided in the control panel for the UPS. This relay will be energized continuously by the UPS. The programmable controller will provide failure monitoring for the UPS as follows:

(1) A normally closed contact on the UPS failure relay will be wired to the programmable controller. When the UPS in the control panel is operating, the relay will be energized and this contact will be open. If the UPS fails, the relay contact will close and a “UPS Failure” alarm message shall be displayed on the operator interface.

d. The UPS failure relay will have two normally open contacts and two normally closed contacts in addition to the normally closed contact being utilized for failure monitoring of the UPS. The UPS will be wired through two normally open relay contacts, and the 120 VAC power will be wired through two normally closed relay contacts. If the UPS fails, the UPS failure relay will be de-energized and the 120 VAC power will power the control panel.

4. Uninterruptible Power Supply Alarms

a. The following alarms for the Uninterruptible Power Supply shall be displayed on the operator interface located on the Pump Station Control Panel:

(1) UPS on Battery Power
(2) UPS Battery Low
(3) UPS Failure

H. PLC FAILURE MONITORING

1. General Description

a. A relay will be provided in the Pump Station Control Panel to monitor the status of the PLC in the control panel.

2. Programmable Controller Outputs

a. The programmable controller monitoring relay for the PLC will be energized continuously by an output from the PLC.

b. Digital Outputs (24vdc):

	Description	Destination Point
(1)	PLC Failure	PLC Monitoring Relay in Control Panel

3. Description of Operation

a. The programmable controller monitoring relay for the PLC in the control panel will be energized by an output from the programmable controller so that it is continuously energized whenever the PLC is operating. A normally closed contact on this relay will be wired to a PLC failure light on the control panel. If the programmable controller fails, the monitoring relay will be de-energized, and the relay contact will close indicating an alarm condition.

b. A normally open contact on the PLC monitoring relay will be wired to new automatic telephone dialer for notification of a PLC Failure alarm.

I. OPERATOR INTERFACE TERMINAL

1. General Description

a. A programmable operator interface terminal will be provided on the Pump Station Control Panel to display alarm messages and process values, and to provide a means for the operator to change process setpoints in the PLC.

2. Description of Operation

a. Whenever an alarm occurs, a corresponding alarm message will be displayed on the operator interface as previously described in the Description of Operation.

b. An alarm message will remain in the system until its corresponding alarm is cleared.

END OF SECTION