Washington County
MARYLAND

PURCHASING DEPARTMENT
DIVISION OF BUDGET & FINANCE

**PUR-1577**

**ADDENDUM NO. 1**
**INVITATION TO BID**

**WASHINGTON COUNTY PUMP STATION UPGRADES**

**DATE: Tuesday, October 18, 2022** **BIDS DUE: Wednesday, November 16, 2022 2:00 P.M.(EDT/EST)**

To Bidders:

This Addendum is hereby made a part of the Contract Documents on which all bids will be based and is issued to correct and clarify the original documents.

Please acknowledge receipt of this Addendum at the appropriate space on the Proposal Form. This Addendum consists of two (2) pages and one (1) attachment.

**NOTE: All Bidders must enter the Washington County Administration Complex through either the front door at the 100 West Washington Street entrance or through the rear entrance (w/blue canopy roof) which is handicap accessible and must use the elevator to access the Purchasing Department to submit their bid and/or to attend the Pre-Bid Conference. Alternate routes are controlled by a door access system. The general public will be subject to wand search and will be required to remove any unauthorized items from the building prior to entry. Prohibited items include but are not limited to: Weapons of any type; Firearms, ammunition and explosive devices; Cutting instruments of any type - including knives, scissors, box cutters, work tools, knitting needles, or anything with a cutting edge, etc.; Pepper spray, mace or any other chemical defense sprays; and Illegal substances.**

**ITEM NO. 1:** *Inquiry:* It appears that the Appendix A- Technical Specifications are missing from the provided documents. Can you please provide the technical specifications?

*Response:* See attachment "A" to this Addendum.

**ITEM NO. 2:** *Inquiry:* Can you please provide a vector copy of the drawings?

*Response:* Assuming you are referring to the AutoCAD drawings, they will be provided to the awarded bidder.

By Authority of:

Rick F. Curry, CPPO
Director of Purchasing

***(NOTE:** The wording of all "Inquiries" submitted are displayed exactly as received.)*

# Attachment A

# Technical Specifications

# Washington County
# Pump Station Upgrades

*Prepared for*

Washington County
Division of Environmental Management
Department of Engineering Services
16232 Elliott Parkway
Williamsport, Maryland 21795

*Prepared by*

EA Engineering, Science, and Technology, Inc., PBC
225 Schilling Circle, Suite 400
Hunt Valley, Maryland 21031
(410) 584-7000


April 2022

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland.

License No. 15453 Expiration Date: 07/02/2023

## TABLE OF CONTENTS

The Washington County Department of Water Quality (DWQ) Standard Specifications, including Standard Details, and all subsequent amendments, are hereby made a part of this contract. Where reference is made herein or on the Contract Drawings to the Standard Specifications or Standard Details, it shall be interpreted to refer to the DWQ Standard Specifications. County-approved specifications have been included in their entirety under the Scope of Work for this project (shown in italics). Special provisions developed to supplement County specifications are as noted in Table of Contents below.

**001-001**
**Summary of Work**

## A. Description

1. The COUNTY currently operates the Farm Lane Pump Station, located at 14135 Pennsylvania Avenue; the Maugans Meadows Pump Station, located at 13500 Elaineôs Way; and the Maugansville Road Pump Station, located at 13635 Maugansville Road, in Hagerstown, MD. The Work to be performed under these Contract Documents consists of pump and equipment upgrades at the Farm Lane and Maugansville Road Pump Stations, demolition of Maugans Meadows Pump Station, construction of a New Regional Pump Station, located at 3240 Cearfoss Pike, and installation of approximately 22,100 linear feet of sanitary gravity and forcemain from the Maugansville Road Pump Station to the Cedar Lawn area.

2. The pump station upgrades include infrastructure to address wastewater capacity needs in Washington County. The work includes installing new and replacement gravity and force main sewer piping for wastewater handling, including pipe removal and replacement, installation by jack and bore, stream diversion, and requiring rock removal as necessary; abandonment in place of existing pump station equipment and structures; removal and replacement of existing pump station equipment and structures; retrofit to existing pump station building and structures; installation of two package pump station enclosures; electrical and mechanical connections and upgrades; and the necessary erosion and sediment control measures throughout construction.

3. This specification section provides a general description of the scope of work. The CONTRACTOR shall refer to the appropriate detailed specification section in the Washington County DWQ Standard Specifications or the Special Provisions for additional information. In general, the work includes, but is not limited to, the following:

    a. Clearing and grubbing within permitted Limit of Disturbance.

    b. Earthwork, including, but not limited to, trench excavation, rock removal as necessary, dewatering, including perched water and groundwater control; pipe bedding placement, backfill and compaction, and surface restoration in areas of sewer pipe installation.

    c. Install sewer gravity and forcemain piping, and associated manholes, vaults, valves, fittings and appurtenances, including air release valves, cleanouts, flushing valves, and stubs for future sewer connection.

    d. Installation of package pump station enclosure system at Maugansville Road Pump Station, and New Regional Pump Station. At each pump

station, equipment to be installed shall include, but is not limited to, pump station enclosure, suction lift pumps, pump intake and discharge piping, valves and appurtenances, motors, controls, power and electrical equipment, flowmeter, wet well, comminutors, site grading, and equipment and gravel pads. CONTRACTOR to install pump station enclosure system and all necessary appurtenances to provide complete and operational pump stations.

e. Pump station upgrades at the Farm Lane Pump Station include, but not limited to, removal of two existing dry-well mounted flooded suction pumps and replacement with two wet well-mounted submersible pumps and motors, installation of pump discharge piping, valves and appurtenances, controls, flowmeter, comminutor, retrofits to existing wet well, installation of valve vault and submersible valve package, retrofits and upgrades to existing pump station building and electrical. CONTRACTOR to install pump station upgrades and all necessary appurtenances to provide a complete and operational pump station.

f. Demolition of existing Maugans Meadows Pump Station includes, but is not limited to, demolition and removal of existing pump station building, sewer gravity piping, removal and replacement of existing manholes as noted in the Contract Documents, abandonment in place of existing wet well, dry well and forcemain piping.

g. Temporary Bypass of wastewater during work at each pump station as necessary to allow continued flow of sewage to the COUNTYõS wastewater collection system throughout construction.

h. Surface restoration, including seeding of grassed areas, installation of gravel access road, and paving and grading as necessary for roadway restoration.

i. Furnish and install erosion and sediment controls included in Contract Documents, and in accordance with applicable local and state regulations, including stabilized construction entrances and silt fence, and controls at stream crossings.

j. Provision of electrical service in coordination with local electric provider, including furnishing and installing transformer, control panels, conduit, sectionalizing cabinets and power connection for pump station equipment.

**B. Special Conditions**

1. The CONTRACTOR is advised that work operations will be adjacent to private homeowners; therefore, working hours, noise and dust control will be monitored and strictly enforced.

2. Construction Staging Areas have been identified on the Contract Drawings for the CONTRACTORõS use during construction. Erosion and sediment controls shall be installed at these staging areas as required.

3. The CONTRACTOR shall be available to meet with the COUNTY and the COUNTYõS REPRESENTATIVE to review as-built drawings on a monthly basis. The reviews may occur after regular progress meetings.

4. CONTRACTOR shall maintain pump stations in operation as noted on individual pump station site plans. CONTRACTOR shall prepare a plan for pump station construction sequence and bypass operations necessary to continue to convey wastewater throughout the duration of the work as noted. CONTRACTOR shall submit plan to COUNTY for review and approval prior to initiation of any work. Plan shall identify the estimated duration of necessary pump station shutdowns and bypass operations.

5. CONTRACTOR shall coordinate with the County for the salvage of pumps or any additional pump station equipment or controls to be removed.

## Chapter 1, Section 101

## Definitions and Abbreviations

## I. Definitions and Abbreviations

### A. Definitions

For the purpose of these specifications the following words and terms shall have the meaning hereinafter ascribed to them.

1. "Washington County Department of Water Quality" or "Department" means the governmental entity furnishing public water and sewer at various areas in Washington County.

2. "Division" means Division of Environmental Management.

3. "Owner" means the Washington County Department of Water Quality and/or it's duly authorized representative acting in its behalf.

4. "Service Area" is the geographical area wherein the County is providing, or intends to provide, public water or sewer service, the "Service Area" having been created and delineated by the County.

5. "Developer" shall mean the person, firm, corporation or agency entering into a contract with the contractor for the construction of the work.

6. "Contractor" shall mean the corporation, company, partnership, association, or individual, named and designated in the contract agreement as "party of the second part" who has entered into this contract for the performance of the work covered thereby, and its, his, or their duly authorized agents or legal representatives. Sub-contractors as such will not be recognized.

7. "Sub-Contractor" shall mean a person, firm, or corporation supplying labor and materials or only labor for work in conjunction with the project and under separate contract or agreement with the contractor.

8. "Engineer" shall mean the person, firm, or corporation responsible for the design of the work and for the preparation of the contract drawings, and other pertinent contract documents.

9. "Inspector(s)" shall mean the engineering or technical inspector(s) duly authorized by the Department, limited to the particular duties entrusted to him(them).

10. The "work" shall mean the labor, tools, materials, equipment, appurtenances and services to be performed under this contract, unless some other meaning is indicated by the context.

11. Whenever in the contractor documents the words "As Directed", "As Required", "As Permitted", or words or phrases or like import are used, it shall be understood, unless otherwise particularly stipulated, that the directions, requirement, or permission of the owner or engineer is intended only to the extent of judging compliance with the terms of the contract documents. None of these terms shall imply that the developer, the County or engineer is intended only to the extent of judging compliance with the terms of the contract documents. None of these terms shall imply that the developer, the County or Engineer has any authority or responsibility for supervision of the contractor's forces or operations, such supervision including sole responsibility therefore shall be strictly reserved to the contractor.

12. Whenever in the contract documents the works "Approved", "Reasonable", "Suitable" "Acceptable", "Properly", "Satisfactory", or words of like effect and import are used, unless otherwise particularly stipulated, shall mean approved, reasonable, suitable, acceptable, proper or satisfactory in the judgment of the County.

13. Whenever any statement in the contract documents contain the expression "It is understood and agreed", or an expression of like import, such expression means the mutual understanding and agreement of the parties executing the contract documents.

14. Whenever in the contract documents the words "By Others", or words or phrases of like import are used, it shall be understood, unless otherwise particularly stipulated, to mean a corporation, company, partnership, association, or individual who has entered into contract with or has been directed by the developer to perform work in the project area.

15. Whenever in the contract documents the phase "Or Equal", or words or phrase or like import are used, it shall be understood to mean the reference to manufacturers' or vendors' names, trade names, catalogue numbers, etc. is intended merely to establish a standard; and any material, article, or equipment of other manufacturers and vendors which will perform adequately the duties imposed by the general design will be considered equally acceptable provided the material, article, or equipment so proposed is, in the opinion of the County, or equal substance and function. The contractor shall not substitute an alternate manufacturers' or vendors' material, article or equipment without prior written approval of the County.

16. "Work Order" shall mean that notification from the County to the Developer specifying any deficiencies or corrective actions that must be made by the Contractor.

17. "Standard Specifications" shall embrace all items and sections included within this volume.

18. "Specifications" shall mean this volume and all items contained herein which are pertinent to the particular project under consideration, together with any other supplemental specification, referred to specifications, and special provisions approved by the County to the extent that affects the sewer or water systems.

19. Whenever in the specifications reference is made to any part or all of the work being subject to acceptance or approval by the County, it shall mean to include acting within the limits of its particular interest or jurisdiction.

20. "May" is permissive, "Shall" is mandatory.

21. "Service Connection" that portion of the sanitary sewer or public water between the sewer main / water main and the property line to which the building is connected.

22. "Sanitary Sewer" – a sewer which carries sewage and to which storm, surface, and ground waters are not intentionally admitted.

## B. Standards

The following standards and their designations used herein are:

1. Aluminum Association – AA

2. American Association of State Highway and Transportation Officials – AASHTO

3. American Concrete Institute – ACI

4. American Institute of Steel Construction – AISC

5. American National Standards Institute – ANSI

6. American Society for Testing and Materials – ASTM

7. American Society of Mechanical Engineers – ASME

8. American Water Works Association – AWWA

9. American Welding Society – AWS

10. Code of Maryland Regulations - COMAR

11. Commercial Standards – CS

12. Federal Specifications- Fed. Spec.

13. Maryland State Highway Administration Standard Specifications for Construction and Materials-SHA

14. Maryland Department of the Environment – MDE

15. Maryland Occupational Safety and Health Administration - MOSHA

16. 1994 Maryland Standards and Specifications for Soil Erosion and Sediment Control (or latest adopted version) – SCS

17. National Electric Code – NEC

18. National Electrical Manufacturer's Association – NEMA

19. National Fire Protection Association - NFPA

20. National Safety Council – NSC

21. National Sanitation Foundation – N.S.F.

22. Occupational Safety and Health Administration, Department of Labor – OSHA

23. Standards of the Hydraulic Institute- SHI

24. Steel Structures Painting Council – SSPC

25. Underwriters Laboratories- UL

## C. Abbreviations

For the purpose of these specifications the following abbreviations shall represent the words and phrases hereinafter ascribed to them:

1. United States Geological Survey Elevation Datum – USGS

2. Elevation – Elev. Or El.

3. Feet – 0'

4. Inches – 0"

5. Degrees fahreneit – F

6. Degrees Centigrade – C

7. Pounds per square inch – PSI

8. Gallons per minute – GPM

9. Revolutions per minute – RPM

10. Percent - %

11. Brinell hardness number (ASTM E 10) BHN

12. Horsepower – HP

13. Angular Degrees – 0

14. Year – yr.

15. Direct Current – DC

16. Alternating Current – AC

17. Kilovolt Amperee – kVA

18. Kilowatt – KW

19. Feet per minute – FPM

20. Pound Feet – LB. Ft. (Torque)

21. Maximum – Max.

22. Minimum – Min.

23. Cubic Feet Per Second – CFS

24. Gallons Per Linear Foot Per Day – Gal/L.F./Day

25. Rockwell Hardness Number (ASTM E 18) – RHN

26. Pounds Per Square Inch – PSI

27. Gage or Gauge – GA.

28. Million Gallons Per Day – MGD

29. Linear Foot – L.F.

30. Cubic Yard – C.Y.

31. Vertical Foot – V.F.

32. Cubic Foot (Feet) – C.F. or CU. FT.

33. Square Foot (Feet) – S.F. or SQ. FT.

34. Thousand Feet Board Measure – MFBM

35. Lump Sum – L.S.

36. Vitrified Clay Pipe, Extra Strength – VCPX

37. Reinforced Concrete Sewer Pipe – RCSP

38. Acrylonitrile Butadiene Styrene- ABS

39. Poly-Vinyl Chloride – PVC

40. Cast-Iron – C.I.

41. Ductile Iron – D.I.

## D. Standard Specifications

Reference to Standard Specifications of any technical society, organization, or association, or to codes of local or state authorities, shall mean the latest standard, code, specification, or tentative specification adopted and published at the date of receiving bids, unless specifically stated otherwise herein

## Chapter 1, Section 103

## Special Conditions

## III. Special Conditions

### A. Approval of Materials

Prior to construction on a project, a complete list of materials must be submitted to the Department for approval. Only those approved materials shall be utilized on the project. No substitutions shall be made during construction. See materials, Chapter 2, Section III and Section VIII.

### B. Notice To Proceed

In order to properly coordinate the inspection services provided by the Department with the schedule of construction activities, the Department requires notification 72 hours prior to construction.

Should the contactor delay operating for a period of time, the Department shall require notification 72 hours prior to continuing operations.

### C. Legal Holidays and The Work Week

Washington County observes the following legal holidays: New Year's Day, Martin Luther King's Birthday, Good Friday, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day, Friday after Thanksgiving, Christmas Eve, Christmas Day and New Year's Eve. The contractor shall be permitted to work on these holidays only in emergency situations. Should inspection by the Department be required on any of these holidays, inspection services shall be invoiced at 2 ½ times the hourly rate.

The 40 hour work week shall be Monday through Friday. The contractor must submit to the Department in writing, and with 48 hours in advance notice, any request for additional work hours above and beyond the normal 40 hour work week. Should inspection by the Department be approved in excess of the normal work hours, inspection services shall be invoiced at 1 ½ times the hourly rate.

### D. Project Completion Time

The Department encourages completion and acceptance of the total project in a timely manner, therefore to emphasize this point, it should be noted that no permits for utility use shall be issued until the project is accepted by the Department.

### E. Scope of Work

The intent of the drawings and specifications is that the contractor shall furnish all labor, materials, tools, equipment, and transportation necessary for the proper execution of the work in accordance with the standard specifications and all

incidental work necessary to complete the project in an acceptable manner, ready for use, occupancy or operation by the Department.

All work that may be called for in the specifications and not shown on the drawings or shown on the drawings and not called for in the specifications shall be executed and furnished by the contractor, as if described in both these ways; and should any work or material be required, which is not defined in the specifications or drawings either directly or indirectly, but which is nevertheless necessary for the proper execution of the intent thereof, the contractor is to understand the things to be implied and required, and shall perform all such work and furnish any such material as fully as if they were particularly delineated or described.

Any discrepancies found between the drawings and the specifications and site conditions or any inconsistencies or ambiguities in the drawings or specifications shall be immediately reported to the Department, in writing. Work performed by the contractor after his discovery of such discrepancies, inconsistencies or ambiguities shall be performed at the contactor's risk.

**F. Access to Work**

The Department, their representatives and the representatives of any governmental body or agency having jurisdiction will at all times have access and observation to the work. Contractor shall provide proper and safe facilities for such access and observation of the work and also for any inspection or testing thereof by others. No work will be performed without the Department having notice thereof and all work shall be subject to inspection by the Department.

The construction drawings are not to be considered as all inclusive. They do not indicate every fitting, elbow, offset, valve, etc., which will be required to complete the job. The Contractor shall prepare shop drawings, as required for the use of his mechanics, to insure proper installation.

**G. Uncovering Work**

If any work is covered contrary to the written request of Department or without the Department's having timely written notice that such work is being performed, it must, if requested by Department, be uncovered for his observation and replaced at contractor's expense.

If any work, the performance of which the Department has given written notice, has been covered without the Department observing it prior to its being covered, or if Department or owner's or owner's representative considers it necessary or advisable that covered work be inspected or tested by others, contractor, at Department's request, shall uncover, expose or otherwise make available for

observation, inspection or testing as Department may require, that portion of the work in question, furnishing all necessary labor, material and equipment.

## H. Department's Status during Construction

1. Clarification and Interpretations

   The Engineer will issue, with reasonable promptness, such written clarifications or interpretations of the standard specifications as he may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the project.

2. Rejecting Defective Work

   The Department's representative will have authority to disapprove or reject work which is "defective"(which term is hereinafter used to describe work that is unsatisfactory, faulty or defective, or does not conform to the requirements of the standard specifications has been damaged prior to approval of final payment. He will also have authority to require special inspection or testing or the work whether or not the work is fabricated, installed or completed.

3. Limitations of Department's Responsibilities

   a. The Department's authority to act under this article or elsewhere in the contract documents nor any decision made by him in good faith either to exercise or not exercise such authority shall give rise to any duty or responsibility to Department or contractor, any subcontractor, any material man, fabricator, supplier or any of their agents or employees or any other person performing any of the work.

   b. Department will not be responsible for contractor's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto; and Department does not guarantee the performance of the work in accordance with the contract documents

   c. Department will not be responsible for the acts or omissions of contractor, or any subcontractors, or any of his or their agents or employees, or any other persons at the site or otherwise per forming any of the work.

## I. Existing Utilities

All work requiring changes to or affecting existing utilities, or affecting their operation, shall be performed in a manner and time approved by the Division. Requests to do such work shall be submitted to the Division at least three (3) calendar days to the time that such work is to be performed.

## J. Location and Protection of Existing Utilities

The contractor will be responsible for locating all existing utilities including, but not limited to, water, steam, oil, gas mains, sanitary and storm sewers, telephone and electric conduits which may be encountered in the performance of the work. He shall also be responsible for locating all underground structures. He shall, at his own expense, arrange with the owners of such utilities for locating them. The contractor shall be responsible for providing adequate protection against damage to utilities encountered during the course of construction.

## K. Use and Storage of Explosives

The Contractor shall give notice to the Department and State Fire Marshall prior to using any explosives. Such explosives shall be stored, handled and used as prescribed by the federal, state and/or local authorities having jurisdiction over such storage and use. The contractor shall comply with all special rules and regulations that may be in effect at the time the work is actually done. The contractor shall obtain the permission of the State Fire Marshal before storing and using any explosives.

## L. Protection of Material and Work

The Contractor shall at all times take necessary steps to protect and preserve all materials, supplies, equipment and shall work which has been performed. Should work be suspended temporarily because of inclement weather or other causes, the Contractor shall take such steps as are necessary to protect materials, supplies, equipment and work performed, work not properly protected shall be removed and replaced at the expense of the Contractor.

## M. Safety and Protection

Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the work. He shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to: all employees on the work and other persons who may be affected thereby; all the work and all materials or equipment to be incorporated therein, whether in storage on or off the site; and other property at

the site or adjacent thereto, including utilities not designated for removal, relocation or replacement in the course of construction.

Contractor shall comply with all applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss.

## Chapter 1, Section 104

## Work Within Public Right-of-Way and Easements

## IV. Work Within Public Right-of-Way and Easements

All work to be performed within Washington County Public Right-of-Way other than State Highway Administration property shall be in strict accordance with the conditions of the special utility installation permit issues by Washington County.

All work to be performed on Maryland State Highway Administration (SHA) property shall be in strict accordance with the conditions of the access and construction permit issued by SHA.

Where right-of-way or easements have been obtained for construction of sewer or water lines on private property, the Contractor shall confine his operations to and conduct all work within the limits of the right-of-way or easements as shown on the drawings or as specified. The contractor shall not enter upon or occupy with men, tools, or materials, any private property outside the limits of the right-of-way or easements obtained, without written consent of the owner of such property.

All work within public right-of-way, easements, and/or private property shall be in accordance with the specification contained herein. Width of easement (temporary and/or permanent) shall be:

A. Thirty (30) feet for permanent conventional easement for gravity sewers, sewer force mains and water lines

B. Fifteen (15) feet for permanent grinder pump service connection

C. Temporary easements will be of determinable width based upon site conditions.

The easement widths listed above are minimum widths and the Department may require the easement to be wider based upon site conditions.

In case of conflict, the agency having jurisdiction and/or issuing the permit for construction shall govern.

**100-001**
**Progress Meetings**

## A. Description

1. Progress meetings will be held throughout the Project. CONTRACTOR shall attend each meeting prepared to discuss all items on the agenda. The representatives present for each party shall be authorized to act on their behalf.

2. Date, Time and Location:

   a. Every other week on a day and time agreeable to COUNTY and CONTRACTOR.

   b. Frequency may be adjusted as required by progress of Work.

   c. Washington County Department of Water Quality Conference Room or other mutually agreed upon location.

3. COUNTY will preside at meetings and will prepare and distribute meeting minutes to all meeting participants.

4. CONTRACTOR shall provide a verbal report at each meeting that includes:

   a. List of work accomplished since the previous progress meeting.

   b. Schedule of Work with specific starting and ending dates for each task, planned until the next progress meeting.

   c. ñLook-aheadò schedule of Work for any shutdowns, major equipment installations, and other important milestones.

   d. List of upcoming planned time off, including dates, for personnel with significant roles on the project and designated contact person during their absence.

## B. Minimum Attendance

1. CONTRACTOR

   a. CONTRACTORôS project manager.

   b. CONTRACTORôS site superintendent.

c. When needed for the discussion of a particular agenda item, CONTRACTOR shall require representatives of Subcontractors or Suppliers to attend a meeting.

2. COUNTY

3. COUNTY'S REPRESENTATIVE

**C. Agenda**

1. Agenda will include, but will not necessarily be limited to, the following:

a. Review and comment on minutes of previous meeting.

b. Review of progress since the previous meeting.

c. Planned progress for next period.

d. Review of overall project schedule, including off site fabrication and delivery schedules and corrective measures, if required.

e. Review of status of critical submittals, including Shop Drawings and Applications for Payment.

f. Review of change issues and change orders.

g. Problems, conflicts, and observations.

h. Quality standards and control.

i. Coordination between parties.

j. Safety concerns.

k. Permits.

l. Construction photographs.

m. Record drawings.

n. Punch list status.

o. Other business.

**100-002**
**Photographic Documentation**

## A. Description

1. CONTRACTOR shall designate onsite personnel to document the construction with digital photographs and videos (when appropriate). Photographs shall be taken pre-construction, during construction, and post-construction to document all of the elements of work.

## B. Execution

1. Photographic Standards and Delivery

   a. Photographic images shall be suitably staged and set up (ñframedò), focused, and with adequate lighting.

   b. For each photograph taken, provide high-quality, color digital image in uncompressed ñ*.JPGò file format.

   c. Image resolution shall be sufficient for clear, high-resolution prints. Resolution shall be the maximum provided by the camera, and no less than 6-megapixles.

   d. Provide a compact disc (CD) or thumb drive with photographic images. CD or thumb drive shall be compatible with Microsoft Windows 7, 8, and 10.

   e. Label each CD and thumb drive with Project Name, date range of photos, and a brief description.

   f. Title each photo file with brief description of photo subject.

2. Pre-Construction Photographs

   a. Submit pre-construction photographic documentation prior to disturbing the Site, including a minimum of 25 photos.

   b. Obtain and submit sufficient pre-construction photographic documentation to record Site conditions prior to construction. Photographs shall document all work areas.

   c. If dispute arises and pre-construction photographic documentation was not submitted prior to the dispute, restore disputed area to extent directed by and to complete satisfaction of COUNTY.

3. Progress Photographs

   a. Take a minimum of 25 photographs on a monthly basis to document progress of the Work. At minimum, photographs shall be taken daily.

   b. Provide interior and exterior photographic documentation of each structure.

   c. Provide photographic documentation of all subsurface construction and structures before any backfill is placed.

   d. Provide construction progress photographic documentation monthly. Submit with each Application for Payment, unless otherwise agreed to by COUNTY.

4. Final Photographs

   a. A minimum of 25 photographs shall be taken after Substantial Completion. Work documented in final photographs shall be generally complete, including painting, furnishings, landscaping, and other visible Work.

   b. Take final photographs of all elements of Work, including interior and exterior of structures and all equipment from multiple perspectives.

   c. Submit final photographic documentation prior to submitting final Application for Payment.

**100-003**
**Health and Safety**

## A. Description

1. In addition to the requirements in the General Conditions, the CONTRACTOR shall comply with the requirements included in this special provision to foster a safe environment for all employees, subcontractors, inspectors, and all interested parties who visit the site.

## B. Execution

1. The CONTRACTOR shall submit a Health and Safety Plan (HASP) in compliance with all applicable health and safety standards, including 40 CFR 1926. The HASP shall include (at a minimum) the following components:

   a. General health and safety requirements and personal protective equipment required to enter the site or be in the proximity of specific activities.

   b. Health and safety requirements and personal protective equipment required to complete work under possible conditions of communicable airborne respiratory illnesses (e.g. Covid-19). Compliance with Washington County and State of Maryland guidelines and Executive Orders must be maintained.

   c. A map and driving directions to the nearest medical facility for non-emergency needs.

   d. Accident reporting procedures.

   e. Confined space entry.

   f. Fall protection.

   g. Excavation safety, including sheeting and shoring plan.

   h. Traffic control plan, in accordance with traffic control guidance per MUTCD.

   i. Lock out tag out procedures.

   j. Blasting safety (if blasting is needed).

   k. Names of key CONTRACTOR personnel and alternates responsible for site safety and health, including identification of responsible contact on-

site throughout construction. Email and cell phone numbers for the identified personnel.

2. The HASP shall be submitted to the COUNTY at minimum of 14 days prior to mobilization to the site. The CONTRACTOR is liable for the health and safety of all its employees and agents and shall indemnify the COUNTY and COUNTY'S REPRESENTATIVE from any defense costs and damages attributable to any claim of any of its employees, independent contractors or agents for injuries at the site.

3. Any changes, updates, revisions, etc. to the HASP shall be submitted to the COUNTY in writing.

4. The CONTRACTOR shall comply with the applicable elements of COUNTY'S safety program, if any. Site-specific and COUNTY-specific procedure will be reviewed at the preconstruction meeting with the selected CONTRACTOR.

5. The CONTRACTOR shall inform the COUNTY of the specific requirements of the CONTRACTOR'S safety program with which the COUNTY'S and other site visitor's employees and representatives must comply while at the Site. While at the Site, the COUNTY'S and other site visitor's employees and representatives shall comply with the specific applicable requirements of the CONTRACTOR'S safety programs of which the COUNTY has been informed.

6. All damage, injury, or loss to any property caused, directly or indirectly, in whole or in part, by CONTRACTOR, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of COUNTY or COUNTY'S REPRESENTATIVE or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of CONTRACTOR or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

7. CONTRACTOR'S duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed until Final Acceptance.

8. The CONTRACTOR shall restrict personnel access to site areas where intrusive activities are occurring with sufficient barricades/fencing. Vehicular access to areas of the site where intrusive activities are conducted shall be restricted to authorized vehicles only.

9. CONTRACTOR'S duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed until Final Acceptance.

**100-004**
**Submittals**

## A. Description

1. This section includes general requirements and procedures related to the CONTRACTOR'S responsibilities for preparing and transmitting submittals to the ENGINEER to demonstrate that the performance of the work will be in accordance with the Contract requirements. Submittals include schedules, test results, topographic surveys, CONTRACTOR'S drawings, samples, manuals, methods of construction, and record drawings. Other requirements for submittals are specified under applicable sections of the standard specifications and special provisions.

## B. Execution

1. Not later than 15 days after the receipt of Notice to Proceed, the CONTRACTOR shall submit in writing a list of materials and equipment that will be purchased, giving name, address, and telephone number of supplier, manufacturer, or processor. No material shall be incorporated into the work until approval of the source has been given. Delivery of materials to the Site prior to approval is made at the CONTRACTOR'S risk and is subject to immediate removal at no cost to the COUNTY should it be determined that the source is not acceptable.

2. At or before the pre-construction meeting, CONTRACTOR shall prepare and submit for review to the ENGINEER an "expanded" construction schedule showing the order in which he/she proposes to carry out the work and the dates upon which he/she proposes to start and complete each major work item. Overlapping work items in sufficient detail shall be provided for approval. The expanded schedule shall be an elaboration of the bid schedule with completion dates remaining unchanged. The schedule shall show each major work item provided in the Contract, and shall include the dates for submittals, sample testing, approval of materials and CONTRACTOR'S drawings, and the procurement of materials and equipment. The construction schedule shall be in chart form showing expected completion percentages and arranged to record actual completion percentages at stated intervals. The schedule will outline in detail the proposed equipment, manpower, and production rates necessary to achieve the schedule.

    a. The CONTRACTOR shall update the schedule every month with any and all changes in equipment, manpower, etc. annotated. The Schedule shall be prepared in Microsoft Project and the CONTRACTOR shall provide the schedule to the ENGINEER for review in Microsoft Project and PDF formats.

b. The ENGINEER may require and the CONTRACTOR shall furnish such additional information and data as required to justify the basis of the schedule.

c. The accepted construction schedule shall be kept up-to-date as work progresses, including work added by change order, and shall be submitted to the ENGINEER every month and with the request for payment. If the CONTRACTOR fails to submit the updated schedule within the time prescribed, the ENGINEER may withhold approval of progress payment estimates until such time as the CONTRACTOR submits the updated schedule.

d. The construction schedule shall determine the order in which the Work is to proceed. However, the ENGINEER may request and authorize minor changes to this schedule whenever such changes are of advantage to or necessary for the operations of the COUNTY.

3. A complete submittal schedule and list of required submittals shall be submitted prior to the Pre-construction Meeting. The schedule for submission of submittals shall be arranged so that related equipment items are submitted concurrently. The ENGINEER may require changes to the submittal schedule to permit concurrent review of related equipment.

4. A detailed Schedule of Values shall be submitted prior to the Pre-construction Meeting. The Schedule of Values shall be developed in accordance with the bid item descriptions as noted in Technical Specification Section 100-005 Measurement and Payment. The ENGINEER may require changes to the Schedule of Values to facilitate review and tracking of bid items as necessary.

5. No progress payment shall be made to CONTRACTOR until acceptable Construction Schedule, Submittal Schedule and Schedule of Values are submitted to ENGINEER and approved.

**C. Contractor's Submittals**

1. General

a. The CONTRACTORôS drawings shall be neat in appearance, legible, and explicit to enable proper review and ensure Contract compliance. They shall be complete and detailed to show fabrication, assembly and installation details, wiring and control diagrams, catalog data, pamphlets, descriptive literature, and performance and test data. They shall be accompanied by calculations or other sufficient information to provide a comprehensive description of the structure, machine, or system provided, and its intended manner of use. If the CONTRACTORôS drawings deviate from the Contract Documents, the CONTRACTOR shall advise

the ENGINEER in writing with the submittal and state the reason therefore.

b. No portion of the work requiring a CONTRACTOR'S drawing shall be started, nor shall any materials be fabricated, delivered to the Site, or installed, prior to the approval by the ENGINEER. Fabrication performed, materials purchased, or onsite construction accomplished that does not conform to approved CONTRACTOR'S drawings shall be at the CONTRACTOR'S risk. The COUNTY will not be liable for any expense or delay due to corrections or remedies to accomplish conformity.

c. The review and approval of CONTRACTOR'S drawings by the ENGINEER shall not relieve the CONTRACTOR from his responsibility with regard to the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the CONTRACTOR, and the ENGINEER will have no responsibility.

d. Contract work, materials, fabrication, and installation shall conform with approved CONTRACTOR'S drawings.

2. Shop Drawings

a. Shop drawings shall show types; sizes; accessories; layouts, including plans, elevations, and sectional views; components; assembly and installation details; and all other information required to illustrate how applicable portions of the Contract requirements will be fabricated, sequenced and/or installed, such as layouts for pump stations or sequences for construction through stream crossings. In the case of pre-cast concrete structures, layout drawings drawn to scale shall be submitted to show structure top and bottom slab design including anti-flotation calculations, side wall thickness, and openings. This will include manufacturer's certified testing data, catalog cuts, pamphlets, descriptive literature, installation, and application recommendations, as required. Shop drawings for closely related items, such as piping, valves, fittings and fastenings, shall be submitted together. Additional shop drawings and information required will be listed in appropriate specification sections. Shop drawings shall be specific for this project. Shop drawings which provide only generic information or are of a generic nature are not sufficient.

b. Where required as noted in Contract Drawings, shop drawings shall document design calculations and be signed and sealed by a licensed Maryland Professional Engineer, Maryland Professional Land Surveyor, or other appropriate credentialed professional. This includes, but is not limited to, pre-cast concrete structures including wet well, wet well replacement slabs and sections, and manholes exceeding depth identified in standard details, with calculations identifying design loading and assumed Factors of Safety.

3. Catalog Data

a. Submittals shall include the manufacturerôs name, trade name, place of manufacture, catalog model number, complete part number, nameplate data, size, layout dimensions, capacity, project specification, and paragraph reference.

b. Submittals for each manufactured item shall be current manufacturerôs descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog data sheets.

c. Clearly indicate proposed unit on all generalized cut sheets. If the catalog data provided has multiple options (dimensions, sizes, optional accessories, etc.) of a piece of equipment proposed for this project, CONTRACTOR must clearly and visibly indicate which option is proposed for this Site. Catalog data with multiple options and no indication of proposed selection from CONTRACTOR will be rejected.

4. Installation Drawings

a. Submit installation drawings that depict Contractor-designed items and methods of construction. Review and approval of such drawings by the ENGINEER shall not relieve the CONTRACTOR from his responsibility with regard to the fulfillment of the terms of the Contract. All risks of error are assumed by the CONTRACTOR.

5. Material List

a. Submit installation drawings that depict Contractor-designed items and methods of construction. Review and approval of such drawings by the ENGINEER shall not relieve the CONTRACTOR from his responsibility with regard to the fulfillment of the terms of the Contract. All risks of error are assumed by the CONTRACTOR.

b. The CONTRACTOR shall submit, along with Shop Drawings, a materials list which shall include full information, including manufacturerôs complete part number, regarding all components of the equipment. Materials of construction shall be presented in the listing by ASTM reference and grade.

6. Manufacturerôs Installation Recommendations

a. Manufacturerôs installation recommendations and instructions shall provide written detailed step-by-step preparation and installation of the materials and products, including recommended quality control testing, pump operations, pipe joining, supports and welding, etc.

7. Method of Construction

a. When so specified or directed by the ENGINEER, submit proposed methods of construction for specific portions of the work. This submittal shall include a detailed written description of all phases of the construction operation to fully explain to the ENGINEER the proposed method of construction. If required by the specifications, submit installation drawings to supplement the description. Review and approval by the ENGINEER will be in accordance with the approval process herein and shall not relieve the CONTRACTOR from his responsibility with regard to fulfillment of the terms of the Contract. All risks associated with the proposed method remain the CONTRACTOR'S responsibility, and therefore the ENGINEER shall have no responsibility.

b. After review and approval, if, in the opinion of the CONTRACTOR, modifications are necessary, submit such modifications in detail, including reasons for the modifications. Modifications shall not be implemented without review and approval by the ENGINEER.

8. Closeout Submittals

a. Operation and Maintenance Data

(1) Submit in PDF composite electronic indexed file.

(2) Submit data bound in 8-1/2 x 11-inch text pages, 3-ring binders with durable plastic covers.

(3) Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS, WASHINGTON COUNTY PUMP STATION UPGRADES," and subject matter of binder when multiple binders are required.

(4) Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

(5) Drawings—Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

(6) Contents—Prepare table of contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:

(7) Part 1—Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.

(8) Part 2—Operation and maintenance instructions, arranged by system and subdivided by Specification Section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Include the following:

(a) Significant design criteria.

(b) List of equipment.

(c) Parts list for each component.

(d) Operating instructions.

(e) Maintenance instructions for equipment and systems.

(f) Maintenance instructions for [special] finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

(g) Safety precautions to be taken when operating and maintaining or working near equipment.

(9) Part 3 ï Project documents and certificates, including the following:

(a) Shop Drawings and product data.

(b) Certificates.

(c) Originals of warranties.

b. Manual for Equipment and Systems

(1) Submit electronic copy of preliminary draft or proposed formats and outlines of contents before start of Work. ENGINEER will review draft and return with comments to be integrated into subsequent manual submittals.

(2) For equipment, or component parts of equipment put into service during construction and operated by COUNTY, submit documents within ten days after acceptance.

(3) Submit four copies of completed volumes before Substantial Completion, 15 days prior to final inspection. Draft copy will be reviewed and returned after final inspection, with ENGINEER comments. Revise content of document sets as required prior to final submission.

(4) Submit four sets of revised final volumes within 10 days after receipt of ENGINEERôs comments.

(5) Submit in PDF composite electronic indexed file of final manual within 10 days after receipt of ENGINEERôS comments.

(6) Each Item of Equipment and Each System—Include description of unit or system and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.

(7) Panelboard Circuit Directories—Provide electrical service characteristics, controls, and communications.

(a) Include color-coded wiring diagrams as installed.

(8) Operating Procedures—Include startup, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and special operating instructions.

(9) Maintenance Requirements—Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

(10) Include servicing and lubrication schedule and list of lubricants required.

(11) Include manufacturerôs printed operation and maintenance instructions.

(12) Include sequence of operation by controls manufacturer.

(13) Include original manufacturerôs parts list, illustrations, assembly drawings, and diagrams required for maintenance.

(14) Include control diagrams by controls manufacturer as installed.

(15) Include Contractorôs coordination drawings with color-coded piping diagrams as installed.

(16) Include charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

(17) Include list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

(18) Additional Requirements—As specified in individual product Specification Sections.

(19) Include listing in table of contents for design data with tabbed dividers and space for insertion of data.

c. Spare Parts and Maintenance Products

(1) Furnish spare parts, maintenance, and extra products in quantities specified in individual Specification Sections.

d. Product Warranties

(1) Obtain warranties executed by responsible Subcontractors, suppliers, and manufacturers within 10 days after completion of applicable item of Work.

(2) Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers.

(3) Verify documents are in proper form, contain full information, and are notarized.

(4) Submit prior to final Application for Payment.

e. Time of Submittals

(1) For equipment or component parts of equipment put into service during construction with COUNTYôS permission, submit documents within 10 days after acceptance.

(2) Make other submittals within 10 days after date of Substantial Completion, prior to final Application for Payment.

(3) For items of Work for which acceptance is delayed beyond Substantial Completion, submit within 10 days after acceptance, listing date of acceptance as beginning of warranty or bond period.

9. Submittal Process

a. General

(1) Each CONTRACTORôS submittal shall have affixed to it the following certification statement signed by the CONTRACTOR:

ñCertification Statement:

By this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers, and pertinent data, and I have checked and coordinated each item with other applicable approved drawings and all contract requirements.ò

b. Identification

(1) With the first submittal, submit a CONTRACTORôS drawing submittal schedule listing as near as practical, by specification section number, all submittals required and approximate date the submittal will be forwarded. All submittals for approval shall have the following identification data, as applicable:

(a) Submittal Number.

(b) Project name and location.

(c) Product identification.

(d) Drawing title, drawing number, revision number, and date of drawing and revision.

(e) Applicable Contract Drawing numbers and Specification section and paragraph numbers.

(f) Subcontractorôs, vendorôs, and/or manufacturerôs name, address, and phone number.

(g) CONTRACTORôS certification statement.

c. Submittal Identification System: Use the following submittal identification system, consisting of submittal number and review cycle number.

(1) Submittal Number: Shall be separate and unique number correlating to each individual submittal required. CONTRACTOR shall assign submittal number as follows:

(a) First part of submittal number shall be the applicable Specification Section number, followed by a hyphen.

(b) Second part of submittal number shall be a three-digit number (sequentially numbered from 001 through 999) assigned to each separate and unique submittal provided under the associated Specification Section.

d. Review Cycle Number: Shall be a letter designation indicating the initial submittal or re-submittal associated with each submittal number:

(1) ñAò = Initial (first) submittal.
(2) ñBò = Second submittal (e.g., first re-submittal).
(3) ñCò = Third submittal (e.g., second re-submittal).

e. For catalog product data or brochures submitted in packages of multiple items, the identification is needed only on the exterior. In such instances, the identification shall include page and catalog item numbers for items submitted for approval. If one or more of the items in such a submittal are not approved, resubmittal of only the unapproved items is required. Catalog, product data, or brochures containing various products, sizes, and materials shall be highlighted to show the particular item being submitted. Likewise, items not applicable to the Contract shall be marked ñnot applicableò or crossed out.

f. Space

(1) Vacant space of approximately 2.5 inches high by 4 inches wide shall be provided adjacent to the identification data to receive the ENGINEERôS status stamp.

g. Number of Copies

(1) For the original submittal and each subsequent resubmittal that may be required, submit two legible prints and an electronic PDF document of all shop and working drawings, and three copies of catalog data, method of construction, and manufacturerôs installation recommendation to the ENGINEER for approval. One PDF of CONTRACTORôS submittals will be returned to the CONTRACTOR with any comments from the ENGINEER.

h. Approval Process

(1) Each submittal shall be in accordance with the CONTRACTORôS drawings submission schedule. Allow 20 days for checking and appropriate action by the ENGINEER. Contractorôs drawings will be returned stamped with one of the following classifications:

(a) APPROVED ï No corrections, no marks.

(b) APPROVED AS NOTED ï A few minor corrections. All items may be fabricated as marked without further resubmission. Resubmit a corrected copy to the ENGINEER.

(c) REVISE AND RESUBMIT ï Minor corrections. Items not noted to be revised and corrected may be fabricated. Resubmit drawings as per original submissions with corrections noted. Allow 20 days for checking and appropriate action by the ENGINEER.

(d) NOT APPROVED ï Requires corrections or is otherwise not in accordance with the contract documents. No items shall be fabricated. Allow 20 days for checking and appropriate action by the ENGINEER.

10. Samples

a. General

(1) The CONTRACTOR is required to collect and test material samples to certify that they meet the requirements of these Specifications. The cost of sample testing shall be borne by the CONTRACTOR. These certified test results shall be submitted by the CONTRACTOR to the ENGINEER for approval of the material. The ENGINEER may conduct separate testing of material samples to confirm test results.

(2) As soon as practicable after the issuance of the Notice to Proceed, the CONTRACTOR shall submit names of material suppliers and borrow sources, along with samples required by the Specifications or requested by the ENGINEER. Unless otherwise specified, the original submittal shall be a sample of each item. Approval shall be obtained from the ENGINEER prior to delivery of the material to the Site. Such samples shall be representative of the actual material proposed for use in the project and of sufficient size to demonstrate design, color, texture, and finish when these attributes will be exposed to view. If samples deviate from requirements in the Contract Documents, the CONTRACTOR shall so advise the ENGINEER in writing with the submittal and state the reason therefore.

b. Identification

(1) Each sample or laboratory test data results shall have the following identification data permanently attached:

(a) Project name and location.

(b) Applicable Contract Drawing and/or Specification section number.

(c) Subcontractorôs, vendorôs, and/or manufacturerôs name, address, and phone number.

(2) Mail under separate cover a letter submitting each shipment of samples containing the identification information listed herein. Enclose a copy of this letter with the shipment.

c. Approval Process

(1) Allow 14 days for checking and appropriate action by the ENGINEER. Certain samples may be tested for specified requirements by the COUNTY before approval is given. Failure of a sample to pass such tests will be sufficient cause for refusal of that material and its source. Rejected samples will be returned upon request, and any or all resubmittals required shall consist of new samples and an additional 14 days for checking and approval. All sample testing will be performed by the CONTRACTOR at the CONTRACTORôS own expense. Upon approval, one sample so noted will be returned and the remainder will be retained by the ENGINEER until completion of the work. When requested, all but one approved sample will be returned for installation provided their identity is maintained in an approved manner until final acceptance of the project.

(2) Samples of various materials or equipment delivered to the Site may be taken by the ENGINEER for testing. Samples failing to meet the requirements of this Contract will automatically void previous approvals, and resubmittal or retesting of the samples will be required.

11. Record Documents

a. The CONTRACTOR shall keep one record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications at the Site in good order and annotated to show all revisions made during construction. Such annotations shall be kept current. These record documents together with all approved Samples and Shop Drawings, inspection reports, test results

and Manufacturerôs instructions will be available to COUNTY and ENGINEER for reference at any time. Failure to maintain current record documents will be cause to withhold progress payments. Record drawings shall be available to the COUNTY and ENGINEER at all times during the life of the Contract.

b. All drawings shall be made a part of the record documents. Record Drawings (As-Builts) shall include the following:

(1) Contract Drawings—Annotate or redraft, as required, to show all revisions, substitutions, variations, omissions, and discrepancies made or discovered during construction. These shall include, but are not limited to, location and depth of utilities, piping, conduits, manholes, excavations, piping connections, and other equipment. Revisions shall be made and shown on all drawing views with actual dimensions established to permanent points.

(2) Installation Drawings—Same as Contract Drawings above when installation drawings are required. Include, for example, layout and piping connections and well head assembly. Sections and details shall be added, as required, for clarity.

c. The scanned drawing sets shall be complete. Each individual sheet contained in the Contract Drawings shall be included in the electronic submittal, with each sheet being converted into an individual TIF (tagged image file). The plan sheets shall be scanned in tif format Group 4 at 400 dpi resolution to maintain legibility of each drawing. Then, the TIF images shall be embedded into a single PDF (Adobe Acrobat) file representing the complete plan set.

d. In addition to PDFs, CAD files (AutoCAD) of CONTRACTORôS prepared Record Drawings shall be submitted.

e. Prior to inspection for Substantial Completion, submit two copies and PDF files of Record Drawings (As-Builts) to ENGINEER for review. Plot and print each Drawing, whether changes and additional information were recorded.

f. At the completion of the Contract, or at the ENGINEERôS request and before final payment is made, furnish the ENGINEER one set of reproducibles and two copies of the final Record Documents. Include two sets of Record Documents in electronic format on compact disc (CD) or thumb drive.

g. Upon completion of the Work, these record documents, Samples, and Shop Drawings will be delivered to ENGINEER for COUNTY.

**100-005**
**Measurement and Payment**

## A. Description

1. The items listed in this Section refer to and are the same pay items listed on the Bid Form. They constitute all pay items for the completion of the Work. Compensation for all such services and materials shall be included in the prices stipulated for the lump sum and unit price pay items listed herein. Items of Work not specifically included in this Section for measurement and payment as described herein will not be measured for payment but will be considered incidental to the Contract with the associated costs borne solely by the CONTRACTOR.

## B. Bid Items Descriptions

1. Mobilization and Demobilization ï Bid Item No. 1

   a. This item consists of all materials, labor, and equipment to complete Work activities for mobilization and demobilization. The Work shall include, but not be limited to: obtaining all required permits; moving all equipment to the site; furnishing and erecting temporary buildings and other construction facilities; bonding, insurance, surety, and administrative costs; temporary utilities; plan and shop drawing preparation; health and safety plans; materials handling plans; excavation plans; construction/installation plans; bypass pumping plan; construction quality control plans; implementation of security requirements; field offices and requirements; surveying and staking out of work area; equipment demobilization; removal of temporary facilities and utilities; submission of final as-builts; and contract completion requirements.

   b. Bid Item No. 1 Mobilization and Demobilization will not be measured and will be paid by lump sum at the Contract price in accordance with the Contract Documents. None of this item will be paid until COUNTY acceptance of the project schedule. No more than 70 percent of this item will be paid until the last payment request is made prior to the request for release of retainage.

2. Site Preparation ï Bid Item No. 2

   a. This item consists of all materials, labor, and equipment necessary to complete clearing and grubbing the project area within the limits of disturbance (only where needed), and establishment of construction staging areas as shown on the Contract Drawings and as necessary. The Work shall include, but not be limited to: clearing, grubbing, test pitting, removal of vegetation and roots both in ground and stockpiled, stripping

and salvaging existing topsoil, tree and stump removal, disposal, stockpiling, hauling, management of cleared and grubbed materials; traffic control, as necessary throughout construction; and all incidentals as specified in the Contract Documents

b. Bid Item No. 2 Site Preparation will not be measured and will be paid by lump sum at the Contract price in accordance with the Contract Documents.

3. Erosion and Sediment Control – Bid Item No. 3

a. This item consists of all materials, labor, and equipment to complete all Work activities relating to erosion and sediment control, including control of dust. The Work shall include, but not be limited to installation and maintenance of stabilized construction entrances; establishment of temporary and permanent vegetative stabilization; placement of seed, sod, fertilizer, lime and mulch; maintenance of stabilized areas; and re-stabilization of any and all disturbed areas; silt/super silt fencing; dewatering, including use of sump pits and portable sediment tanks; temporary asphalt berms; temporary stone outlet structures; dust control; road cleaning, use of filter bags, and maintenance of installed erosion and sediment controls. The Work shall include furnishing all labor, equipment, and materials needed to complete the Work and maintain the control devices throughout construction and leave them in a clean, acceptable, operable condition at the end of construction. All erosion and sediment control measures shall be provided to contain all Work activities in accordance with the Contract Documents. Erosion and sediment controls required during sewer main installation at stream crossings is excluded from this bid item and included in Bid Item No. 13 Stream Crossing.

a. Bid Item No. 3 Erosion and Sediment Control will not be measured and will be paid by lump sum at the Contract price in accordance with the Contract Documents.

4. Farm Lane Pump Station Upgrades – Bid Item No. 4

a. This item consists of all materials, labor, and equipment to complete all Work activities relating to completion of upgrades at the Farm Lane Pump Station. The Work shall include, but not be limited to, the following: removal of two existing dry well-mounted 15-horsepower (hp) pumps; replacement with two wet well-mounted submersible 50-hp pumps; existing dry well abandonment in place; installation of discharge piping; installation of valve vault and appurtenances, including dewatering as necessary during installation; connection of discharge piping to existing forcemain; removal of existing equipment and appurtenances within wet

well; structural modifications to existing wet well; existing pump station building modifications; existing electrical demolition; provision of pump system and valve package; provision and installation of grinder and pre-fabricated manhole assembly, and appurtenances, including controls; provision and installation of flowmeter and controls; existing pump station building mechanical, architectural upgrades; electrical upgrades, including generator, panelboards, transformer, enclosures, conduit, wiring and all other necessary electrical equipment; installation of temporary bypass system, and operation throughout construction, including bypass pumping; installation of generator and equipment pads; site fence and gate; electrical service, outdoor lighting, additional site demolition; site restoration; and all incidentals, as specified in the Contract Documents.

b. Bid Item No. 4 Farm Lane Pump Station Upgrades will not be measured and will be paid by lump sum at the Contract price in accordance with the Contract Documents.

5. Maugansville Road Pump Station Upgrades ï Bid Item No.5

a. This item consists of all materials, labor, and equipment to complete all Work activities relating to completion of upgrades at the Maugansville Road Pump Station. The Work shall include, but not be limited to, the following: provision and installation of wet well including excavation of unclassified soil and rock, rock disposal, sheeting and shoring, bedding, and dewatering of groundwater and perched water; wet well piping; DIP discharge piping; provision and installation of pump package enclosure system, including two 40-hp suction lift pumps, appurtenances, controls and enclosure; pump station enclosure pad and enclosure installation; grinder and grinder motor, and appurtenances, including controls; existing wet well and dry well abandonment in place, including backfill and surface restoration; existing pump station building modifications, including electrical demolition, generator removal, architectural modifications, and electrical new work; removal of existing fuel tank; installation of temporary bypass system, and operation throughout construction, including bypass pumping; provision and installation of flowmeter and controls; installation of generator and equipment pads; electrical upgrades, including generator, panelboards, transformer, enclosures, conduit, wiring and all other necessary electrical equipment; electrical service; outdoor lighting, site finish grading, gravel driveway, site restoration; and all incidentals as specified in the Contract Documents. HDPE Forcemain piping, and PVC gravity main piping are excluded from this bid item and included in Bid Item No. 8 Forcemain and Bid Item No. 11 Gravity Main, respectively.

b. Bid Item No. 5 Maugansville Road Pump Station Upgrades will not be measured and will be paid by lump sum at the Contract price in accordance with the Contract Documents.

6. Maugans Meadows Pump Station Demolition – Bid Item No. 6

a. This item consists of all materials, labor, and equipment to complete all Work activities relating to demolition of the Maugans Meadows Pump Station, excluding new gravity piping and manholes. The Work shall include, but not be limited to, the following: removal of existing pump station brick building and slabs on grade; abandonment of existing wet well and dry well in place; removal and/or abandonment of existing gravity sewer main and manholes as indicated in Contract Documents; installation of temporary bypass system, and operation throughout construction, including bypass pumping; demolition of existing electrical; removal of existing transformer; reconnection of existing piping to remaining (MH15-1151) and replaced (MH15-1152 manholes; site restoration; and all incidentals as specified in the Contract Documents. PVC gravity main piping is excluded from this bid item and included in Bid Item No. 11 Gravity Main.

b. Bid Item No. 6 Maugans Meadows Pump Station Demolition will not be measured and will be paid by lump sum at the Contract price in accordance with the Contract Documents.

7. New Regional Pump Station – Bid Item No. 7

a. This item consists of all materials, labor, and equipment to complete all Work activities relating to construction of the New Regional Pump Station. The Work shall include, but not be limited to, the following: provision and installation of wet well including excavation of unclassified soil and rock, rock disposal, sheeting and shoring, bedding, and dewatering of groundwater and perched water; wet well piping; DIP discharge piping; provision and installation of pump package enclosure system, including two 75-hp suction lift pumps, appurtenances, controls and enclosure; pump station enclosure pad and enclosure installation; grinder, grinder motor, and appurtenances, including controls; installation of temporary bypass system, and operation throughout construction, including bypass pumping; provision and installation of flowmeter and controls; electrical upgrades, including generator, panelboards, transformer, enclosures, conduit, wiring and all other necessary electrical equipment; electrical service; generator and equipment pads, outdoor lighting, site fencing, site grading and finish grading; existing access road repairs at New Regional Pump Station; new access road at New Regional Pump Station; site restoration; and all incidentals as specified in the Contract Documents. HDPE Forcemain piping, and PVC gravity main

piping are excluded from this bid item and included in Bid Item No. 8 Forcemain and Bid Item No. 11 Gravity Main, respectively.

b. Bid Item No. 7 New Regional Pump Station will not be measured and will be paid by lump sum at the Contract price in accordance with the Contract Documents.

8. Forcemain ï Bid Item No. 8

a. This item consists of all materials, labor, and equipment to complete Work activities to install Forcemain to the limits shown on the Contract Drawings. The Work shall include, but not be limited to, the following: topsoil salvage, excavation of unclassified soil and rock, trenching, undercut, groundwater management including perched water (if required), blasting (if approved), hauling, crushing, onsite stockpiling, rock disposal, installation of HDPE SDR11 DIPS force main pipe, pipe bedding, backfill and compaction, warning tape and tracer wire; removal of existing piping; fittings; valves and manholes, except as included in other bid items; surveying, grading, site restoration, testing and all incidentals, to complete the Work in accordance with the Contract Documents. Traffic control required during forcemain installation is excluded from this bid item and included in Bid Item No. 2 Site Preparation. Air Release Valves and associated valve vaults and appurtenances are excluded from this bid item and included in Bid Item No. 9 Air Release Valves and Vaults. Flushing connections and associated manholes and appurtenances are excluded from this bid item and included in Bid Item No. 10 Flushing Connections.

b. Bid Item No. 8 Forcemain will be measured on a linear foot basis of the length of forcemain piping installed. Payment will be made at the Contract unit price in accordance with the Contract Documents.

9. Air Release Valves and Vaults ï Bid Item No. 9

a. This item consists of all materials, labor, and equipment to complete Work activities to install air release valves and vaults at locations shown on the Contract Drawings. The Work shall include, but not be limited to, the following: provision and installation of air release valves, isolating valves, plug valves, fittings, valve box, vaults, frame and cover, vault bedding, backfill and compaction; surveying, testing and all incidentals, to complete the Work in accordance with the Contract Documents.

b. Bid Item No. 9 Air Release Valves and Vaults will be measured on an each basis. Payment will be made at the Contract unit price in accordance with the Contract Documents.

10. Flushing Connections ï Bid Item No. 10

a. This item consists of all materials, labor, and equipment to complete Work activities to install flushing connections at locations shown on the Contract Drawings. The Work shall include, but not be limited to, the following: provision and installation of flushing connections, valves, valve box, fittings, lateral piping, frame and cover, vault, vault bedding, backfill and compaction; surveying, testing and all incidentals, to complete the Work in accordance with the Contract Documents.

b. Bid Item No. 10 Flushing Connections will be measured on an each basis. Payment will be made at the Contract unit price in accordance with the Contract Documents.

11. Gravity Main ï Bid Item No. 11

a. This item consists of all materials, labor, and equipment to complete Work activities to install PVC SDR26 HW Gravity Main and laterals to the limits shown on the Contract Drawings. The Work shall include, but not be limited to, the following: topsoil salvage, excavation of unclassified soil and rock, trenching, undercut, groundwater management including perched water (if required), blasting (if approved), hauling, crushing, onsite stockpiling, rock disposal, installation of gravity main pipe, pipe bedding, backfill and compaction; warning tape; fittings, manholes and vaults, including appurtenances, except as included in other bid items; surveying, grading, site restoration, testing and all incidentals, to complete the Work in accordance with the Contract Documents. Traffic control required during forcemain installation is excluded from this bid item and included in Bid Item No. 2 Site Preparation.

b. Bid Item No. 11 Gravity Main will be measured on a linear foot basis of the length of gravity main piping installed. Payment will be made at the Contract unit price in accordance with the Contract Documents.

12. Jack and Bore ï Bid Item No. 12

a. This item consists of all materials, labor, and equipment to complete Work activities to install sewer pipe with steel casing by jack and bore at the locations shown on the Contract Drawings. The Work shall include, but not be limited to, the following: sending and receiving drill pit excavation, including topsoil salvage, excavation of unclassified soil and rock, undercut, groundwater management including perched water (if required), blasting (if approved), hauling, crushing, onsite stockpiling, rock disposal; steel casing, casing spacers, end seals, bulkheads, jack and bore; drill pit backfill and compaction; surveying, grading, site restoration,

testing and all incidentals, to complete the Work in accordance with the Contract Documents.

b. Bid Item No. 12 Jack and Bore will be measured on a linear foot basis of the length of steel casing piping installed. Payment will be made at the Contract unit price in accordance with the Contract Documents.

13. Stream Crossing ï Bid Item No. 13

a. This item consists of all materials, labor, and equipment to complete all Work activities relating to installation of sewer pipe at stream crossing locations. The Work shall include, but not be limited to: installation of pump around for clear water diversion, including establishment of dike, sandbags, impermeable sheeting, erosion control matting, fiber rolls and stakes; diversion and pump around piping, anchoring; silt/super silt fencing; dewatering, including use of sump pits and portable sediment tanks; road cleaning, pumping and maintenance of installed erosion and sediment and stream diversion controls. The Work shall include furnishing all labor, equipment, and materials needed to complete the Work. All shall be provided in order to contain all Work activities in accordance with the Contract Documents.

b. Bid Item No. 13 Stream Crossing will not be measured and will be paid by each at the Contract price in accordance with the Contract Documents.

14. Roadways and Surface Restoration ï Bid Item No. 14

a. This item consists of all materials, labor, and equipment to complete Work activities to perform restoration of all surfaces upon construction completion, to the limits shown on the Contract Drawings, and not included in other bid items. The Work shall include, but not be limited to, the following: preparing subgrade; furnishing and installing graded aggregate base, hot mix asphalt base course, and surface course; gravel access road; driveway repairs; testing; permanent seeding; and all incidentals to complete the Work in accordance with the Contract Documents.

b. Bid Item No. 14 Roadway Restoration will not be measured and will be paid by lump sum at the Contract price in accordance with the Contract Documents.

**100-006**
**Special Conditions**

## A. Description

1. This Section includes requirements for Special Conditions to supplement specifications included in the Washington County Department of Water Quality (DWQ) Standard Specification Section 103 Special Conditions.

## C. Legal Holidays and the Work Week

ADD: The following legal holiday to the first sentence:

Juneteenth Day.

## Chapter 2, Section 201

## Surveys and Construction Stakeout

## I. Surveys and Construction Stakeout

### A. General

The Contractor / Developer shall perform and furnish all survey and stakeout required for the work. The Contractor / Developer shall provide competent personnel under the employ of professional surveyor(s) or engineer(s) and shall provide the necessary materials and equipment for setting stakes and making measurements in order to complete the installations in accordance with the plans and specifications. All information obtained by the surveys shall become the property of the Department.

Cut / reference sheet(s) shall be submitted to the Department, in triplicate, at least 72 hours in advance of intended start of construction. No pipeline work shall begin by the Contractor without approved cut / reference sheet(s) in his possession at the work site.

Surveyor shall stakeout all right-of-way, property corners, and easements adjacent to water/sewer utility construction. All proposed work shall be confined to County right-of-way or easements. This paragraph doesn't apply to residential developments.

All sewer laterals shall be located within the County right-of-way or platted easement. No lateral shall be placed within a drainage swale, or other depressions.

### B. Gravity Sewer Stakeout

Standard Detail S-12.3, *CUT SHEET,* shall be utilized to show all stakeout information for gravity sewers containing manholes, cleanouts, include service lateral location, benchmarks, or other structures, consisting of horizontal layout and vertical control at each manhole. Only one manhole-to-manhole section shall be described per each cut sheet submittal.

Vertical control shall be achieved by a bench mark set at within 100 feet of each manhole. Datum shall be *U.S.G.S.* looped and tied to a monument, or established County bench mark.

Additional vertical control shall be provided by field run centerline profile ground elevations at 25 feet stations. (Offset hubs and cut-to-invert shall be used at 25 feet stations for batter board construction. At least three (3) consecutive stakes shall be set with the same cut-to-invert.) Where profiles determine that embankments are required for minimum pipe cover, the location must be listed under *REMARKS.* Embankment must be constructed to a minimum of 3 feet above crown of pipe prior to pipe line installation.

Where the laser beam method of construction is utilized, offset stakes will be required at 100' intervals, at all connections, and at each manhole for horizontal and vertical control. Laser beam set-up shall be made utilizing this control. In this case, sewer stakeout grade and cut sheets shall be required as above.

Sewer slope shall be calculated by actual pipe length from outside face of manhole (i.e. two feet from center of 4' manhole) to outside face of manhole. *CUT TO INVERT* shall be computed and listed on Standard Detail S-12.3. Inverts of additional manhole connections (invert) as well as lateral connections to manholes shall be described under *REMARKS.*

Horizontal control shall be referenced by right angle beginning at the downstream structure or manhole. Two offset hubs and tacks shall be set for each manhole center location. Offsets shall be located out of the path of construction traffic. Turned angles shall be shown for additional manhole connections. Sketch shall show street names, etc. for visual reference.

## C. PRESSURE PIPE

Pressure pipe shall include water lines, force mains, low-pressure sewers, and service connection. Standard Detail SW-12.4, *REFERENCE SHEET*, shall be utilized to show all stakeout information, consisting of horizontal layout and vertical control.

Vertical control shall be achieved by a bench mark set at three hundred (300') feet intervals maximum. Datum shall be *U.S.G.S.* looped and tied to an existing monument, or County benchmark.

Additional vertical control shall be provided by field run centerline profile ground elevations at 25 feet stations. Where profiles determine that embankments are required for minimum pipe cover, the location must be listed under *REMARKS.* Embankment must be constructed to a minimum of three feet pipe cover prior to pipeline installation.

Horizontal control shall be provided by offset hubs and tacks set at one hundred (100') feet intervals listing station and offset, and at all valves, fittings and appurtenances, listing the same. Offsets shall be located out of the path of construction traffic. Sketch shall show street names, etc. for visual reference.

*REMARKS* column shall show the beginning and ending stations of stabilized area construction, and the limits of paving restoration, top soil, seeding & mulch, stone drives, parking lots and concrete.

## D. SURVEY REPSONSIBILITIES

The method employed by the Contractor for transferring line and grade from the stakeout to the pipe laying shall be subject to the Department's approval. The Contractor shall be responsible for any error in the line or grade of the finished work.

The Contractor shall carefully preserve bench marks, reference points and stakes, and in case of willful or careless destruction, the Contractor shall be responsible for any mistakes that may be caused by their unnecessary loss or disturbance.

Prior to the final acceptance of the work by the County, the Contractor shall re-establish and replace any disturbed property monuments within the project limits of work at no cost to the affected property owner, easement holder, or the Department and shall furnish the property owner with a property survey of the affected portions of the project site certifying by a licensed P.S. or P.L.S. that all disturbed property monuments have been accurately replaced.

**Chapter 2, Section 202**

**Excavation and Backfill**

## II. Excavation and Backfilling

### A. Scope of Work

The Contractor shall furnish all plant, labor, material and equipment to perform all excavation of every kind required for the work under the Contract. Contractor shall perform all filling and backfilling, shall construct all embankments and fills including furnishing, hauling and placing all material required for constructing embankments and fills. Contractor shall perform all grading, shall remove all water, shall satisfactorily dispose of all unsuitable and excess materials, shall furnish, install and remove all sheeting, bracing and shoring necessary to hold the sides of the excavations and to protect the work and existing structures and utilities. Contractor shall perform all incidental and appurtenant work required to satisfactorily complete the work as shown on the drawings, standard details and as specified, herein, and or as directed.

### B. General

All excavation for pipes shall be in open trenches, except where and to such extent as the Department may authorize or direct that the same be constructed by tunneling, jacking or boring, or where such is specified herein or shown on the Contract Drawings. Trenches may be, in general, excavated and backfilled either by machinery, or by hand as the Contractor may elect, provided however, that the Department shall be empowered, wherever such necessity exists, to direct that hand excavation be employed, and provided further, that excavation and backfilling by hand shall be performed to the extent herein specified or directed if so deemed necessary. The Contractor shall have no claim for extra compensation due to the fact that hand, instead of machine, excavation may be made necessary from any cause whatsoever. Excavation shall be considered as the removal of all necessary materials from their present location to their final location, as shown on the plans as described in these Specifications.

### C. Clearing and Grubbing

The Contractor shall be responsible to perform all work in accordance with the Maryland Standards and Specifications for Soil Erosion and Sediment Control. The approved Soil Erosion and Sediment Control plan shall be a guide of acceptable practices required for this project. Any additional measures required due to field conditions or the methods of construction utilized shall be provided by the Contractor at no additional cost to the Department.

The work under this item shall include the furnishing of all labor, materials and equipment necessary to clear and remove from the site, or dispose of in an

approved manner, all perishable and objectionable materials, including stumps, roots, and rocks within the line of construction to be accomplished.

As herein used, perishable material shall include boards, fences, trees, brush, vines, shrubs, logs, stumps, roots, weeds, rubbish and other organic matter above the surface of the ground, but not sod or topsoil, although a portion of sod and soil may be removed in connection with other materials.

All stumps and organic material shall be removed from areas to be occupied by structures, or areas that are to be finish-graded. Rock shall be removed to 12" below final grade to allow for a clay cap and topsoil for establishing ground cover as specified.

**D. Removal of Pavement and Storage of Trench Materials**

The Contractor shall clear and grub the surface and remove all surface materials of whatever nature over the line of the trench; he shall properly separate and classify the materials removed; and he shall store, guard and preserve said materials as may be required for use in backfilling, earth, sand, curbing, gutter and flagstones, and all sectional paving units which may be moved, together with all materials taken from the trenches, shall be removed from the street or roadway area to the approved waste area, or such other suitable place, and in such manner as shall be approved or directed by the Department. The Contractor shall be responsible for any loss of, or any damage to, paving materials through his own or his employees' careless removal or neglectful or wasteful storage, disposal or use of same.

The Contractor shall remove all pavements, road surfaces, curbing, driveways and sidewalks within the lines of excavation. Portland Cement Concrete pavements shall be opened by sawing at close joint and asphalt pavements by cutting two neat straight lines with channeling machine, hand operated pneumatic tools or by such other methods as will furnish a clean cut in the pavement and base without undue shattering. All concrete curbing, driveways or sidewalks within the lines of excavation shall be broken up and removed by the Contractor. All such work as above designated shall be performed at the Contractor's expense and in accordance with the rules and regulations of the municipality in which the work is performed. *The use of "pear" or weight dropped on pavement for breaking will not be allowed except by prior written permission of the Department.*

The Contractor shall remove paving of such width only as is necessary for the excavation of the trench, and in case he removes the paving for a greater width than is deemed necessary or in case he removes or disturbs any paving on account of settlement, slides or cave-ins or in making excavation outside the lines of the work without the written order of the Department, cost of permanently replacing the paving so removed shall be borne entirely by the Contractor. The Contractor

shall replace the pavement at his expense, to the extent (as directed) by the Depatment.

In case more material is excavated from any trench than can be backfilled over the completed pipe line or can be stored within the limits of the right-of-way, leaving space for drainage as herein provided, the excess material shall be removed to some convenient place, provided by the Contractor. The Contractor shall at his own cost and expense, bring back so much of the material so removed, as may be required to properly backfill the trench, if of the proper kind; or, if so directed by the Department, the Contractor shall, at his own cost and expense, furnish such other suitable material as may be deemed necessary.

When it is necessary to haul soft or wet material over the streets or roads, the Contractor shall provide suitable, tight vehicles, of a pattern approved by the Department for the purpose.

## E. Removal of, Stockpiling of, and Replacement of Surface Materials

Sod and/or topsoil shall be removed from all areas where excavations or fills are to be made. Sod, if specified to be replaced, shall be cut in suitable strips and carefully removed and stored for subsequent use. During the period of storage, the sod shall be kept suitably protected and watered.

Where seeding, sodding, or grading of areas is called for on the drawings or by these specifications, or where the topsoil or loam, or overburden is unsuitable for use in embankments, dams, or filled areas, the topsoil shall be removed and stockpiled for future use, or where unsuitable for use, as called for above, shall be discarded to such areas approved by the Department and/or the Washington County Soil Conservation District, where applicable, otherwise it shall become the property of the Contractor and shall be removed from the site.

In placing topsoil for sodding or seeding, all roots, logs, sticks, weeds, and other debris shall be removed. Stones or rocks that can be removed by garden rakes, as normally used, shall also be removed. The topsoil shall be spread to a minimum depth of four inches (4"), and shall be well raked and graded to drain, and depressions shall be filled in to leave the area level or to the lines and grades indicated on the drawings. Final raking shall take place at the time seeding or sodding is to be performed.

All shrubbery and trees located in the Right-of-Way, easements and work area which would interfere with or become damaged by the construction, shall be removed by balling in burlap, stored in a protected area and watered. Upon completion and backfill the shrubs and trees shall be replanted, except over utility lines or within easement area, in which case they shall be relocated as approved by the owner. The Contractor shall replace all shrubs and trees that are destroyed

by his removal or are not thriving at the end of the guarantee period, incidental to all work at no cost to the Department.

## F. Excavation Unclassified

All excavation unless otherwise specified shall be unclassified and shall include all material of any kind encountered, whether earth, rock, concrete, old foundations or other obstacles, hard or soft material, wet material, silt, water or other material. Unless and except as shown on the drawings, no subsurface explorations have been made to determine the character of the material at the side of the work.

The County has not investigated subsurface conditions to determine soil types, rock, water table, etc., and shall not be responsible for extra compensation nor delays caused by any encountered conditions.

If during construction a solution cavity is discovered, the Department may elect to have the developer to retain the services of a Geotechnical Engineer or other professional to evaluate and recommend corrective measures when a solution cavity (sinkhole) or a hazardous material is encountered in the excavation or project area. The Geotechnical Engineer shall submit a proposed recommendation to the County for review and approval. The Contractor shall perform the corrective measures as recommended within the report prepared by the Geotechnical Engineer.

## G. Trench Excavation General

The Contractor shall excavate, protect and backfill all trenches that may be necessary for completing the work to be performed under the contract. All excavation shall be in open trenches, except where and to such extent as the County may authorize or direct that the same be performed in tunneling, jacking/boring, or where such is specified in the special conditions or Contract plans. The use of excavation machinery shall be permitted. Hand methods of excavation shall be performed in places where operation of machinery will cause damage to trees, buildings, or other existing utilities above or below ground. No tunneling, boring, or forcing shall be allowed without special permission from the Department. The excavated material in non-paved areas must be stored in such a manner as not to encroach on private property, endanger the work, obstruct sidewalks nor interfere with surface drainage. In roadways and paved areas, all excavated material must be immediately removed from the work area to an approved storage site or removed from the project area for disposal by Contractor.

The Contractor may elect, provided, however, that the Department shall be empowered, wherever such necessity exists, to direct that hand excavation shall

be performed to the extent hereinafter specified. The Contractor shall have no claim for extra compensation due to the fact that hand, instead of machine, excavation may be made necessary from any cause whatsoever.

The Contractor shall perform all excavation of every description and of whatever substances encountered, to the depth indicated by the drawings, as specified herein or as directed by the Department. All excavated materials not required for backfill shall be removed and wasted or otherwise disposed in a legal manner by the Contractor.

## H. Removal of Water

The Contractor shall, at all times during construction, provide and maintain proper and satisfactory means and devices for the removal of all water entering the excavations, and shall remove all such water as fast as it may collect, in such a manner as shall not interfere with the prosecution of the work or the proper placing of concrete or other work, and in such a manner as will provide against the flotation of any structure, or pipe, without flooding such structure or pipe.

The Contractor shall build all dams and other devices necessary and provide and operate pumps, or well-point systems, of sufficient capacity for continuous dewatering of the excavations. The Contractor shall provide for the disposal of the water removed from excavations, in such manner as shall not cause injury to the public health, to public or private property, to any portion of the work completed or in progress, or produce any impediment to the use of highways, roads, lanes and streets by the public.

All discharge areas of pumping devices shall be in full compliance with the Washington County Soil Conservation District's regulations and specifications.

## I. Excavation Below Sub-Grade

When excavation is carried below sub-grade without the direction of the inspector the excavation is to be brought back to sub-grade with materials and in a manner approved by the Department.

If the Contractor excavates to the grade shown on the plans and the inspector finds on inspection of this sub-grade that it will not sustain the loads to which it will be subjected, the inspector may then direct further excavation and backfill with specified materials. The Contractor shall perform the corrective measures as directed by the Department and shall be paid for said work as unclassified excavation.

The term "sub-grade" as used herein shall mean the bottom of the excavated

trench, ready to receive bedding material.

## J. Width and Depth of Trenches

Sides of trenches shall be kept as nearly vertical as possible and shall be excavated true to line so that a clear space eight (8") inches in width is provided on each side of the barrel of the pipe to a height not less than the top of the pipe. If sheeting is required at the level of the pipe, the dimensions in the foregoing shall be applicable to the faces of the sheeting.

The depth of the excavation for the pipe or other structure herein specified shall be such that the proper grade as established on the plans is achieved in accordance with the installation detail.

Should the Contractor excavate beyond the limits herein specified, the space so caused alongside or below the sub-grade of the pipe shall be completely filled with materials approved by the Department, at the Contractor's expense.

Wherever necessary to prevent caving, trenches shall be adequately sheeted and braced. Trench sheeting shall remain in place until pipe has been laid and backfill completed to a minimum height of one foot above the crown of the pipe. All sheeting shall be raised and/or removed as backfilling is completed and no sheeting to remain in place without the written permission of the inspector.

Sub-grade of pipe trenches shall be taken to mean a horizontal plane six inches (6") below the underside of the pipe barrel or other structure as shown on the standard detail drawings herein.

## K. Length of Open Trench

The Department shall have the right to limit the amount of trench opened in advance of pipe laying and the amount of pipe laid in advance of backfilling, as determined and directed by the inspector. Generally, in undeveloped cross-country work areas, no more than two hundred feet (200') of trench shall be opened at any one place in advance of the completed trench. The amount of pipe laid in advance of backfilling shall not exceed 60 feet. In all roadways and residential areas, no more than fifty feet (50') of trench shall be opened in any one place in advance of the completed trench. In all cases, trench excavation shall be fully completed, except for the shaping of the bottom of the trench, at least twenty-five feet (25') in advance of the pipe placement, and shall be kept free from obstructions, except that at the close of the work at night, or at the discontinuance of work, the pipe laying shall be completed to within ten feet (10') of the end of the open trench. In all roadways and residential areas, all open trenches must be suitably bridged against intruders and traffic loading at the end

of each work day.

The inspector shall be empowered, at any time, to require the refilling of open trenches over completed pipelines, if, in his judgment, such action is necessary, and the Contractor shall thereby have no claim for extra compensation, even though to accomplish said refilling he is compelled temporarily to stop excavation or other work at any place.

If work is stopped on any trench, for any reason except by order of the Department, and the excavation is left open for any unreasonable length of time (in the opinion of the Department) in advance of construction, the Contractor shall, if so directed, refill such trench, at his own cost, and shall not again open said trench until he is ready to complete the structure therein.

## L. Protection of Traveling Public

Contractor shall in all cases be held liable for the safety of the general public entering or near the work area as related to his methods of construction, use of equipment, or control of traffic.

Streets, roads and alleys shall not be completely closed during construction unless authorized in writing, by the Washington County Division of Public Works.

The roadway on one side of the line of work shall be kept open at all times, and driveways shall be kept open.

The Contractor shall construct and maintain such adequate and proper bridges over excavation as may be necessary or as directed for safe accommodation of pedestrians or vehicles. The Contractor shall furnish and erect substantial barricades at crossings or trenches, or along the trench, to protect the traveling public.

Roadways, driveway, and sidewalks shall be kept clean, clear and free for the passage of vehicles or pedestrians, unless otherwise authorized in writing by the County. A straight and continuous passageway on sidewalks and over crosswalks, at least three feet (3') in width, shall be preserved free from all obstructions.

Where deemed necessary, such additional passageway as may be directed shall be maintained free of obstructions. Under no circumstances shall the Contractor obstruct fire hydrants or prevent their use at any time.

## M. Accommodation of Drainage

Gutters, sewers, drains and ditches shall be kept open at all times for surface drainage. No damming or ponding of water in gutters or other waterways will be permitted, except where stream crossings are necessary and then only to an extent, which the Department shall consider necessary in accordance with applicable permit. The Contractor shall not direct any flow of water across or over pavements except through approved pipes or properly constructed troughs, and he shall when so required, and at his own cost and expense, provide pipes or troughs of such sizes and lengths and as may be required, and place the same as directed. The grading in the vicinity of trenches shall be controlled so that the ground surface is properly pitched to prevent water running into the trenching.

In open water courses, ditches or pipes, encountered during the process of the work, the Contractor shall provide for the protection and securing of a continuous flow in such courses or pipes and shall repair any damage that may be caused by construction.

## N. Obstruction Shown on Drawings

Certain information regarding the reputed presence, size, character and location of existing underground structures may be shown on the contract drawings. There is no certainty of the accuracy of this information. The location of underground structures shown may be inaccurate and other obstructions than those shown may be encountered. The Contractor hereby distinctly agrees that the Department is not responsible for the accuracy of the information given; that he shall have no claim for delay, or extra compensation due to inaccuracy, insufficiency or absence of information regarding obstructions either revealed or not revealed by the drawing. The Contractor shall have no claim for relief from any obligation or responsibility under the Contract, in case the location, size or character of any pipe or other underground structure is not as indicated on the drawings, or in case any pipe or other underground structure is encountered that is not shown on the drawings.

## O. Removal of Obstructions

Should the position of any pipe, conduit, pole or other structures, above or below the ground, require its removal, realignment, or change due to the Contract work; but not be indicated in the Contract documents as part of the work, as determined by the Department; the work shall be performed by the owner of the obstructions, without cost to the Contractor; but the Contractor shall uncover and sustain the structures, at his own expense, before such removal and before and after such realignment or change as constituting part of the contract; and the Contractor shall not be entitled to any claim for damage or extra compensation on account of the

presence of said structure, or on account of any delay in the removal or rearrangement of the same.

The Contractor shall, without extra compensation, break through and reconstruct, if necessary, the invert or arch of any sewer, culvert or conduit that may be encountered and damaged, if the said structure is in such a position that, in the judgment of the County, removal, realignment or complete reconstruction is required.

The Contractor shall not interfere with any persons, firms, or corporations, or with the Owner in protecting, removing, changing, or replacing their pipes, conduits, poles, or other structures; but he shall offer said persons, firms, or corporations, or the owner, to take all such measures as they may deem necessary or advisable for the purpose aforesaid, and the Contractor shall thereby be in no way relieved of any of his responsibilities under the contract. At railway or railroad track crossings, any expense to which the owner of the trackage is put, in shoring up tracks, or in maintaining traffic shall be borne by the Contractor, whether same is billed directly to him, or the owner. Should any such bill be unpaid by the Contractor, before final payment under the contract is made, the Owner shall be empowered to pay said bill and retain the amount thereof, from any monies due, or to become due to the Contractor.

Except when trees are in rights-of-way, in immediate proximity to the trench, and are indicated for removal, relocation, or replacement, they shall not be cut down except by authorization of the County or owner of the project, and the Contractor shall have no claim for the extra compensation owing to the fact that he may be required to excavate by hand, or tunnel in the vicinity of trees that may be left standing. Trees located in SHA's Right-of-Ways needing to be removed require the Contractor to first apply and be granted a roadside tree permit from Maryland Department of Natural Resources.

## P. Change of Trench Location

Any change in the location of the trench, from that shown on the approved drawings, shall be authorized by the Department. The developer shall prepare revised construction drawings showing the proposed alignment prior to installing any pipe.

## Q. Miscellaneous Excavation

The Contractor shall do such miscellaneous excavating work as may be necessary or directed. Such excavation shall be subject to the same conditions and requirements as specified for trench excavation.

Miscellaneous excavation shall include the digging of test pits, or excavation for any special structure, outside the trench, that may not be shown on the drawings or described in the specifications, where such excavation is performed at the direction of the inspector.

Test pits shall be dug by the Contractor in areas of questionable existing utilities locations shown on the drawings, or utilities located by "Miss Utility", to verify size, location, and type prior to performing work in close proximity, at his own expense. All test pitting shall be done in the presents of the County's Inspector. Any utility, so shown or marked, and damaged by the Contract work, shall be repaired immediately, by direction of the respective utility.

## R. Embankment

Where embankment is necessary to achieve the subgrade of the pipe or structure, it shall be made to a minimum height of three feet (3') above the crown of the proposed pipe grade, or to the height, width, and slope shown as finished grade on the plans. The embankment shall then be excavated to the proper form and grade of the trench for the pipe installation.

For proposed roadways, the entire embankment or such portion thereof as may be deemed necessary, as directed by the Department, shall be made prior to the construction of the pipe utility, at such time and in such order as the Department may direct; and the embankment and the pipe and its appurtenances which may be laid thereon or therein, shall be maintained by the Contractor, at his own cost and expense, until the completion of the period of twelve (12) months from and after the date of the certificate of completion and acceptance unless otherwise noted for a longer period.

After carefully grubbing and clearing the ground, removing all loose rock and stone, and all muck and improper material, to such a depth as the inspector may determine, the embankment shall be built up of specified or selected approved materials, free from all stones above six inches (6") in diameter.

In case materials, which is unsatisfactory for the foundation of an embankment is encountered, said material shall be removed to such depth, and for such length and width as may be directed by the inspector. Acceptable embankment foundation (subgrade) shall be not less than 92 percent of maximum dry density as specified in AASHTO T-180.

The material for embankment shall be deposited in layers of not more the eight inches (8") in compacted thickness. Each layer shall be separately compacted to ninety five percent (95%) of maximum density at moisture content of within two (2) percentage points of optimum to final subgrade. The whole embankment shall be carried up evenly to the height given by the inspector in such a manner as to

make a compact and solid foundation. All performance/acceptable testing shall be the responsibility of the Contractor at his own expense. Field testing results shall become the property of the Department and provided to the inspector at the end of each day unless otherwise approved by the Department. Reports shall be completed and given to the inspector at the end of the work day or the start of the next work day. Complete test reports shall include the following: Date, weather, site conditions, test locations & results, maximum dry density & optimum moisture of fill material tested.

## S. Pipe Trenches in Fill

Where pipes are to be laid in areas of fill, the fill shall be made prior to laying pipe. After the fill is in place, the pipe trench shall be excavated to subgrade or to natural ground if lower than subgrade. Where it is necessary to excavate below subgrade, that portion of the trench above natural ground and below subgrade shall be filled with gravel or crushed stone as specified herein.

## T. Rock Excavation

Unless otherwise directed by the Department, rock or boulders shall be fully taken out at least twenty-five feet (25') in advance of pipe laying, and to a point at least six inches (6") below the invert of the pipe, and to a width not to exceed the width of the trench, for the size of pipe to be laid therein. The space below the outer bottom of the pipe shall be filled with specified aggregate bedding, as detailed. If rock below the specified trench subgrade is shattered due to excessive drilling or blasting, and, if in the opinion of the inspector, it is unfit for foundations, such shattered rock shall be removed and the area backfilled to the proper grade with material acceptable to the inspector, at the expense of the Contractor.

Where manholes are excavated in rock, they shall be excavated to a point twelve inches (12") from the outside the exterior lines of the masonry and to a depth of six inches (6") below the outside bottom of the masonry.

Wherever rock is encountered in the excavations for manholes where future connection are shown on the Contract drawings or where manholes would accept future connections as determined by the Department, or where stubs are to be left for future extension, the excavation shall conform to the lines of the prism required by the dimensions of such extension, but not less than five feet (5') from outside the exterior lines of the manhole, structure, or pipe end.

Rock appearing in miscellaneous excavations directed by the Department, shall be removed to lines and grade prescribed by the Department, if directed by the Department.

## U. Use of Explosives and Blasting

### 1. General

The Contractor shall provide all labor, materials, equipment, and services necessary for, and incidental to, the use of explosives and blasting for excavation.

Failure to comply or to complete any work in accordance with any specifications set forth will be sufficient grounds for suspension of privilege to blast. The Contractor shall not be entitled to any claims or any additional compensation, which shall arise from the suspension of the blasting.

Wherever rock is encountered in the excavation, it may be removed by means of explosives, however, the Contractor shall be solely responsible for injury to persons or property that may result from his use of explosives, and the exercise of, or failure to exercise control on the part of the Department shall in no way relieve him of responsibility for injury or damage resulting from their use.

All blasting shall be performed under the supervision of a licensed blasting expert, and subject to NFPA 495, Explosive Material Code, latest edition.

Blasting for excavation shall be permitted only after securing the required license for the use and handling of explosives from the State Fire Marshal. The Contractor shall notify the State Fire Marshall as required for any and all blasting operations. The Contractor's method for procedure relative to blasting shall conform to state laws and local municipal ordinances.

The State Fire Marshall is empowered to enforce regulations concerning the character and strength of explosives used, and the manner of their use and storage. Handling and storage of explosives shall be in accordance with Federal Regulation 18 U.S.C., Chapter 40, Sections 841-848.

Only the amounts of explosives required shall be kept in an approved location and shall be kept under lock, the key to be only in the hands of a licensed blaster.

The Contractor shall use the utmost care in the use of explosives necessary for the prosecution of the work, so as not to endanger life or property.

All explosives shall be transported and stored in a secure manner, and in accordance with local, state and federal laws, all vehicles and such storage

places shall be marked clearly "DANGEROUS – EXPLOSIVES".

*Controlled blasting techniques shall be used.* Modify the blasting round as necessary to achieve the best obtainable results and to keep the air blast over pressure, vibrations and noise within the limits of COMAR 12.03.01.09 "Control of Airblast and Ground Vibration for Blasting Operations". Exercise all possible care in drilling and blasting operation to minimize overbreak and blast damage of adjacent unexcavated ground. It shall be the Contractor's responsibility to produce a satisfactory excavated surface by determining the proper relationships of the factors of burden, spacing, depth of charge, amount of type of explosive, hole size and delay pattern, and other necessary considerations to achieve the required results.

Blasts shall be made only during daylight hours and all blasts shall be carefully confined and adequately covered, to prevent injury to persons and to protect adjacent structures and pipes against damage. Before detonation of each blast, ample warning shall be given to permit all persons to reach positions of safety. The Contractor shall control fly rock and materials so as to prevent damage to persons or structures. Rubber tire mats shall be used prior to blasting.

Equipment used for drilling of holes shall have a positive means of dust control to the Department's approval, and maintained in working order.

Whenever any pipe main or conduit is encountered in the trench, the right is reserved to direct that all rock within five feet (5') of the same is to be removed by some method other than blasting.

Any damage resulting from lack of control during the blasting last operation shall be the responsibility of and repaired at the expense of the Contractor.

**2. Blast Report**

The Contractor shall complete, maintain and submit permanent blast reports including logs of each blast. Logs shall be available for inspection by the County or authorized personnel at all times and retained for at least three (3) years. Reports may be accrued for one (1) week and must be submitted within five (5) days after the end of each week. Complete reports after each blast shall include the following:

1. Name of company or Contractor.
2. Location, date, and time of blast.
3. Name and signature of blaster in charge.
4. Type of material blasted.

5. Number of holes, burden, and spacing.
6. Diameter and depth of holes.
7. Types of explosives used.
8. Total amount of explosive used.
9. Maximum amount of explosive per delay period of 8 msec or greater.
10. Method of firing and type of circuit.
11. Direction and distance in feet to nearest structure neither owned nor leased by the person conduction the blasting.
12. Weather conditions including such factors as wind direction, etc.
13. Height or length of stemming.
14. If mats or other protection so as to prevent fly rock where used.
15. Type of detonators used and delay period used.
16. Seismograph recording including seismograph reading when required shall contain:
    a. Name and signature of individual operating the seismograph
    b. Name of individual analyzing the seismograph recorder
    c. Seismograph reading
17. The maximum number of holes per delay period of 8 msec. Or greater.
18. The person taking the seismograph reading shall accurately indicate the exact location of the seismograph, if used and shall also show the distance of the seismograph from blast.

### 3. Blasting Within Existing Development

All blasting will be monitored by the Contractor and at the expense of the Contractor, to control vibrations in the vicinity of roadways, structures and utilities. The Contractor shall provide the Department of Water Quality with 24 hours advance notice prior to any blasting with an existing development.

Peak particle velocity shall not exceed one inch (1") per second in the vicinity of structures and utilities and other objects subject to damage from the blasting operation. Particle velocities in excess of these limits shall be classified as out-of-control blasting and shall not be permitted.

The monitoring device shall be capable of measuring the velocity parallel and transversely to the direction of the blast and vertically. The equipment shall be capable of providing a permanent record of all recordings.

Monitoring instruments shall be placed directly on bedrock at a sufficient number of locations to develop attenuation curve. At least five percent of

the measurements shall be made within ten (10) feet of the blast.

The Contractor shall furnish to the County a certification of calibration for each monitoring instrument used on the project, and a list of qualified personnel certified to operate field equipment.

All data obtained from monitoring equipment shall be interpreted by an independent firm and a report to be forwarded directly to the Department on a timely basis. If the equipment used is capable of analyzing and interpreting data, that equipment must be approved by the Department prior to use.

## V. Blasting Within State Highway Right-of-Way

All blasting within the Maryland State Highway Right-Of-Way shall be in strict accordance with the "Standard Blasting Plan Within State Highway Right-Of-Way".

## W. Responsibility for Condition of Excavation

The Contractor shall be responsible for the condition of all excavations made by him. All slides and cave-ins shall be removed without extra compensation at whatever time and under whatever circumstances they may occur.

Neither action nor omission by the Department to order the use of bracing, sheeting, or their associated materials and equipment, shall relieve the Contractor of his responsibly concerning the safety of the excavation.

Delays caused by any action or lack of action by the Contractor or the Department, their agents or employees, which result in the excavation being kept open longer than necessary shall not relieve the Contractor from properly and adequately protecting the excavation from caving or slipping.

The Contractor shall maintain at his expense, all refilled excavations in proper condition until the end of the one (1) year period following the date of acceptance of the work by the owner, unless otherwise noted for a longer duration. All depressions appearing in the refill excavations shall be properly refilled and surface restored. If the Contractor shall fail to do so within a reasonable time after the receipt of written notice from the owner, the Department may refill and restore said depression and the expense thereof shall be the responsibility of the Contractor. In case of emergency the owner may refill and restore any dangerous depression without giving notice to the Contractor, and the expense of so doing shall be the responsibly of the Contractor.

The Contractor shall be responsible for any injury or damage that may result from improper maintenance of any excavation, within the one (1) year maintenance period, unless otherwise noted for a longer duration.

## X. Sheeting, Bracing and Shoring

The Contractor shall be responsible for properly supporting the sides of all trenches and excavations with sheeting, bracing, shoring, or other supports so as to furnish safe and acceptable working conditions. Bracing shall be arranged so as not to place any stress on portions of the completed work until the general construction thereof has proceeded far enough to provide ample strength.

The Contractor shall furnish all labor, materials and equipment and perform all operations required for sheeting, bracing, and shoring of excavations and for constructing foundations. The Contractor is responsible for complying with all OSHA and MOSHA requirements.

Sheeting, sheet piling, bracing and shores shall be withdrawn and removed as the excavations are being backfilled, except where and to such an extent as the Department shall order, in writing, that the same be left in place, or where the County shall permit the Contractor to leave the same in place, at the Contractor's own cost and expense. Any sheeting or sheet piling left in place, whenever and at such point as the County shall order or permit, shall be cut off at least one (1') foot below finished grade, and the Contractor shall remove and dispose of the portion cut off.

In withdrawing sheeting and sheet piling, special care shall be taken to insure that all voids or holes left by the planks as they are withdrawn are filled with satisfactory material and thoroughly rammed with thin rammers provided especially for that purpose.

## Y. Protection of Property and Structures

The Contractor shall, at his own expense, sustain in their places, and protect them from direct or indirect injury, all pipes, tracks, walls, buildings and other structures or properties in the vicinity of his work, whether above or below the ground, or that may appear in the trench. He shall at all times have sufficient quantity of timber and planks, chains, ropes, etc., on the site and shall use them as necessary for sheeting the excavations and for sustaining or supporting any structures that are uncovered, undermined, endangered, threatened, or weakened.

The Contractor shall take all risks attending the presence or proximity of pipes, poles, tracks, walls, buildings, and other structures and property, of every kind and description, in or over his trenches, or in the vicinity of his work, whether above or below the surface of the ground; and he shall be responsible for all

damages and assume all expenses for direct or indirect injury, caused by his work, to any of them, or to any person or property by reason of injury to them, whether such structures are or are not shown on the drawings.

Where necessary, in order to keep one side of the street or roadway free from any obstruction or to keep the material piled alongside of the trench from falling on private property outside the right-of-way, a safe and suitable fence shall be placed alongside the work.

In the event of encountering unstable material, subsurface streams or similar dangerous contingencies, or when passing buildings or any structures which by its construction or position might have its foundation undermined or cause unsafe pressure upon the trench; the right is reserved by the Department to direct that such building, or structure, shall be underpinned, or supported and protected; or that special sheeting shall be driven in such a manner and to such a depth, as may be directed; or that only a short length of trench shall be opened at one time; and furthermore, if necessary that the trench shall be securely sheeted and braced on all sides, after the manner of a shaft, and that the permanent work shall be constructed in the same and the shaft backfilled before another opening is made. Any work directed by the Department to be performed by the Contractor, shall be at the cost and expense of the Contractor.

The Department reserves the right under such conditions to stop the excavation or any other part of the work, and to require the Contractor to complete the pipe and the backfilling up to such a point as the Department may direct before proceeding further with the excavations; and the Contractor shall not thereby become entitled to demand or receive any allowance or compensation.

## Z. Pipe Bedding and Granular Encasement

Trenches shall be filled for their entire width with compacted granular material, as specified in section "Sanitary Sewer Materials" and "Water Line Material", 6" below invert of the pipe. The bedding material shall be thoroughly compacted by means of mechanical tampers the full width of trench, and screened to a uniform plane on grade having dust out of bell, ready to receive the pipe. After the pipe has been placed to the proper grade and alignment, backfill and lightly tamp both sides, evenly, in 6" loose lifts and to a 12" horizontal plane above the crown of the pipe with the same pipe bedding aggregate material. Areas along side of the installed pipe and to a level plane two (2') feet above the crown of the pipe must be mechanically tamped using a hand tamper and in such a manner as to not damage or disturb the pipe or its alignment. Compaction achieved shall be ninety-two percent (92%) of maximum density per AASHTO T-180 to finish grade. Areas within proposed County right-of-ways shall be compacted in accordance to the Department of Public Work's S-3 Policy.

## AA. Backfilling of Trenches (General)

Backfilling of trenches include all backfill material, compaction as specified, re-grading of adjacent disturbed areas, replacing other surface and sub-surface pipes and structures, placing and maintenance of temporary sidewalks and driveways, re-sodding lawns and replacing trees and shrubbery outside of the trench limits damaged by the Contractor and all appurtenant work incidental thereto refilling of excavations.

All lumber, rubbish and debris shall be carefully removed from spaces to be backfilled and kept clean of such during backfilling. All trenches and excavations shall then be backfilled to the subgrade of the respective surface restoration materials or other foundation subgrade.

No backfilling shall be performed prior to the time that joints in pipelines are set, inspected, measured, and approved.

All excavations in stabilized and non-stabilized surface areas must be backfilled or satisfactorily bridged at the end of each day's work. Adequate fencing may be allowed in undeveloped areas by the approval of the Department. Otherwise, partially excavated or open trenches will not be permitted outside the work day.

Puddling and/or jetting of trenches with water will not be permitted. The condition of the trench shall be restored to the full satisfaction of the Department.

Trenches shall be carefully backfilled without causing shock to the pipe and to prevent after-settlement. The backfill shall be of specified materials, selected for the purpose, in section "Sanitary Sewer Materials" and "Water Line Materials".

Every precaution shall be taken in the backfilling of excavations to prevent materials so placed from falling directly upon or against any pipe, conduit or other structures in such a way as to cause the displacement of or damage to said pipe, conduit or structure. The backfilling, filling and embankments shall be brought up evenly and all eccentric loading shall be avoided.

As the trenches are filled in and the work completed, the Contractor shall, at his own cost and expense, remove and dispose of all surplus earth, stone or other materials as specified hereinbefore. The Contractor shall leave all roads, sidewalks and other places free, clear and in good order. In case the Contractor shall fail or neglect to do so, or to make satisfactory progress in doing so, after the receipt of a written notice from the Department, the owner may remove such surplus material and clear the roadways, sidewalks and other places, and the cost of said work shall be charged to the Contractor.

Should there be a deficiency of proper material for refilling; the Contractor shall

furnish the same at his own cost and expense. Material lacking any specified property shall not be used as backfill.

No backfilling shall be made during freezing weather except by permission of the Department. No backfill shall be made when the material already in the trench is frozen, nor shall frozen material be used in backfilling.

Backfill may be deposited using mechanical or power equipment, except that care shall be exercised in placing material directly from a machine bucket, cars or other vehicle, such that the pipe is not damaged or displaced.

Compaction density shall be measured as specified by AASHTO T-180, and shall be as follows:

| LOCATION | LOOSE LIFT | MAX DENSITY | OPTIMUM MOSTURE |
|---|---|---|---|
| a. More than 7' off roadway or driveway edge (open area) | 8" | 90% | +/-2% |
| b. Within 7' of road or driveway edge to 1' below grade | 8" | 90% | +/-2% |
| c. Within 7' of road or driveway edge top one (1) foot | 8" | 90% | +/-2% |

Backfill of trench in State and County Roads, or areas to be accepted or maintained by same, shall be in accordance with the requirements of the State Highway Administration and Washington County Division of Public Works, respectively.

The Contractor shall furnish and install six inch (6") wide non-detectable warning tape two feet (2') centered above and continuous with the pipe, including service connection piping. The tape shall be colored and marked appropriate to the respective utility pipe. The Contractor shall also furnish and install a continuous 12 gauge copper tracer wire, with all pressure PVC piping. The tracer wire is to be laid along side the pressure pipe, with testing boxes installed at maximum spacing of five hundred feet (500').

## BB. Backfill of Trenches Within New Developments

### 1. Stabilized Areas

Stabilized areas are areas within seven (7') feet of a proposed or future roadway, street, or driveway; measured from the edge of shoulder or curb; shall be backfilled from a plane one foot (1') above the crown of pipe using materials as specified by Washington County Division of Public

Works.

**2. Non-Stabilized Areas**

Non-stabilized areas are areas greater than seven feet (7') outside or off of a proposed or future roadway, street, or driveway; measured from the edge of shoulder or curb; and usually as open, vegetated area; may be backfilled from a plane one foot (1') above the crown of the pipe using clean earth free of rocks over six inches (6") in any dimension.

## CC. Backfill of Trenches Within Existing Developments

**1. Stabilized Areas**

Stabilized areas are areas within seven (7') feet of a proposed or future roadway, street, or driveway; measured from the edge of shoulder or curb; shall be backfilled from a plane one foot (1') above the crown of pipe using materials as specified by Washington County Division of Public Works.

**2. Non-Stabilized Areas**

Non-stabilized areas are areas greater than seven feet (7') outside or off of a proposed or future roadway, street, or driveway; measured from the edge of shoulder or curb; and usually as open, vegetated area; may be backfilled from a plane one foot (1') above the crown of the pipe using clean earth free of rocks over six inches (6") in any dimension.

## DD. Backfilling of Structures

Special care will be required in backfilling around structure walls. Backfill to be placed on both sides of a foundation all, shall be placed in simultaneous lifts on both sides of the wall so that there is no uneven pressure against the wall surface.

Backfill against one (1) exposed surface of a structure wall shall not begin prior to the completion of the floors or other portions of the structure tending to brace the walls in their final position. Vehicle and heavy equipment loads shall not be imposed prior to the time that the materials in the wall construction have reached their design strength.

Backfill material and compaction shall be as specified, detailed, and/or shown on the Contract drawings.

## EE. Dust Control Clean-up and Repair

The Contractor shall remove from the site of the work, all materials not to be utilized in the scope of work. All construction materials and equipment during non-working hours must be stored so as not to impede traffic. The streets during working hours shall be kept free from surplus material and in a convenient condition for travel.

The Contractor shall be responsible for maintaining the streets, driveways, parking areas, etc. in clean and dust free condition in so far as the dust and dirt relates to his work. Dust control materials shall be calcium, water or other materials approved by the Department.

Upon direction of the County and the failure of the Contractor to control dirt and dust, the Department shall stop the progress of construction until such time the work is performed as directed. At the end of each day's work, the work area(s) shall be swept (hand or mechanical) until area is clean and free of dirt and debris.

The Contractor may store, during the work day, excavated material from the trench that is suitable backfill material to the extent of the amount required to complete backfilling in the general localized are of the work, as approved by the Department. However, at the completion of backfill or at the end of the day's work, all material must be removed, stored, and/or disposed as specified hereinbefore.

The Contractor shall be responsible for maintaining the streets during the construction period. Temporary asphalt base paving (cold mix) shall be placed, rolled and maintained, to provide a smooth riding surface over trench areas until such time the trench areas in existing paving are permanently restored.

The Contractor shall repair any and all damage he has caused to the streets, sidewalks, shrubbery, lawns, lawns, ornamental works, real property, etc., and shall save free and harmless the principal in this contract from all suits for damages to person or property arising from or caused by this construction.

Before final acceptance of the work the Contractor shall remove all equipment and material from the site; restore and/or repair all property, private or public, to a condition equal to or better than originally found.

## FF. Tunneling Jacking and Boring

All methods of tunneling, jacking or boring shall be performed to the requirements and satisfaction of the agency issuing the permit, and/or having jurisdiction over same.

It shall be the Contractor's responsibility and expense to provide any additional insurance coverage which may be required by the agency issuing the permit. The

Contractor shall also be responsible for any cost involved in inspection by the Railroad Company, state highway or agency having jurisdiction over same.

All construction methods and materials proposed for use in tunneling, jacking or boring shall be submitted to and approved by the Department prior to construction. The Contractor shall assume all responsibility for the sufficiency and safety of his method.

The staging excavation shall be kept to a minimum size required to perform the work. During non-working hours, the excavation shall be kept tightly secured (if greater than three feet deep) by solid fencing and safety flagging, or bridging.

All erosion and sediment control, dewatering, restoration and appurtenant work relating to the tunneling/jack and bore operation, shall be incidental to the work.

Steel casing pipe shall meet the following minimum Requirements:

| Sewer Diameter | Minimum Casing Inside Diameter | Minimum Casing Thickness |
|---|---|---|
| 4" | 12" | 0.251" |
| 6" | 18" | 0.313" |
| 8" | 18" | 0.313" |
| 10" | 18" | 0.313" |
| 12" | 24" | 0.407" |
| 15" | 30" | 0.469" |
| 24" | 36" | 0.532" |
| 27" | 42" | 0.563" |
| 30" | 48" | 0.626" |
| 36" | 54" | 0.688" |

The encasement pipe shall be installed with even bearing throughout its entire length, and shall maintain the grade required for the carrier pipe to function as designed. The completed installation shall meet the requirements as shown in the Standard Detail Drawings.

Care should be used in trimming the surfaces of the excavated section. It is extremely important that firm contact exist between the casing pipe and the ground around the entire ring. Any space outside of the casing pipe shall be filled with uniform mixture of grout placed under pressure. Grouting shall start at the lowest middle hole of each grout panel, with grout holes above being open, and proceed upward progressively and simultaneously on both sides of the casing.

The staging excavation shall be entirely backfilled and compacted in accordance with these specifications, while protecting the end of the installed carrier pipe. The completed backfill excavation may then be excavated to the proper form and

grade of the trench for the pipe installation to connect to the carrier pipe at the casing end.

The Contractor shall provide and install sacrificial anodes on all carrier pipes. The anodes shall be sized according to the pipe diameter, thickness, and length of the pipe.

## Chapter 2, Section 203

## Sanitary Sewer Materials

## III. Sanitary Sewer Materials

### A. Scope

This section of these Specifications details the requirements governing the quality of the various materials specified for use in other Sections and on the Construction Drawings and Details.

All pipes, fittings and other related materials used in the construction of sewer lines shall have the approval of and be in compliance with the Specifications and Standards of the Washington County Department of Water Quality, as set forth herein.

### B. General

Material of construction, particularly those upon which the strength and durability of the structure may depend, shall be subject to inspection and testing to establish conformance with specifications and suitability for uses intended.

Whenever reference is made to the requirements of the American Society for Testing Materials (ASTM), the American Water Works Association (AWWA), the American National Standards Institute (ANSI), or other standard specifications or codes, the latest modifications or revisions of such specifications by ASTM, AWWA, ANSI, or other standards organizations, shall be certified in writing by the manufacturer.

Representative samples of materials, intended for incorporation in the work, shall be submitted, when indicated or directed, for examination and/or test.

The Contractor shall furnish to the Department a minimum of seven (7) copies of Shop Drawings and/or certifications for each type of material used in the work. The Department will retain three (3) copies for our records and will return the remaining four (4) copies to the Contractor. If the Contractor requires more than four (4) copies, the Contractor will have to submit additional copies as part of his submittals. All materials to be used in construction shall have the Department's prior approval before use in the work.

No material shall be used until it has been inspected and approved on the site of the work by the inspector. Such inspection shall not relieve the Contractor of his obligations to complete the work as specified. Any defective material or workmanship which may have been passed by the Department shall be at all times liable to rejection when discovered, until the final completion of the project.

Where a manufacturer's name is used in these Specifications, it is used to designate a standard of quality. The use of said manufacturer's name does not

eliminate other manufacturer's equipment and materials equally as good and efficient and that can perform the same function, as approved by the Department.

## C. Sewer Pipe and Fittings

### 1. General

Poly Vinyl Chloride (PVC) pipe and fittings shall be made from PVC compounds as defined and described in ASTM D-1784, Type I, Grade 1, Cell Classification 12454-B for rapid poly vinyl chloride compounds. Chlorinated poly vinyl chloride compounds (CPVC) shall be Type IV, Grade 1, Cell Classification 23447-B. All pipes shall be NSF Standard 14 certified. All fittings shall be one-piece injection molded.

All PVC pipe and fittings supplied shall have the following markings on each:

1. Manufacturer's name or trademark
2. Nominal Size
3. Material designation
4. Psm (and type for pipe)
5. ASTM designation
6. National Sanitation Foundation (N.S.F.) seal of approval
7. Full insertion mark

PVC pipe and fittings shall be manufactured by North American, J. M. Eagle, Harco, R & G Sloane, Spears, or equal. Installation shall be in accordance with the manufacturer's recommendations and as specified herein, whichever is more stringent.

The Contractor shall furnish to the Department sworn statements from the manufacturer that the inspection and all specified tests of the applicable ASTM Standards for PSM poly vinyl chloride gravity and pressure sewer pipe have been made and the results thereof comply with the requirements of these Specifications.

### 2. Gravity Sewer Main and Fittings

PVC pipe for gravity sewer shall be SDR-26 Heavy Wall PS 115 and must conform to the requirements of ASTM D-1784, ASTM F-679, and ASTM D-2241. All PVC sewer pipe must utilize the bell and spigot concept with the utilization of a single sealing rubber gasket provided by the manufacture.

SDR-26 PVC heavy wall gasketed sewer fitting 4" through 18" shall be manufactured in accordance with ASTM D 3034 and F 1336. Fitting

gaskets shall comply with ASTM F 477 or ASTM F 913. Fitting gaskets shall be locked firmly in position to prevent displacement. 4" through 8" SDR-26 fittings shall have green color coded gasket retaining rings for easy identification. 4" through 8" fittings shall be injection molded from virgin PVC compound having a minimum cell classification of 12454 or 13343 in accordance with, and certified by the National Sanitation Foundation (NSF), to meet ASTM D 1784. 10" through 15" gasketed SDR-26 sewer fittings may be injection molded or fabricated from pipe meeting the requirements of ASTM D 3034. Gasket joints of all fitting sizes must comply with ASTM D 3212 Internal Pressure Test (exfiltration) and vacuum test (infiltration) at 5 degrees of gasket joint deflection. Gasketed SDR-26 sewer fittings shall be certified by the NFS to meet ASTM D 3034.

Jointing for all PVC gravity sewer pipe and fittings shall be bell and spigot concept (ASTM D-3212) with the utilization of a flexible elastomeric seal (ASTM F-477) provided by the manufacturer. All spigots shall have a full insertion mark and beveled end. Lubricant for the gasket shall be as recommended by the pipe manufacturer.

**3. Gasketed Long Radius Tee Wye**

SDR 26 Heavy Wall gasketed tee wye shall be manufactured to meet the following requirements:

a) ASTM D 3034 – Fittings
b) ASTM D 1784 – Materials
c) ASTM D 3212 – Joints
d) ASTM F 477 – Gaskets or F913
e) Fitting Wall Thickness – Minimum SDR 26

Long sweep tee wyes shall be made from PVC compounds, as defined and described in ASTM D 1784 for rigid PVC compound and shall have the following markings:

a) Manufacturers Name or Trademark
b) Nominal Size
c) Material Designation
d) ASTM Designation
e) Color coded green end rings

The dimensions shall be as follows:

| | | |
|---|---|---|
| a) | Bell Depth | 2-1/2" GSK to pipe minimum |
| b) | Wall | SDR 26 H.W. Minimum |
| c) | Height | 14" Minimum |
| d) | Length | 14" Minimum |
| e) | Gasket Cross Section | .21 Square Inches Minimum |

Long sweep tee wyes may be factory fabricated until such time as a one piece injected molded fitting is available. At which time the molded fitting shall be required. Each fitting shall have a factory fabricated sticker for inspection purposes.

Fittings shall have the same warranty as the manufacturer applies to their other products.

Certification required.

**4. Pressure Sewer and Fittings**

Buried PVC pressure pipe 1½" through 4" diameter shall conform to the requirements of ASTM D-2241 (SDR-21) for working pressure of 200 psi.

Buried PVC pressure pipe 6" diameter and larger, shall conform to the requirements of ASTM D-2241 and AWWA C-900 class 150 (DR-18), for 150 psi working pressure unless otherwise specified.

Integral bell and spigot joints shall utilize flexible elastomeric seals and shall meet or exceed the requirements of ASTM D-3139 with rubber gasket meeting the requirements of ASTM F-477. Spigot ends shall have a reference mark around the circumference to denote the depth of seating into the bell or coupling. Lubricant for elastomeric gasket shall be specified by the pipe manufacturer.

**5. Ductile Iron Pipe (DIP) and Fittings**

Ductile iron pipe shall meet the requirements of AWWA C-150 and C-151, thickness Class 54. All pipe shall be centrifugally cast with double thickness cement-mortar lining and seal coated with asphaltic material inside and outside in accordance with AWWA C-104.

Underground installations shall maintain mechanical joints complying with AWWA C-110 with working pressure rating of 350 psi.

Inside of structure and above ground installations shall be flanged joints complying with ANSI/AWWA C-110/A21.10, with water working pressure rating of 250 psi. Flanges shall be flat faced and bolt arrangement shall be compatible with ANSI B 16.1, Class 125 flanges.

ASTM A307 bolts and ASTM A563 nuts used to connect the flanges in a mechanical joint shall conform to ANSI B18.2.
Bolt length shall be such that after installation, the projection of the thread is 1/8 inch to 3/8 inch. All mechanical joints shall be restrained utilizing Megalug or approved equal joint restraining device.

All pipe fittings shall be cement lined and coated inside and outside with coal tar pitch varnish. The varnish shall be made from coal tar to which sufficient oil has been added to make a smooth coating tough and tenacious when cold and not brittle with any tendency to scale off. The coating and the varnish shall both be heated to a temperature of 300 degrees F prior to dipping of the casting.

Flanged adapter shall be manufactured of ASTM A-126, Class B cast iron with Standard ANSI B16.1 125 pound flange. Mechanical joint shall be Standard ANSI/AWWA C-111/A21.11. Unit shall be rated for 250-psi water working pressure. Adapter shall be factory-coated exterior with corrosion resistant manufacturer coating and interior with coal tar epoxy.

Wall pipe shall meet the requirements of D.I.P. Pipe shall be sized to allow a minimum clearance of six inches (6") from face of flange to face of wall for mechanical joints and three inches (3") for flanged joints.

The Contractor shall submit to the Department, prior to installation of the pipe and fittings, a certificate, certifying that the pipe and/or fittings were manufactured and tested in accordance with AWWA Specifications.

### 6. Cast Bronze Fittings

Pipe and fittings shall be composition bronze, ASTM B-62, made of 85% copper, and 5% each of tin, lead, and zinc, and shall be threaded NPT, in accordance with ANSI B16.15.

## D. Valves

### 1. General

Valves shall be of the sizes and types shown on the Drawings and shall joint as specified or be compatible with the pipes in which they are installed. All valves of one classification shall be of the same manufacture, and shall open left, counter-clockwise.

All wetted parts of valves shall be of materials or coatings resistant to corrosion caused by sulfides in sewage, and rated for 150-psi water working pressure in either direction.

Buried valves shall have bituminous, epoxy, or other approved coating applied to the exterior of the value along with the extension stems and valve boxes.

No valves may be placed within the wetwell area.

### 2. Ball Valves: 1-½" Thought 2-½" Pipe Size

Valve body, ball and stem shall be ASTM B-62 (85-5-5-5) bronze with ball specially coated to compliment ease of turning and no leakage against the resilient Buna-N rubber seat. Stem shall be Buna-N rubber o-ring sealed. Open valve shall allow full port flow. Actuator shall be the tee-head style capable of connecting to an extension stem for buried applications. End connections shall be female threaded NPT. Valves shall be as manufactured by Ford Meter Box Co. B-11 Series, A.Y. McDonald Mfg. Co. Pattern 3101, or equal.

**3. Plug Valves: 3" and Larger Pipe Size**

Plug valves shall be of the non-lubricated, eccentric plug type, as manufactured by Dezurik, or approved equal. Minimum full-open flow area through the cast iron (ASTM A-126, Grade 'B') body shall be 100% of full pipe, and shall not drip when closed. Valve shall have nickel seat, neoprene plug facing, stainless steel bolts, and stainless steel bearings. Packing shall be nitrile butadiene (buna vee).

Actuator type: lever, handwheel, chainwheel, square nut, cylinder, and electric motor.

All valves shall have 2 coats of Tnemec Series 141 Pota-Pox 80 applied to all surfaces by the factory prior to shipping.

**4. Check Valves: 1-½" Through 3" Pipe Size**

Horizontal swing check valves shall have a removable cap to allow for seat and disc renewal. Valve body, cap and disc material shall be ASTM B-62 (85-5-5-5) bronze. Hinge pin material shall be a 300 series stainless steel. End connections shall be female threaded NPT. Valves shall be as manufactured by Nibco Inc. Figure No. T-413-B, or equal.

**5. Check Valve: 4" and Larger Pipe Size**

Resilient seated check valves shall be manufactured from ductile iron meeting or exceeding ASTM A536 65-45-12. Valves shall be rated for 250 p.s.i.g. cold water working pressure.

Valves shall have a ductile iron disc fully encapsulated with rubber. Disc travel to closure shall not be more than 35 degrees and shall seal drop tight at pressures above 5 p.s.i.g.

Valves to be coated with fusion-bonded epoxy on all internal and external ferrous surfaces.

Bronze seat rings are not allowed. Disc shall be the only allowable moving part. No O-Rings, pivot pins or other bearings are allowed. Disc must be reversible such that either side will seal equally.

Valves shall be equal to American Flow Control's Series 2100 Ductile Iron Resilient Seated Check Valve.

All resilient seat check valves shall be placed inside a building or within a vault. Resilient seat check valves can not be direct buried.

**6. Combination Air & Vacuum Pressure Release Valve**

Combination air valves shall be heavy-duty "Universal" style single body units incorporating the functions of an air and vacuum valve with an air release valve in a single housing.

Combination air valves shall release accumulations of air at high points within a pipeline by exhausting large volumes of air as the pipeline is being filled, and then by releasing accumulated pockets of air while the pipeline is in operation and under pressure. Combination air valves shall also be designed to permit large volumes of air to enter the pipe-line during pipeline drainage.

The valve body and cover flange shall be cast or fabricated 316 stainless steel and shall incorporate a "sanitary clamp" to attach the flange to the body at the outlet. Valves that use traditional bolting to attach the cover flange to the body are not acceptable. The flange clamp must be located at the outlet of the body for ease of cleaning and maintenance. Other clamping locations are not acceptable.

All non-sealing internal metal components shall be 316 stainless steel. No plastic, nylon, or fiberglass components will be acceptable.

The valve shall incorporate an Air Release orifice of 3/16" for use at 200 psig. No deviation from this orifice size will be allowed. This orifice will be located in the outlet of the valve and shall be drilled in a 316 stainless steel. orifice plate that seals against a Buna-N rubber seat. Valves with seals that flex or "roll" will not be acceptable.

Unit may have a maximum height of 14 inches and a maximum weight of 28 lbs.

The valve shall be Crispin "X" Series, model # UX20 or approved equal.

All combination air valves shall be placed inside a building or within a vault. If the value is placed within a building, it must be vented to the outside. Air valves can not be direct buried.

### 7. Sewage Surge Relief Valve

The sewage surge relief valve shall have standard 125 lb flanged elbow type body. The valve shall open immediately upon the inlet pressure exceeding the preset relief setting specified for the project.

The valve shall have a cast iron body and a stainless steel ring to hold the resilient, replaceable seat in position. The valve shall have a normally closed drop tight position. The valve disc movement shall allow for full flow opening when required but the opening stroke shall be limited to that needed to provide surge protection set by the operator. The disc movement shall be guided throughout its stroke length. Valve closure shall be at a slow speed consistent with adjustment of a self-contained oil cushion chamber integral to the valve. The valve closure rate shall be adjustable over a range to prevent hammer.

External springs shall be enclosed in protective casings and in compression. The disc stem bushing shall be bronze capped with a lantern-type gland, which is vented to the atmosphere to reveal seal leakage.

The valve shall be Golden-Anderson Figure 625-D or equal and sized as shown on the drawings.

## E. Pipeline Appurtenances

### 1. Valve Box and Lid

Valve boxes shall be two-piece screw-type adjustable, made of gray cast iron, and shall have a coal tar epoxy coating (or equal) inside and out. Boxes shall be 3 to 4 feet long with one adjustment. Mid box extensions may be required for greater depths. Compatible lid shall be cast iron drop lid type with coal tar epoxy coating and "sewer" identification cast in.

4-¼" roadway valve box barrel shall have an arched bottom for 1-½" through 2-½" valves.

5-¼" valve box barrel shall have a flat round bottom for 3" and larger valves.

### 2. Valve Extension Stem

All buried valves shall have extension stems that attach to the valve operator and extend inside of the valve box to within approximately one foot (1') of finished grade.

Stem materials shall be coal tar epoxy (bitumastic or equal) coated ASTM A-36 steel and/or ductile iron. Rod shall have a welded end piece to

connect to the valve operator by means of a stainless steel or brass cotter pin or set screw, provided by the stem manufacturer. The top end of the rod shall have a welded tee-head aligned with the valve operator or a two inch (2") square nut, each of which shall indicate open or closed valve position.

A ¼" steel centering ring piece, ¼" in diameter less than the inside diameter of the valve box, shall be welded to the rod within three to six inches of the top, for alignment.

**3. Warning and Identification Tape**

All piping including service connections shall have a 4-mil polyethylene tape; 6" wide placed centered, continuous, 2 feet above the crown of the sewer.

Color shall be bright green with black printed letters on one side spaced continuously stating:

**CAUTION – SEWER LINE BURIED BELOW**

Tape shall be Terra Tape Mark Line or Sentry Line as manufactured by Reef Industries, or equal.

**4. Flushing Connection Vault**

Heavy wall PVC bullet meter vaults shall be manufactured to meet the following requirements:

a. Manufactured of a one piece molded construction.

b. Manufactured from a three layered polyethylene.

c. Dimensionally tapered at its top with an expanded body with the maximum inside dimension starting at approximately 6" down from the top of the box.

d. The nominal wall thickness shall be not less than 0.550 inches.

e. Each box shall have molded in the wall an insulation layer having a minimum thermal transfer of 4.0 according to ASTM C171 to resist frost jump.

f. The vertical free standing load should be minimum of 25,000 lbs.

g. Each box shall have a top flange for frame & cover seating and bottom flange for anti-settling at its base.

h. The box shall incorporate a top lip shelf to facilitate the use of an additional insulation disc as need may arise.

i. The interior shall be bright white in color for light reflection to ease meter reading and provide light for maintenance work.

j. The exterior shall be black in color to retard UV degradation.

k. Material shall be modified polyethylene with low temperature brittleness exceeding 76 degrees Fahrenheit.

l. The manufacture shall be able to provide grade box adjustment in heights of 3" to 12" with tapered risers to accommodate scoping installation.

m. Meter vaults shall have the following dimensions: 20"(opening)X24"(inside diameter)X30"(depth).

n. Meter vaults shall be manufactured by Carson Industries L.L.C. or approved equal.

**5. Flushing Connection Frame and Cover**

Frame and cover shall be cast iron, factory bituminous coated, double lid type, with 11" – 13" diameter recessed cover, and an inner lip on the bearing flange equal in diameter to the vault I.D. An extension ring collar may be utilized to meet the vault I.D. and must have the same inner lip on the bearing flange.

The cover shall have a standard pentagon bolt / 'lifter worm lock' locking device, and shall have the word 'SEWER' cast in. The plastic inner lid shall provide sufficient dead air space for frost protection.

Frame and cover shall be as manufactured by Ford Meter Box Co., or equal, to the following Ford catalog numbers:

| | TRAFFIC AREA | NON-TRAFFIC AREA |
|---|---|---|
| Frame Cat. No. | W32H | W32 |
| Cover Cat. No. | WA32LH | WA3L |
| Inner Lid No. | W3BP | W3BP |

**6. Cast Iron Clean-Out Adaptor and Brass Plug**

The cast iron clean-out adaptor shall have a heavy-duty designation, suitable for use in light traffic areas. All castings shall be tough and of even grain free of gas holes and flaws thoroughly coated at the factory

with one coat of a bitumastic protective coating. The casting shall have a grooved retainer ring for installation of a single piece "O" ring gasket provided by the manufacturer, which joint when properly fitted to the riser pipe shall produce a flexible and water tight connection. The brass plug shall be threaded to fit the cast iron adaptor with a two inch (2") square countersunk head, brass to cast iron threads shall be coated with anti-seize compound. The cast iron adaptor and plug shall be the Panella clean-out Order #PA_SVCSK as manufactured by the Jones Manufacturing Co., Inc., or equal.

### 7. Tracer Wire and Testing Station

Tracer wire shall be UL Listed, Type THHN, gasoline and oil resistant, and suitable for operations at 600 volts as specified in the National Electric Code. Conductor size shall be a 12 AWG solid copper conductor (or "12 AWG 19-Strand copper conductor"). Conductor shall be annealed copper, insulated with high-heat and moisture resistant PVC, jacketed with abrasion, moisture, gasoline, and oil resistant nylon or listed equivalent. Tracer wire shall be manufactured on 500' non-returnable plastic spools. Splicing of tracer wire shall not be permitted. Tracer wire shall be Pro-Line Safety Products Company or approved equal.

All tracer wires are to be connected to a combination cast iron & ABS tamper proof tracer wire access box. The cover is to be manufactured of cast iron and ABS components produced in the USA. Cast iron collar & cover is to be manufactured in accordance with ASTM A 48 Class 25. The ABS is to be manufactured in accordance with ASTM D 1788. The cover shall be lettered Electric and shall have a standard AWWA size cast-in pentagonal bolt. Testing station shall be manufactured by C.P. Test Services-Valvco, Inc. or approved equal. The maximum spacing for the test stations shall not exceed 500 feet.

## F. Manholes

### 1. Precast Base, Section and Top

All manhole sections shall be constructed of precast reinforced concrete pipe having an inside diameter of 48" unless otherwise shown on Drawings. The pipe shall conform to the requirements of ASTM designation C-478, and to the configuration shown in the Standard Details.

The pipe shall have tongue and groove joints, which utilize an extruded, butyl sealant (AASHTO M-198) in flexible rope form to achieve watertight joints.

The base section shall be cast integral (monolithic) with side wall to 12" minimum height above the pipe crown.

Lifting holes shall be provided with inserts not longer than 4". The bottom riser section shall fit into the concrete base and the top section shall either be an eccentric tapered section, tapering from 48" inside diameter to 30" inside diameter respectively and thickened upper walls at frame and cover, or flat top section as shown on Standard Details.

All top sections shall have embedded inserts positioned 90 degrees apart for anchoring bolts to hold the cast iron frame in place. Bolt inserts shall be designed to withstand a 400-pound pullout force and shall be threaded to receive 5/8 inch galvanized all thread rod. Length of bolt is determined by the height of grade rings to place the frame and cover at the proper finished grade.

The Department reserves the right to require HDPE lined manhole where high concentration of sewer gasses are expected.

**2. Steps**

Each step shall be manufactured using 0.5 inch (13 mm) diameter deformed reinforcing steel, grade 60 standards, and conforms to ASTM A-615. The steel shall be covered with high impact copolymer polypropylene which has been proven non-corrosive in sewer environments and conforms to an ASTM D-4101 specific number.

The steps shall be contoured to fit the hand for comfort and a sure grip with sturdy tread design with side molded slip-resistant wings. Each step shall be stamped with manufacturing data.

Steps shall be installed by the manhole manufacturer as per the step manufacturer's requirements, to achieve minimum horizontal pullout strength of 400 pounds, and withstand a 70 foot-pound vertical impact at 6 degrees F.

**3. Pipe to Manhole Seal**

All seals shall be resilient elastomeric material conforming to the physical requirements of ASTM C-923. Manufacturer shall certify that the seal is designed to accommodate the respective pipe outside diameter. Installation configurations shall comply with Standard Detail SW-2.10.

New precast manholes shall have flexible seals, through which the pipes are inserted, simultaneously cast with the manhole into the wall by the precast manufacturer.

Cast-in place seals shall have a water stop feature molded into the embedded surface and a retainer groove molded into the inside surface to hold the elastomeric seal.

Seals for core-drilled connections to existing manholes shall be the expansion ring & rubber boot type, with all stainless steel hardware including "worm screw" tightening mechanism.

Seals shall follow the style of "Hail Mary Rubber Co., Inc., Star Seal", "Kor-N-Seal Wedge Korband", or equal.

**4. Frame and Cover**

Frame and cover manhole castings shall be of ASTM A-48 Class 30B gray iron or ASTM A-536 Grade 60-40-18 Ductile Iron, conforming to the configuration and dimensions shown on the Standard Details. Frame and cover shall be certified to withstand H-20 traffic loading and have a minimum opening of 30".

For manholes located in non-traffic areas and not within the 100 yr floodplain, the frame and cover shall pivot away from the hole opening, eliminating the need for manually raising or lowering the cover. The cover rotates in either direction on a cast-in stainless steel rod that ensures its remains attached to the frame. No special tools are required to open or close the cover. The frame and cover shall be East Jordon Iron Works, Inc. Revolution Access Assembly of approved equal.

Castings shall be true to pattern in form and thickness, free from cracks, gas holes, flaws and excessive shrinkage, sound, cleaned by means of sand blast and neatly finished. Runners, fins, risers and other cast-on pieces shall be removed. All castings shall be tough and of even grain.

Makings shall be cast-in to the cover as shown on Standard Details SW-2.6, 2.7, and 2.9.

Watertight frame and cover shall meet the above requirements.

**5. Grade / Leveling Rings**

Grade rings shall be manufactured of the same class of concrete as manhole riser sections. Grade rings shall conform to and be compatible with dimensions shown on Standard Details, and shall be provided with openings to match the inserts installed in the conical or flat top section of manhole. Grade rings shall be set in full bed of mortar and two (2) rings of ½ inch butyl sealant.

High Density Polyethylene (HDPE), ASTM D-1248, grade rings shall be one-piece injection molded, UV resistant, withstand HS-25 loadings

without permanent deformation, and seal watertight utilizing butyl rope sealant. Two inch (2") maximum riser rings shall be capable of adjustment to conform to grade slopes, such as manufactured by Ladtech, Inc. or equal. Prior to installation of grade rings, the Contractor shall demonstrate their ability to install grade rings per manufactures requirements. All grade ring installations shall be inspected by a Department's representative.

**6. Access Hatch**

Access hatches shall be aluminum checkerplate cast into the precast concrete slab flush, designed for H-20 traffic loading. Access hatches shall be watertight utilizing gaskets with a drip channel to collect water and direct it to a 1" NPT discharge pipe connection. All hardware shall be 300 series stainless steel including hinges, hold-open latch with release handle, spring loaded cylinder lifting assist, latch and latch handle, recessed lifting handles, and recessed hasp. Portions of frame embedded in concrete shall be bituminous coated. Doors shall be Bilco Type 'J', size as indicated on drawings. Provide master padlocks keyed to Department of Water Quality's standard.

## G. Concrete

All classes of concrete utilized in the work shall conform to the Maryland State Highway Specifications and ASTM C-150 for Portland Cement, ASTM C-33 for aggregates, and shall be acceptable to the Department.

The Contractor shall submit a certified mix design and test results for each class of concrete to be used in the work. Mix designs shall be proportioned in accordance with Section 4.4 of ACI 318. Design shall achieve the minimum 28-day compressive strength specified in pounds per square inch (psi).

Type I Portland Cement may be used in general concrete construction when the special properties specified for Type II are not required, where detailed, or as directed by the Department. Type II Portland Cement shall be used in general concrete construction exposed to moderate sulfate action or where moderate heat of hydration is required, where detailed, or as directed by the Department.

All concrete shall have a maximum water-cement ratio of 0.45, a minimum cement content of 564 pounds per cubic yard, a maximum slump of three inches (3"), and a total air content of six percent (6%) +/- one percent (+/- 1%).

Fine aggregate shall consist of natural sand, manufactured sand or a combination thereof, with maximum particle size of 3/8 inch. Course aggregate shall consist of graded crushed limestone material of sizes within the range 3/8 inch to 1 inch.

Water used in concrete shall be free from objectionable quantities of impurities, as determined by the inspector.

## H. Concrete Bonding Agent

A bonding agent shall be applied to bond new concrete to existing concrete and shall be Weldcrete as manufactured by Larsen Products Company, Perma-Lok as manufactured by Sinclair Paint Company or other approved equal.

Surface preparation, application and curing shall be in strict accordance with the manufacturer's recommendations.

## I. Non-Shrink Grout

Non-shrink grout shall be used for patching concrete, sealing joints, or setting anchorages, where specified; shall be non-metallic and meet the requirements of ASTM C-827, no shrinkage or expansion. Minimum 28-day compressive strength shall be 6000 psi (ASTM C-39).

Surface preparation, application and curing shall be in strict accordance with the manufacturer's recommendations, and shall be Penngrout as manufactured by IPA Systems, Waterplug as manufactured by Thoro System, or equal.

## J. Mortar

Mortar shall conform to the requirements of ASTM C-270 proportion specifications and shall be composed of Type II cement (ASTM C-175), or Type II masonry cement (ASTM C-91), if specified, ASTM C-144 fine aggregate, and water. Proportioning shall be one-part cement; two-parts fine aggregate and water, by volume.

Water used in mixing mortar shall be free from objectionable quantities of impurities, as determined by the inspector.

The ingredients must be in proportions that can be controlled and accurately maintained by measurement and not by estimation. All cementitious materials and aggregates shall be mixed for a minimum period of three (3) minutes, with the amount of water required to product the desired workability, in a drum type batch mixer. Hand mixing of mortar will be permitted on small jobs with approval from the inspector. No greater quantity of mortar shall be prepared than is required for immediate use, and any mortar that has begun to set shall not be re-tempered or used in any way. Mortar, which has been mixed more than one (1) hour, shall not be used.

The Department shall approve precautions that shall be taken in the mixing and use of mortar during freezing weather.

## K. Pipe Bedding Aggregate

### 1. Pipes Four Inches (4") Diameter and Larger

Maryland State Highway Administration designation "Crusher Run Aggregate CR-6", meeting the requirements of ASTM D-2940.

### 2. Pipes One and One Half (1-½") Inches to Three (3") Inches Diameter

Stone aggregate shall have the designation of B-10. B-10 aggregate is rounded stone without sharp edges and having a maximum size of one half inch.

## L. Trench Backfill Material

### 1. Clean Earth

Clean earth shall be those materials complying with ASTM D-2487 Soil Classification Groups GM, GC, SE, SP, SM, SC, CL, and ML, or combinations thereof. The minimum AASHTO T-180 Method C density for clean earth shall be not less than 100 pounds per cubic foot at Optimum Moisture Content. Clean earth shall not contain rocks over six (6") inches in any dimension, nor shall it contain any noticeable amounts of loam, topsoil, or organic matter.

### 2. Dirty Crusher Run (CR-D)

Granular limestone material with 100 U.S. standard sieve and gradation similar to Maryland State Highway Administration Graded Aggregate for Sub base (GA S/B). The aggregate shall be thoroughly blended with 25 to 40 percent by volume or 19 to 32 percent by weight of clean earth material as defined above, except that all constituents must pass the 1-½ inch sieve.

Submit moisture/density curve and graduation analysis, with percent of organic material found.

## M. Stone Aggregate Below Subgrade

The aggregate to be utilized below subgrade is dependent upon the site conditions. The inspector will provide the direction as to which aggregate is to be

utilized below subgrade. The Contractor shall perform the corrective measures as directed by the Department, as a change in the scope of work.

## N. Bituminous Concrete (Asphalt Pavement)

All asphalt paving materials and placement shall be in accordance with Sections 504, 505, and 904 and all Sections referenced, of the *"Standard Specifications for Construction and Materials"* Maryland Department of Transportation – State Highway Administration – October 2008 or latest edition.

## O. Bituminous Protective Coating

When indicated in the Plans and Specifications or directed by the Department, some materials shall be given a bitumastic protective coating. This coating shall consist of one (1) or more coats of bitumastic Super Service Black, as manufactured by Koppers Company, Inc., or Marine Foundation as manufactured by Carboline Company or equal.

The bitumastic material may be applied by brush or spraying. If sprayed, it must be applied at 70 square feet per gallon per coat. Each coat shall have a dry film thickness of 0.016 inches (16 mils).

## P. Material Safety Data Sheets

Material Safety Data Sheets (M.S.D.S.) shall be provided for all applicable materials used in performance of the work by the Contractor or his employees, as part of the Shop Drawing Submittal for the sanitary sewer materials used.

M.S.D.S. shall be properly displayed at the site of the work, accessible and visible to all persons within the area of the work.

The inspector may require the Contractor to stop work without compensation or recourse for delay, if the M.S.D.S. for applicable materials being used, are not available at the site.

## Q. Steel Pipe Encasement

Where indicated on the Contract Drawings the sanitary sewer pipe shall be installed as a carrier pipe inside of a steel casing pipe within an open trench or by jacking and boring. The carrier shall be adequately secured in place with casing insulators and the ends of the casing shall be sealed, watertight, as indicated on the Standard Detail. Piping joints within the casing pipe shall be restrained with mechanical restraints.

### 1. Steel Casing Pipe

Casing pipe shall conform to AWWA C200, A-139 Grade 36 steel minimum. Diameter and wall thickness shall be as shown on the Standard Detail for the respective carrier pipe diameter.

All joints shall be welded the full circumference, watertight. Field welding shall comply with AWWA C206, single-welded butt joints. Joints shall be tested for water tightness by means of a vacuum-type look box (AWWA C200), or equal, prior to jacking or setting into place. Casting shall be coated inside and outside with coal tar epoxy in accordance with AWWA C210, to obtain a minimum dry film thickness of 15 mils (0.015 inch).

The contractor shall install #4 anode bags to each end of the casing pipe.

### 2. Pipe Insulators

Carrier pipe insulators (casing spacers) shall be manufactured to tightly fit the specific class and outside diameter of the carrier pipe so as not to allow slippage along the carrier. The 12-inch wide two-piece solid sleeve band and runner studs shall be either stainless steel lined with PVC or an insulating coating, or steel with a complete coating of fusion bonded PVC. Connecting hardware shall be stainless steel. The runners shall be glass reinforced plastic, HDPE, or UHMW polymer, 2 inches wide, of adjusted size to provide the designated pipe gradient, or be centered within the casing. The outside diameter of the runners shall be within one half inch of the inside diameter of the casing.

Insulators shall be Model AL2G-2 as manufactured by Pipeline Seal and Insulator, Inc., or Model CCS as manufactured by Cascade Waterworks Mfg. Co., or equal.

### 3. Casing End Seals

Casing end seals shall conform in design to Pipeline Seal and Insulator, Inc., Model 'S', or equal. All banding and tightening device materials shall be 300 Series stainless steel. Size shall be suitable to make a non-crimped, water tight fit between casing and carrier pipes.

## R. Sewer Line Markers

Markers shall be Carsonite Utility Markers, Model No. SNFB-072 with 1854-SL decal marked "Sewer Line". Markers shall be installed as per manufacturer's recommendations adjacent to valve boxes or directly over the pipeline where indicated on the Contract Drawings.

## S. Wet Well

The wet well shall be constructed of precast reinforced concrete pipe manufactured with Type II Portland Cement and with strength of 4000 psi per ASTM C-478 and shall be fully lined with H.D.P.E. liner. All dimensions and the configuration shall be as shown on the drawings. The wet well foundation shall be cast-in-place, reinforced concrete.

Materials shall conform to ASTM C-76, except as otherwise specified. Fine aggregate shall be natural sand conforming to the requirements for concrete subject to surface abrasion. Manufacture shall be by the wet cast method. Include steam curing, water curing or combination thereof as included in applicable standard.

Rubber gaskets for joints in circular pipe shall be o-ring type, circular cross section conforming to ASTM C-361.

Basis of acceptance per physical test requirements of applicable manufacturing standard and ASTM C-497, primarily performed by manufacturer's testing lab and quality control personnel. Provide mill tests on steel, cement and gasket materials throughout the manufacturing and delivery period. Perform concrete compression tests on molded cylinders on days of production during which pipe cores not required.

## T. Wet Well Coating

### 1. Interior

Concrete wetwell shall be fully coated on the interior and across the full width of all joints, by the wetwell manufacturer with a High Density Polyethylene (H.D.P.E.) liner, as manufactured by AGRU, GSE Studliner, or an approved equal. The H.D.P.E. liner is not required to be installed on the floor of the wet well.

### 2. Exterior

The exterior of the wet well shall have a protective coating of bitumastic applied to all exterior surfaces. This coating shall consist of one (1) or more coats of bitumastic super service black, as manufactured by Koppers Company, Inc., or marine foundation as manufactured by Carboline Company or approved equal. The bitumastic material may be applied by brush or sprayed; it must be applied at 70 square feet per gallon per coat. Each coat shall have a dry film thickness of 0.016 inches (16 mils).

Once the bitumastic coating has been applied, a protective board will need to be applied to the exterior surfaces. The protective boarding shall be Warm-N-Dri as manufactured by Owens Corning or approved equal.

Board thickness is determined based upon manufacture's information and depth. Varying board thickness, on the exterior of the wet well, will not be permitted. The thickness recommended protective board shall be utilized on the entire exterior of the wet well.

## U. Mechanical Restraints

When piping is required to be restrained against movement, this shall be achieved through the use of mechanical restraints. The use of concrete thrust blocks is prohibited.

All mechanical restraints shall be manufactures by Ford Meter Box Company, Inc and shall be the Uni-Flange series or approved equal. The Contractor shall determine which Uni-Flange series is applicable for the intended use and shall submit appropriate shop drawing to the Department of Water Quality for approval.

**Chapter 2, Section 204**

**Sanitary Sewer Installation**

## IV. Sanitary Sewer Installation

### A. Scope

The Contractor shall furnish all plant, labor and materials and perform all operations required for the construction of sewers and appurtenances including all pipe, jointing materials and joints, laying pipe, fittings, tracer wire, manholes, concrete, granular bedding, backfill, testing, and all incidental work necessary to complete the work as shown on the drawings and/or as specified.

### B. General

Included in this section are specifications for the installation of all sanitary sewers of whatever size, material or type required. Gravity sanitary sewer shall consist of straight sections of poly vinyl chloride pipe connected by precast concrete manholes of the size and with jointing materials, as shown on the drawing or specified in Chapter 2, Section III, "Sanitary Sewer Materials". Other sewers shall be as specified.

### C. Laying Pipe and Fittings

#### 1. Gravity Sewers

Following the trench excavation and preparation of the aggregate bedding material, as specified in Section III, "Excavation and Backfill", pipe laying shall proceed upgrade with pipe laid carefully, bells upgrade, spigot ends entered into adjacent bells to the insertion mark, and true to lines and grades shown on the drawings. Each length or section of pipe or fitting shall be carefully inspected before installation and those containing cracks or other defects shall be removed from the site.

Extreme care must be exercised to prevent breakage when pipe is handled especially during cold weather. Bells and spigots shall be carefully cleaned before pipes are lowered into trenches. The pipes shall be lowered so as to avoid unnecessary handling in the trench.

In laying pipe, special care shall be taken to insure that each length shall abut against the next in such a manner that there shall be no shoulder or unevenness of any kind along the inside of the pipe. Before joints are made, each section of pipe shall rest upon the pipe bed for the full length of its barrel, with recesses prepared where required to accommodate bells and joints. After jointing, the recess shall be fully backfilled to provide

adequate support throughout the entire length. Pipe joints shall be made in strict accordance with the pipe manufacturer's specifications.

No pipe shall be brought into position until the preceding length has been adequately braced and backfilled such that it is secure against movement or misalignment.

Field cutting of pipe shall be kept to the minimum required for fitting placement and manhole connection.

The interior of all pipes shall be thoroughly cleaned before they are laid and shall be kept clean until the acceptance of the completed work. The open ends of all pipe and fittings shall be provided with a stopper carefully fitted so as to prohibit dirt and other substances from entering into the pipe. The stoppers shall be kept in the end of pipe at all times when laying is not in actual progress.

Under no circumstance shall pipe be laid in water or on subgrade into which frost has penetrated, nor at any time when the inspector shall deem that there is danger of the formation of ice or the penetration of frost at the bottom of the excavation, unless all required precautions as to minimum length of open trench and promptness of refilling are observed. In all cases water shall be kept out of the trench.

Walking or working on the completed pipeline except as may be necessary in tamping or backfilling will not be permitted until the trench has been backfilled to a height of at least two (2) feet over the top of the pipe.

Any pipe that has its grade or joint disturbed after laying shall be taken up and relaid. Any section of pipe already laid and found to be defective shall be taken up and replaced with new pipe, without expense to the Department.

No pipe shall be laid within ten (10) feet of the machine excavating the trench, including in rock excavation, nor within twenty five (25) feet of any place where blasting is being performed. The mouth and exposed portions of the pipe shall be carefully protected from all blasts.

**2. Pressure Sewer**

Pressure sewer shall be installed in accordance with and as specified herein before under paragraph "1" "Gravity Sewers". Location and grade or depth shall be as shown on the drawings, holding four (4) feet minimum cover unless otherwise indicated to avoid unnecessary high points (air pocket). *Maximum joint deflection shall be limited to one half (1/2) of the maximum joint deflection specified by the pipe manufacturer.*

Tracer Wire Installation

a. All buried pressure sewer shall be accompanied by a #12AWG standard copper tracer wire and shall terminate in an approved test station located at values, flushing connections or Air Release and or as directed by the Engineer.

b. The tracer wire shall form a mechanically and electrically continuous line throughout the pipeline.

c. Tracer wire shall be tested for continuity in the presence of the inspector, prior to acceptance of the infrastructure.

## D. Joints

Before joints are made, the Contractor shall thoroughly clean and inspect all bell and spigot ends to insure there are no defects.

Factory cut or field cut D.I.P. shall have the edge ground smooth to a minimum level width of 1/8", cleaned of extraneous materials and double coated with coal tar epoxy inside and out within three inches (3") of the cut edge and to a dry film thickness of 6 mils each coating. The coating system shall meet the requirements of AWWA C205 and or C210.

### 1. Elastomeric Gasket Joints

The gasket shall be removed, if possible, from the retainer, thoroughly cleaned and checked for defects, and then reassembled. Gasket shall be fully seated in retainer and facing in the correct direction. Lubricant shall be used and as specified by the manufacturer.

Field cut pipe shall be beveled to the angle specified by the manufacturer. Prior to insertion, a full insertion mark shall be drawn around the visible top half of the cut end of pipe.

### 2. Mechanical Joint

The last eight inches (8") outside of the spigot and inside of the bell of mechanical joint pipe shall be thoroughly cleaned of foreign matter. The cast iron gland shall then be slipped on the spigot end of the pipe. The

rubber gasket shall be placed on the spigot end with the thick edge toward the gland. The spigot end is inserted into the bell. The gasket is then slid toward the bell and presses into the v-notch of the bell. The gland is placed against the gasket and all of the bolts shall be inserted in the joint and the nuts screwed up tightly with the fingers. All nuts shall be tightened with an automatic cut off torque wrench. The torque for various sizes of bolts shall be as follows:

| Size of Bolt (inches) | Torque Setting (FT-LB) |
|---|---|
| 5/8 | 50 |
| 3/4 | 75 |
| 1 | 85 |

Nuts spaced 180 degrees apart shall be tightened alternately to produce equal pressure on all parts of the gland.

**3. Flanged Joint**

Flanged pipe shall be installed in strict conformance with the ANSI/AWWA C110/A21.10 standards. Flanged fittings must be installed with the centerline of the bolts holes properly oriented to ensure correct alignment of the piping system. The responsibility for proper alignment and tightening of the flanges in the field rest solely with the Contractor.

**4. Branches**

Branches shall be installed at the locations indicated on the drawings, or as directed by the Department, and shall conform with the materials and arrangement as shown in "Standard Detail Drawing S-3.1". Branches for the various types of sewer lines shall be:

a. Branches for connecting a gravity lateral to a gravity main, shall consist of a commercially manufactured sanitary tee with a one eight (1/8) bend.

b. Branches for connecting a pressure lateral to a gravity main, shall consist of a commercially manufactured sanitary tee with a one eight (1/8) bend. Reducer bushings shall be utilized as required for small diameter low pressure sewer.

c. Branches for connecting a pressure lateral to a pressure mains, shall consist of a commercially manufactured standard tee.

## E. Concrete Cradles and Encasements

Concrete cradles or encasements may be required, as directed by the Department, due to conditions encountered, if not specified or shown in the Contract Documents.

Concrete shall have a 28 day compressive strength of 2500 P.S.I. "Dry-Mix" concrete shall not be used without prior approval by the Department.

Method of placement shall be so as to prevent water, earth, or foreign materials from becoming mixed with the concrete.

Formed or unformed concrete shall be placed under or around the pipe for cradle or encasement conforming to the dimensions shown on the standard details or as indicated on the drawings. The final limits of the beginning and ending of cradles and encasements shall be as approved by the inspector.

## F. Potable Water Clearance

Sanitary sewer crossing any potable water pipe shall be one foot (1') minimum clear below the water pipe, measured from the outside of pipes. Sewer parallel to water shall maintain a horizontal clearance of ten feet (10') minimum and the sewer crown shall be below the invert of the water pipe.

In cases where the above clearance cannot be achieved, as determined by the Department (if not shown or specified), the sewers shall be encased in 2500 P.S.I. concrete to ten feet (10') each side of the water crossing or for the entire length of the parallel encroachment. The final limits shall be as directed by the Department; or the sewer shall be installed inside a casing pipe or if approved by the inspector, shall be laid if applicable so that no joint be within 10' either side of the water crossing.

## G. Manhole Construction

### 1. General

The Contractor shall furnish all material for and labor necessary to construct all manholes and appurtenances, as shown, detailed and specified, at such point on the lines of the sewers as are shown on the drawings or as directed by the Department. *Dry cast manholes, risers or tops are not acceptable.*

Drop manholes will be located on sewers only at such points and with such drops as are shown on the drawings or as directed by the Department.

Manholes shall be built as pipe laying progresses. The Department may stop work entirely on laying pipe, until the manhole just passed has been completed and passed vacuum test.

The masonry shall be carried up to such point above or below the ground surface, as the Department shall in each case require. Flow channels for receiving and passing sewage shall be formed in the bottom of manholes.

Manholes shall be built in accordance with the design shown on drawings and conforming to the requirements of the Standard Details and ASTM C-478.

**2. Excavation For Manholes:**

Excavate as near a vertical plane one (1) foot outside of the manhole base, with the exception that existing pavement shall be cut to a square shape with dimensions two (2) feet greater than the diameter of the manhole base.

Subgrade shall be not less than eight inches (8") below the downstream invert of the sewer except as otherwise shown on the drawings. When it is necessary to excavate wider or deeper foundations that specified or shown, such foundations shall be built of compacted granular material or 500 P.S.I. type II portland cement concrete as directed by the Department, to the specified lines and grades.

**3. Precast Concrete Bases:**

Shall conform to applicable sections of ASTM standard specification C 478. The base shall be monolithically cast and shall consist of a manhole bottom and a wall which shall extend a minimum of twelve inches (12") above the top of the highest inflowing sewer. The top of the base shall be formed to receive tongue of barrel section. There shall be a minimum distance of four (4) inches between the invert of the lowest out flowing sewer and floor of the precast base to provide for the construction of a formed flow channel and bench within the manhole. No more than two (2) lift inserts shall be cast in the base. Lift inserts shall not extend into the wall more than four (4) inches.

Precast manhole bases shall be installed on top of a layer of Maryland State Highway Administration G.A.S.B. (CR6) crushed stone coarse aggregate which shall be well compacted, screeded to level and uniform bed, have a minimum depth of six (6) inches and be installed on undisturbed earth approved by the inspector.

The pipe-to-manhole seals shall be a compression type rubber joint cast integrally into the manhole base at the time of casting. The minimum pipe to manhole seal/adapter shall be 4". It shall form a flexible watertight joint, as manufactured by A-Loc or Star Seal.

**4. Precast Concrete Sections:**

The base shall be monolithically cast consisting of a bottom and a wall which shall extend a minimum of twelve inches (12") above the top of the highest inflowing sewer crown. No more than two (2) lift inserts shall be cast in the base. Lift inserts shall not extend into the wall more than four inches (4").

Precast manhole bases shall be installed on top of a layer of aggregate bedding material, placed on disturbed earth subgrade approved by the inspector to a minimum compacted depth of six inches (6").

The pipe-to-manhole seals shall be a compression type rubber joint cast integrally into the manhole section(s) at time of casting. The minimum pipe to manhole seal/adapter shall be four inches (4"). It shall form a flexible watertight joint.

All joints between sections shall be of the tongue and groove configuration utilizing butyl rubber gasket material to provide a watertight seal.

The base, rise (barrel), conical section, and top, shall be the production of one recognized manufacturer of precast manholes manufactured by wet casting.

**5. The Top Of All Precast Manholes**

Tops of all precast manholes may be brought to proper grade for receiving manhole frames by using not more than twelve (12) inches of concrete grade rings. Masonry construction shall be performed by experienced and qualified workmen only. All work shall be laid plumb, straight, level, square and true. All joints shall be full and not more than one-half (1/2) inch in thickness. All steps and miscellaneous items specified elsewhere shall be bonded in the masonry. The masonry walls shall be parged on the outside with a one-half (1/2) inch coat of Portland Cement mortar.

Mortar to be used in laying the concrete grade rings or laying and parging the leveling courses of brick and for setting manhole frames shall be prepared by thoroughly mixing; one (1) volume of Type II Portland Cement with two (2) volumes of sand and sufficient clean water to produce a rich mass of approved consistency. Mixing mortar on the

ground or any paved surface shall not be permitted. Sand to be used in making mortar shall be clean, well-graded and shall pass a standard no. 4 sieve.

## 6. Frame and Cover Installation

Precast concrete grade rings shall be used to bring the top of the frame and cover to final grade. No more than twelve inches (12") of concrete grade rings may be used. Rings shall be set in mortar by experienced and qualified workmen. All steps and miscellaneous items specified elsewhere shall be bonded in as the masonry proceeds.

In non-paved areas, rings shall be laid plumb, straight, level, square and true. All joints shall be full and between three eighths inched (3/8") and one-half inch (1/2") in thickness.

In paved roadways only, to match final road grade or pitch, frame and cover shall have beveled grade rings installed to match the roadway cross slope.

Five-eighths inch (5/8") hot-dipped galvanized or stainless steel all thread rod and nuts & washers shall secure the frame to the top manhole section with holes through the leveling courses.

## 7. Flow channels

Type II Portland cement concrete with 28-day compression strength of 1500 P.S.I. shall be used. Flow channels shall have a smooth trowel finish free of defects and accurately shaped to a semi-circular bottom conforming to the inside of the adjacent sewer sections.

Changes in size and grade shall be made gradually and evenly, and have not less than one-tenth foot (0.10') slope from invert in to invert out. Pipes of differing diameter shall have inverts set such that crowns are level (matching crowns). Changes in direction of the sewer and entering branches shall have a true curve of as large a radius as the size of the manhole will permit.

Benches shall be installed having a 1/4 inch per foot slope toward the flow channel and have a brushed concrete finish. *Steep slopes outside the flow channel will not be permitted.*

Flow channels may be cast by the manhole manufacturer upon prior approval by the Department.

Flow channels shall be formed in conjunction with forming and pouring of cast-in-place concrete bases, and shall be the same 3500 P.S.I. type II portland cement concrete as the base.

Prior to placement of concrete in manhole bases to form channels, the Contractor shall completely wrap "Styrofoam rope" around the pipe ends at the inside face of the manhole wall to provide a void between the concrete and pipes to insure a flexible pipe to manhole joint.

### 8. Bedding and Backfilling

Manholes shall be bedded and backfilled the same as pipe with material suitable to the location (i.e. stabilized or non-stabilized), compacted in layers and to the density specified in Chapter 2, Section III, "Excavation and Backfilling".

### 9. Internal Drop Connection

All internal drops must be installed in a minimum 60" diameter manhole. The inside drop bowl, stainless pipe brackets, and manhole channel system, shall be the RELINER® Inside Drop System. The RELINER® Inside Drop System shall be installed according to the manufacture's requirements.

If more than two internal drops are proposed for a manhole, the manhole shall have a minimum diameter of 72".

## H. Connection to Existing Manhole

The Contractor shall neatly core an opening into the existing manhole by methods approved by the Department, and shall fix into place an approved watertight adapter to accept new sewer pipe. (See Standard Detail SW-2.10) For connections of sewer mains and/or services smaller than 4" in diameter, the minimum allowable pipe to manhole adapter shall remain at 4" and a reducer shall be used to adjust the pipe size accordingly outside of the manhole as approved by the Department.

The existing bench shall be saw cut and removed to receive the new pipe invert. The elevation shall be such that all pipes match crowns unless otherwise specified. A new bench and flow channel shall be shaped of brick or concrete to the top of the new pipe. The manhole shall be repaired and made watertight to the satisfaction of the inspector. Vacuum testing may be required.

## I. Future Extension

Where directed by the Department, or when indicated on the drawings, provisions shall be constructed for future extension of sewer, as follows.

The flexible manhole seal shall be cast into the manhole base at the time of manufacture, to receive a stub of capped pipe for future extension.

Manhole sections shall be constructed in their entirety for future extensions when any section of a temporary termination falls in or within 7' of a paved area. The full section of sewer to be a future manhole location in a temporary or permanent non-stabilized area shall be built. All backfill requirements as specified in Chapter 2, Section III, "Excavation and Backfilling" shall pertain.

## J. Sewer in Casing Pipe

All sewer shall be fitted with pipe insulators and casing end seals as specified and shown in the Standard Details.

All casing pipe shall be true and straight in alignment and grade with no deviation from that as indicated on the drawings.

The carrier pipe shall be centered within the casing. Pipe insulators shall be sized so the skids are snug against the casing pipe in all directions of the circumference in order to prevent movement or change in the grade or alignment of the carrier pipe.

The sewer pipe installed within the casing pipe shall be mechanically restrained by mechanical restraints. The mechanical restraints shall also be installed a minimum of 20' from each end of the casing.

## K. Service Piping and Appurtenances

Service piping shall be installed in accordance with and as specified in paragraph 204 - C, "Laying Pipe and Fittings" and Standard Detail Drawings S-3.1 and S-4.1.

### 1. Gravity

All piping and fittings shall be gasketed PVC SDR26 Heavy Wall. The contractor shall install a gasketed long sweep TEE WYE for the cleanout connection. The cleanout shall be located on the right-of-way or property line but in no case shall it be installed in a swale or another type

depression. Provide easements if so required due to such drainage conflicts.

**2. Low Pressure**

All piping and fittings shall be gasketed PVC SDR21. The brass ball valve with cast iron roadway valve box shall be located on the right-of-way or property line with a brass swing check valve 18" behind it with a 5' stub of pipe and cap. But in no case shall it be installed in a swale or any other type depression. Provide Easements if so required due to such drainage conflicts.

## L. Abandoning of Existing Sewer

The Contractor shall furnish all materials for and labor necessary for the construction of the re-routed sewer main and appurtenances and the abandonment of the existing sewer, as shown on the contract drawings, as specified herein, or as directed by the Department. All abandoned sewer lines shall be removed in the entirety.

Whenever the construction of a new utility or structure over an existing sewer in-place requires the abandoning of the existing sewer the following procedures shall be adhered to.

**1. Abandoning Gravity Sewer Mains**

Flow shall be maintained in the existing sewer main(s) and/or manhole(s) until such time as the relocated sewer(s) and manhole(s) are constructed and ready for use; this shall include excavation and backfill, testing, flow channel(s), frame(s) and cover(s), service laterals, if applicable; final inspection and acceptance of the newly constructed sewer and appurtenances. Upon acceptance, the flow channel shall be constructed in the existing manhole(s) in which the relocated sewer main has been installed. The sewage is then routed through the new sewer main(s). The Contractor shall then excavate the abandoned sewer main(s) at the face of the existing manhole(s) and remove all portion of the abandoned line.

**2. Abandoning Manholes**

When existing manhole(s) are to be abandoned, said manhole(s) shall be removed and disposed of by the Contractor. Excavations made for the removal of existing manholes shall be refilled with suitable material as may be required in a stabilized or non-stabilized area, and shall be well compacted to the satisfaction of the inspector.

### 3. Abandoning Pressure Mains

Flow shall be maintained in the existing pressure main(s) until such time as the relocated pressure main construction is completed; including bends, fittings, thrust blocking, buttresses, testing, final inspection and acceptance of the newly constructed pressure main. Upon acceptance, connection to the existing pressure main shall be performed at a time as specified and as co-coordinated by the Department by cutting out a section of existing pressure main and by utilizing mechanical joint repair sleeves and nipples, mechanical restraints, etc. Upon placing the new pressure main into service, the Contractor shall excavate, remove, and dispose of the abandoned pressure main.

## M. Testing

All installed sewers shall be tested in the presence of the inspector together with a representative of the Contractor in the manner prescribed in the "testing" section of these standard specifications. It is the intent that the described testing procedures are to be systematically carried out as an integral part of the pipe-laying procedures. Failure to accomplish the testing will be considered as non-completion of construction.

If, at any time before the completion of the contract or warranty period any broken pipes or any defects are found in the sewers or in any of their appurtenances; the Contractor shall cause the same to be removed and replaced by proper material and workmanship, without compensation.

## Chapter 2, Section 205

## Sanitary Sewer Testing

## V. Sewer Testing

### A. Laboratory Testing

All materials require written certification of compliance from the manufacturer stating that resentative samples have undergone laboratory tests by the methods and procedures of the ASTM, ANSI, AWWA, or other standards agency and do comply as specified.

Reports of the results of such tests may be requested to be submitted to the Department as sufficient evidence of the acceptance or rejection of the quality of the materials tested.

Representative samples of materials may be requested to be submitted to the Department, properly packaged and identified indicating manufacturer, material name and specification, and the intended use of the material in the project. The Department will determine, based on the materials submitted, whether additional laboratory testing by an independent laboratory will be required, prior to approval for the use of material in the work.

### B. Field Testing

All sewers and appurtenances shall be tested in the field in the presence of a inspector together with a representative of the Contractor in the manner prescribed herein.

It is intended that the herein described testing procedures be systematically carried out as an integral part of the pipe-laying procedures. Failure to accomplish the testing may be considered as non-completion of construction.

The Contractor shall furnish without charge, all labor and equipment necessary to complete specified testing.

Any section of sewer showing leakage in excess of the amounts specified herein shall be repaired or replaced by the Contractor at no cost to the Department.

### C. Low Pressure Air Test

Gravity sewers shall be tested by Low Pressure Air Testing. The test is conducted between two (2) consecutive manholes, as directed by the Department. The length of test section for small diameter gravity sewers shall be as directed by the Department. The test procedure is as follows:

1. The test section of the sewer line is plugged at each end. One of the plugs used must be tapped and equipped for the air inlet connection for filling the line from the air compressor. All service laterals, stubs and fittings into the sewer test section shall be complete and properly capped or plugged, and carefully braced against the internal pressure to prevent air leakage by slippage and blowouts.

2. Connect air hose to tapped plug selected for the air inlet then connect the other end of the air hose to the portable air control equipment which consists of valves and pressure gauge used to control the air entry rate to the sewer test section, and to monitor the air pressure in the pipe line.

   More specifically, the air control equipment includes a shut-off valve, pressure regulation valve, pressure reduction valve and a monitoring pressure gauge having a pressure range from 0 to 5 psi. The gauge should have minimum divisions of 0.10 psi and an accuracy of +/-0.04 psi.

3. Supply air to the test section slowly, filling the pipeline until a constant pressure of 4.0 psi is maintained. The air pressure must be regulated to prevent the pressure inside the pipe from exceeding 5.0 psi.

   When constant pressure of 4.0 psi is reached, throttle the air supply to maintain the internal pressure above 3.5 psi for at least 5 minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall. During this stabilization period it is advisable to check all capped and plugged fittings with a soap solution to detect any leakage at these connections.

   If leakage is detected at any cap or plug, release the pressure in the line and tighten all leaky caps and plugs. Then start the test operation again by supplying air. When it is necessary to bleed off the air to tighten or repair a faulty plug, the five-minute equalization period must be restarted after the pipe has been refilled.

4. After the stabilization period, adjust the air pressure to 4.0 psi and shut off or disconnect the air supply, observe the gauge until the air pressure reaches 3.5 psi, at 3.5 psig commence timing with a stop watch which is allowed to run until the line pressure drops to 2.5 psi at which time the watch is stopped, for a pressure loss of 1.0 psi is used to compute the air loss.

The section of the pipe undergoing the test shall be considered acceptable if the time for the 1.0 psi drops in air pressure from 3.5 to 2.5 psi is greater than given by:

$$\mathbf{T}\ (\text{MINUTES}) = \frac{\mathbf{0.0119 \times D^2 \times L}}{\mathbf{60}}, \text{ where:}$$

**D** = pipe diameter in inches,
**L** = length of pipe tested in feet

An air pressure correction is required when the prevailing ground water is above the sewer line being tested. Under this condition, the air test pressure must be increased 0.433 psi for each foot the ground water level is above the invert of the pipe.

The air test form, Standard Detail S-12.6, shall be completed for each air test by a inspector.

## D. Vacuum Test

1. Manholes

Each manhole shall be tested immediately after installation and prior to backfilling. All pipes entering the manhole shall be plugged, taking care to securely brace the plug from being drawn inward. The test head shall be placed at the inside or the top of the cone section, or manhole frame and the seal inflated in accordance with the Manufacturer's recommendations.

A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9 inches. The manhole shall pass if the time is greater than 60 seconds for 48" diameter, 75 seconds for 60", and 90 seconds for 72" diameter manholes.

If the manhole fails the initial test, necessary repairs shall be made with a non-shrink grout to manhole exterior, while the vacuum is still being drawn. Retesting shall proceed until a satisfactory test is obtained.

Comparable times for a successful vacuum test for different size manholes are:

| DEPTH (ft) (height of manhole) | TEST TIME (sec) for DIAMETER (inches) | | |
|---|---|---|---|
| | 48" | 60" | 72" |
| 8 | 14 | 18 | 23 |
| 10 | 17 | 23 | 28 |
| 12 | 21 | 28 | 34 |
| 14 | 25 | 32 | 40 |
| 16 | 28 | 37 | 45 |
| 18 | 32 | 41 | 51 |
| 20 | 35 | 46 | 57 |
| 22 | 39 | 51 | 62 |
| 24 | 42 | 55 | 68 |
| 26 | 46 | 60 | 74 |
| 28 | 49 | 64 | 80 |
| 30 | 53 | 69 | 85 |

2. Septic Tanks

Each tank shall be tested immediately after installation and prior to backfilling. All openings shall be plugged, taking care to secure plugs from being drawn inward. The test head shall be placed in inlet opening and the seal inflated in accordance with the manufacturer's recommendations.

A vacuum of 3.5 inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 2.5 inches. The tank shall pass if the time is greater than 5 minutes.

If the tank fails the initial test, necessary repairs shall be made in accordance with the manufacturer's recommendations or, if repairs cannot be made the tank shall be replaced. Retesting shall proceed until a satisfactory test is obtained.

## E. Hydrostatic Leakage Test

Force mains and pressure sewers shall be tested by hydrostatic testing for leakage. The test section shall not exceed 1,000 feet in length where practical and shall be approved by the inspector. Each section shall receive the following hydrostatic test:

1. The pipe shall be slowly filled with water and tested to a pressure specified by the Department based on the elevation of the lowest point of the line of section under test. Before applying the specified test pressure, all air shall be expelled from the pipe. The pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Department.

2. The Contractor shall furnish the gauge and flow meter for measuring pressure and leakage. Leakage is defined as the quantity of water to be supplied to the pipe, or any section thereof necessary to maintain the specified test pressure after the pipe has been filled with water and the air expelled.

3. The duration of the test shall be for a period of not less than four (4) hours.

The Contractor shall furnish the water, pump, pipe, connections, meter and all other necessary apparatus, as shown on Standard Detail SW-12.7, and shall furnish all necessary labor to conduct the tests at no cost to the Department.

No pipe installation will be accepted until the leakage is less than the number of gallons per hour as determined by the formula:

$$\mathbf{L = \frac{N \times D \times (P)^{1/2}}{7400}}$$ , WHERE:

**L** = allowable leakage in gallons per hour,
**N** = number of field joints in the test section,
**D** = nominal diameter of pipe in inches,
**P** = average test pressure during the test in pounds per square inch.

The pipe shall be pressure tested at 1.5 times the operating pressure.

Should any test of pipe laid disclose leakage greater than that specified above, the Contractor shall locate and repair the line until the leakage is within the specified allowance.

## F. Testing Equipment

1. Air Test

Equipment shall be the Unitest System 200 air test system manufactured by United Survey, Inc., Cherne Air Loc low-pressure air testing system, or equal.

All necessary equipment for conducting air testing shall come complete in a self-contained unit. The unit shall include an air test control panel, air hose, hose reel, regulated air tank, air compressor, sewer plugs, float line kit, air test winch, segmenting test kit for each pipe size and other equipment necessary for conducting the air tests.

All labor and equipment shall be furnished by the Contractor.

2. Hydrostatic Test

A pressure test pump shall be provided. The pump shall be capable of providing a minimum flow of six (6) gpm and pressures of 300 psi or greater. The pump shall be the Hydro-Test II, Model No. 36452 manufactured by Wheeler-Pilot International or equal.

A meter to measure make-up water shall also be installed.

The water, pump, pipe connections, taps into the pipe, all necessary apparatus labor and materials shall be furnished by the Contractor.

All testing equipment must be certified by the manufacturer. Before testing can take place, the testing equipment must be calibrated per manufacturer's specification prior to use.

## G. Concrete

1. Laboratory Tests

All concrete to be used in the work shall be laboratory tested, and certified by a Maryland Registered Professional Engineer, and a report submitted to the Department for approval prior to use, as specified in Section, "Materials".

Aggregates shall be tested in accordance with ASTM Specifications: C-29, C-40, C-127, C-128, and C-136.

Methods for compressive strength testing shall conform to ASTM Specifications C-31, C-39, and C-192.

The report shall show in detail at least three (3) different water-cement ratio mix designs for each class of concrete to be used, and 7-day, 14-day and 28-day compressive strengths obtained. The strength determinations shall be based on not less than two (2) concrete test specimens for each age and each water-cement ratio.

The tests shall establish three (3) curves representing the relation between the average strength of the concrete at each age, for each water-cement ratio, for each class of concrete to be used in the work.

The maximum water-cement ratio allowed to be used in the work shall be that corresponding to a point on the curve established by these tests, representing a strength of concrete 15% higher than the minimum compressive strengths called for.

The Department shall have the right to make adjustments in concrete proportions if necessary, to meet the requirements of these specifications.

Test results of concrete made with materials from the same sources and of the same class as called for in the current work, along with a certified report dated not more than one (1) year prior to the Contract date, may be submitted for approval by the Department, subject, however, to any provisions to the contrary as required by building codes or ordinances of the governing or permitting authority.

2. Field Tests

During concrete operations, the Department will arrange to have Slump Tests (ASTM C-143), Air Content Test (ASTM C-173), and Test Cylinders (ASTM C-31) made to determine whether the concrete as being produced complies with the standards of quality specified. Tests shall be in accordance with this section. The Contractor shall provide, at no cost to the Department, the required test cylinders.

Sets of four (4) cylinders will be made for each class of concrete used in any one day's operation, but not less than one (1) set for every fifty (50) cubic yards of concrete poured. Two (2) cylinders will be tested at 7 days and two (2) at 28 days.

Whenever it appears that tests fail to meet the requirements herein and/or of the approved mix, the Department shall have the right, at the Contractor's expense, to:

a. Order changes to the proportions of the mix to increase the strength.
b. Require additional tests of specimens cured entirely under field conditions.
c. Order changes to improve procedures for protecting and curing the concrete.
d. Require additional tests in accordance with "Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete", ASTM C-42.

If the above tests fail to prove that the questionable concrete is of specified quality, the Contractor shall replace such portions of the concrete work as the Department may direct, all at no cost to the Department.

In the event that concrete is placed during freezing weather or that a freeze is expected during the curing period, an additional cylinder will be made for each set, and it will be cured under the same conditions as that part of the work, which it represents.

The Contractor shall provide and maintain for the sole use of the Department, adequate facilities for safe storage and proper curing of concrete test specimens on the project site for the first 24 hours as required by ASTM C-31.

The Department reserves the right, if they elect, to retain the services of a testing laboratory for inspection at the mixing plant.

The Contractor shall make no change from the approved mix or the source or brand of materials used in the concrete without the prior approval of the Department. The Department reserves the right to have periodic checks made to ensure against such changes.

## Chapter 2, Section 206

## Standard Repair of Main and Service Laterals

## VI. Standard Repair of Mains and Service Laterals

### A. Repair of ABS Truss Pipe, Concrete Pipe, or Clay Pipe

Repairs to existing Sanitary Sewer mains and/or service lines, consisting of ABS Truss Pipe, Concrete Pipe or Clay Pipe shall be as directed by the Department. A section of the pipe to be repaired shall be cut out at a point as close as possible to the damaged area. The existing pipe shall be sawcut at a right angle to the pipe and shall not have any shoulder or unevenness. The existing pipe ends shall be cleaned and squared up. A Fernco coupling or approved equal Elastomeric flexible coupling shall be installed on each end of the existing pipe and made ready for the replacement pipe. The length of PVC pipe of equal strength as approved by district, ends cut at right angles and to a length as long as possible to permit installation, shall be installed. The Fernco couplings shall then be centered up over the cuts and the couplings tightened by use of stainless steel clamps. The area of excavation for the repair shall then be backfilled for the length of the repair and for a minimum height of 12" over the pipe, using aggregate specified in Chapter 2, Section III, Sanitary Sewer Materials.

### B. Repair of PVC Pipe

Repairs to existing Sanitary Sewer mains and/or service lines, consisting of PVC pipe shall be as directed by the Department. A section of the pipe to be repaired shall be cut out at a point, as close as possible to the damaged area. The existing pipe shall be sawcut at a right angle to the pipe and shall not have any shoulder or unevenness. The existing pipe ends shall be cleaned and squared up. A Harco, or approved equal, gasketed repair coupling shall be installed on each end of the existing pipe and made ready for the replacement pipe. A length of PVC pipe equal to that removed, ends cut at right angles and to a length as long as possible to permit its setting, shall be installed. The repair couplings shall then be centered up over the cuts. The area of excavation for the repair shall then be backfilled for the length of the repair and for a minimum height of 12" over the pipe using aggregate specified in Chapter 2, Section III, Sanitary Sewer Materials.

* Concrete encasement of the repair, may be directed by the Department, in certain circumstances.

** Methods employed to make pipe repairs in sections A and B, may be altered to allow for installation of a Sanitary Tee to connect another main or service line. At that time the Tee is installed in the length of "Repair" pipe.

## C. Repair of Cast-Iron or Ductile-Iron or PVC Force Main

Repairs to an existing Cast-Iron or Ductile-Iron or PVC force main shall be as directed by the Department. A section of pipe to be repaired shall be cut out at a point as close as possible to the damaged area. The existing pipe shall be sawcut at a right angle to the pipe and shall not have any shoulder or unevenness. The existing pipe ends shall be cleaned and squared up. A Ductile-Iron mechanical joint repair coupling or a Dresser coupling shall be installed on each end of the existing pipe and made ready for the replacement of pipe. A piece of Ductile-Iron or PVC replacement pipe, the same strength as the pipe repaired, shall then be cut at right angles and a length of it installed. The use of Ductile-Iron "Spacers" may be needed at one or both of the repair couplings, to keep the replacement pipe from shifting out of the repair couplings. The repair couplings shall then be centered up over the cuts and the couplings tightened up. The use of a split sleeve repair coupling may be an option considered by the Department. The excavation for the repair shall then be backfilled for the length of the repair and for a height of 12" over the pipe, using aggregate specified in Chapter 2, Section III, Sanitary Sewer Materials.

## D. Pipe Repair Fittings

### 1. Repair Clamp

Clamps for pipe sizes four (4) inches diameter and larger shall be as manufactured by Dresser, Ford, Romac, or equal.

All 300 Series stainless steel repair clamp shall be minimum twelve (12) inches wide, 20 gauge, with a full length circumferential rubber gasket seal, pressure rated greater than or equal to the pipe. A bolt retainer-tightening clamp (minimum 3-bolt) shall be continuous welded to the shell.

When required for a service connection, a fully welded all stainless steel, gasketed, I.P. threaded outlet shall be factory made integral with the clamp.

## Chapter 2, Section 207

## Sewer Lateral Construction

## VII. Sewer Lateral Construction

### A. Construction Methods

SCOPE OF WORK - The Contractor shall furnish all plant, labor and materials and perform all operations required for the construction of Sewer Service Laterals and Appurtenances including all pipe, tanks, pumps, jointing materials, joints and fittings, laying pipe, installing tanks and pumps, electrical service, conduit, controls, concrete and granular bedding backfill, testing and all incidental work required for a complete and functional installation as shown on the drawings and/or as specified herein.

GENERAL – Included in this section are specifications for the installation of all Service Laterals including conventional gravity, low pressure (grinder pumps), small diameter gravity and septic tank effluent pumps (S.T.E.P.)

Sewer Service Laterals shall be installed as shown in the Standard Details and shall be laid in accordance with the Specifications herein for Sanitary Sewer Pipe.

The Department shall furnish and provide complete units, in accordance with the Department's Sewer Service Policy, for Sewer Service Laterals requiring the installation of grinder pumps/basins, septic tanks, effluent pumps/basins. The Department shall be the "Supplier" with no exceptions.

### B. Conventional Gravity Service

The Contractor shall construct the Service Lateral from the main to a feasible point on the property line, Right-of-Way, easement line, or as directed by the Department.

Gravity sewer services shall be constructed as shown on the Standard Details S-3.1, S-3.2, and S3.3; and shall be laid in accordance with Specifications for Gravity Sewer Pipe.

Gravity Sewer Laterals shall connect to the main sewer through a sanitary tee branch and a forty-five degree (45°) bend. Laterals connecting to the main sewer through a manhole shall be in accordance with Specifications for Connections to Manholes herein.

Where gravity service connections are specified to be made to an existing sewer at such locations where there are no tee branches provided in the sewer line, connections shall be in accordance with Specifications for Connections to Existing Sewers herein.

Where laterals of different materials the main line are approved, the connection of the lateral to the main shall be made by using an approved adaptor in conjunction with the tee branch and forty-five degree (45°) bend.

From the end of the forty-five degree (45°) bend all Gravity Sewer Laterals shall be SDR-26 Heavy Wall PVC.

Gravity Sewer Laterals shall be installed at a minimum grade of two percent (2%), except as otherwise approved by the Department.

Gravity Sewer Laterals shall be a minimum of six inches (6") in diameter.

Double lateral shall only be permitted for duplexes and townhouse construction.

When a designated depth at the property line has been determined by the owner or Department, a sloped riser may be installed to raise the service lateral to the determined depth. Risers sloped at forty-five degrees (45°) maximum shall be permitted. Risers shall be of the same material as the pipe to which they are being fitted, unless otherwise directed, and shall enter the sewer through a tee branch, in conjunction with the Standard Detail Drawings herein. All fittings used in the installation of the riser shall be installed in such a manner as to complete the lateral from the riser to the property line at a constant two percent (2%) grade.

Excavation for Service Lateral shall be opened for the entire length before any pipe is laid therein. If rock is encountered within ten feet (10') of any building or structure, it must be removed by means other than blasting.

Sewer Service Laterals shall be installed to the property line, Right-of-Way, easement line at such depths and at such locations as the Department may direct. Excavation shall be made five feet (5') beyond this location to remove any rock which would prohibit the property owner's connection or possible damage to the installation service. This area shall then be backfilled with suitable material.

All Sewer Service Laterals shall be closed at the end with an approved watertight plug or cap, and guarded by a minimum three foot (3') stake placed vertically.

Vertical clean-outs on each sewer service shall be installed at the property line and 10 feet beyond the property line as shown in the Standard Details S-3.1, S-3.2, and S-3.3. Materials shall be the same as the sewer service.

The top of the clean-out shall be installed approximately three (3) feet above the proposed finish grade. When the final grading is performed, the plumber shall then cut the clean-off at finish grade.

## C. Low Pressure Grinder Pump Service

The Contractor shall construct the service lateral from the main line to the grinder pump assembly and shall install the grinder pump system complete at the location designated and determined by the property owner and approved by the Department.

Low pressure services shall be laid in accordance with and as specified herein under the section entitled "Sanitary Sewer Installation" and constructed as shown in the Standard Details. Pressure services and appurtenances shall be installed to line and grade and at locations as shown on the drawings.

Low pressure services shall connect to main sewers through a tee branch. Service Laterals connecting to the main sewer through a manhole shall be installed in accordance with the Specification for "Connections to Manholes".

A low pressure service connecting to an existing gravity sewer main shall be installed by using a "Cut-In" connection to the main line as directed by the Department. Should the flow, size and type of pipe prohibit this method the connection shall be made by tapping the sewer main as directed by the Department of Water Quality.

Low pressure services connecting to an existing pressure main shall be installed by using a "Cut-In" connection to the main. The Contractor shall contact the Department of Water Quality seventy-two (72) hour in advance of performing the work. The Department of Water quality will perform the actual cut-in and will supply the tee, pipe, valve, and concrete. The Contractor will be responsible for the remainder of the work such as but not all inclusive: excavation, backfill, stone backfill, restoration, traffic control, obtain all permits, having a septic hauler's vacuum tanker truck on site, and disposal of all sewage collected by the tanker.

Low pressure service lines shall be SDR-21 PVC pipe and shall extend from the main sewer to the property line, Right-of-Way or easement line, at which point a ball valve and a swing check valve with valve box shall be installed and from that location to the grinder pump location as determined by the owner and approved by the Department.

The Department shall install grinder pump units at the location agreed upon by the Department and the Contractor. Grinder pump units shall be furnished by the Department and shall include grinder pump(s) and motor, fiberglass reinforced basin with cover, guide rail assembly, internal check valve, anti-siphon valve, junction box, level controls, internal wiring to the junction box, shut-off valve, external alarm and control panel. The Department will furnish a unit complete and functional for installation.

Prior to installation, the site for the grinder pump basin shall be excavated to neat lines 12" below the bottom of and the outside dimensions of the basin. A bedding of 4" of Maryland S.H.A. B-10 stone shall be installed and consolidated. Contractor shall furnish and install a concrete anti-flotation collar upon the compacted bedding material. The basin shall be set on top of the concrete and fasten as shown in the Standard Details S-5.1 and S-5.2. Pump and basin shall be installed according to the Manufacturer's instructions. Prior to installation each basin shall be inspected and tested for water tightness. Any tank failing that test shall be rejected. After installation, the area around the outside of the pump shall be backfilled with B-10 stone and to the requirements set forth in Specification Section "Sanitary Sewer Materials".

The Contractor shall furnish and install electrical power for the pump as specified by the pump supplier and shall be installed from the property owner's electric power panel board to the pump.

## D. Small Diameter Gravity Service

The Contractor shall construct the service lateral from the main to the septic tank assembly complete at the location designated and determined by the property owner and approved by the Department.

Small diameter services shall be laid in accordance with and as specified herein under the section entitled "Laying Pipe and Fittings" and be constructed as shown in the Standard Details. Small diameter gravity services and appurtenances shall be installed to the line and grade and at locations as shown on the drawings.

Small diameter sewer laterals shall connect to the main sewer through a wye or sanitary tee branch and a forty-five degree (45°) bend. Laterals connecting to the main sewer through a manhole shall be in accordance with specifications for connecting to manholes herein.

Where small diameter gravity service connections are specified to be made to an existing sewer at such locations where there are no wye/tee branches provided in the sewer line, connecting shall be in accordance with specifications for connecting to existing sewers herein.

Where laterals of different material than the main line are approved, the connection of the lateral to the main shall be made by using an approved adaptor in connection with the wye/tee branch and forty-five degree (45°) bend.

Small diameter gravity laterals shall be installed at a minimum grade of two percent (2%), except as otherwise approved by the Department.

Small diameter gravity sewer laterals shall be the same size as the small diameter gravity line they are connecting to.

The section under paragraph B "Conventional Gravity Service" shall apply pertaining to the installation of "Risers".

Excavation for small diameter gravity service laterals shall be opened for the entire length before the pipe is laid therein. If rock is encountered within ten feet (10') of any building or structure, it must be removed by means other than blasting.

A vertical clean-out on each service lateral shall be installed at the property line as shown in the Standard Details. Materials shall be the same as the sewer service.

The top of the clean-out shall be installed to meet final finish grade.

The Contractor shall install the septic tank at the location designated and determined by the property owner and approved by the Department. The septic tank unit shall be furnished by the Department and shall include the tank and all internal and external piping. The Department shall furnish the unit complete and functional for installation.

Prior to installation, the site for the septic tank shall be excavated to a depth of twelve inches (12") below the bottom of and the outside dimensions of the tank. A bedding of twelve inch (12") CR-6 stone shall be compacted prior to setting the tank. The tank shall be installed according to the manufacturer's instructions. After setting the tank, the Contractor shall fill the tank with potable water, at his expense, to an elevation of the inlet/outlet holes in the tank. Prior to installation each basin shall be inspected and tested for water tightness. Any tank failing that test shall be rejected. After installation, the area around the outside of the tank shall be backfilled with B-10 stone and to the requirements set forth in specification section "Excavation and Backfill".

**E. Materials**

1. Gravity service connections shall consist of sections of SDR 26 HW PVC, or in special cases, other materials of the diameters and with jointing materials, shown on the Drawings or specified under the section entitled "Sanitary Sewer Materials".

2. Low pressure service connections shall consist of sections of SDR 21 PVC, or in special cases, other materials of the diameters and with jointing materials, shown on the Drawings or specified under the section entitled "Sanitary Sewer Materials".

Generally, where main line and service lines are constructed under the same contract, they shall be of the same material and by the same manufacturer. Exceptions to this shall be as approved by the Department.

## F. Laying Pipe and Fittings

Service Connections

Following the trench excavation and preparation of the crushed stone bedding by the Contractor, as specified, in the section entitled "Excavation and Backfill", pipe laying shall proceed upgrade with pipe laid carefully, bells upgrade, spigot ends fully entered into adjacent bells, and true to lines and grades shown on the Drawings. Each length or section of pipe shall be carefully inspected before installation and those containing cracks or other defects shall be removed from the site or destroyed. Extreme care must be exercised to prevent breakage when pipe in handled, bells and spigots shall be carefully cleaned before pipes are lowered into trenches. The pipes shall be lowered so as to avoid unnecessary handling in the trench. In laying pipe, special care shall be taken to insure that each length shall abut against the next in such a manner that there shall be no shoulder or unevenness of any kind along the inside of the pipe. Before joints are made, each section of pipe shall rest upon the pipe bedding for the full length of its barrel, with recesses prepared where required to accommodate bells and joints. No pipe shall be brought into position until the proceeding length has been thoroughly backfilled and secured in place. Pipe joints shall be made in strict accordance with the pipe manufacturer's specifications. The interior of all pipes shall be thoroughly cleaned before they are laid and shall be kept clean until the acceptance of the completed work. The open ends of all pipe and fittings shall be provided with a stopper carefully fitted so as to keep dirt and other substances from entering. The stoppers shall be kept in the end of pipe at all times when laying is not in actual process.

Under no conditions shall pipe be laid in water or on subgrade into which frost has penetrated, nor at any time when the Department representative shall deem that there is danger of the formation of ice or the penetration of frost at the bottom of the excavation, unless all required precautions as to minimum length of open trench and promptness of refilling are observed. In all cases water shall be kept out of the trench until concrete cradles or support, where used, and materials in the joints have hardened.

Walking or working on the completed pipeline except as may be necessary in tamping or backfilling will not be permitted until the trench has been backfilled to a height of at least two feet (2') over the top of the pipes.

Any pipe that has its grade or joint disturbed after laying shall be taken up and re-laid. Any section of pipe already laid and found to be defective shall be taken up and replaced with new pipe, without expense to the Department.

No pipe shall be laid within ten feet (10') of the machine excavating the trench nor within twenty-five feet (25') of any place where blasting is being performed. In all cases the mouth of the pipe shall be provided with a stopper, carefully fitted to the pipe to prevent any substance from entering. In rock excavation, the mouth of the pipe shall be carefully protected from all blasts, and the excavation shall be fully completed at least ten feet (10') in advance of the laying of the pipe.

If, at any time before the completion of the contract or warranty period any broken pipes or any defects are found in the sewers or any of their appurtenances, the Contractor shall cause the same to be removed and replaced by proper material and workmanship, without compensation.

Joints

Before joints are made, the pipe layer shall thoroughly clean and inspect all bell and spigot ends for defects.

Gasket Joints

Where gasket joints are used, the gasket shall be removed, if possible, from the retainer, thoroughly cleaned and checked for defects, and then reassembled. The gasket shall be fully seated in retainer and facing in the correct direction. The type of lubricant shall be used as specified by the manufacturer.

## G. Concrete

Concrete Foundation

Where required by the Department, pipes shall be placed on a formed concrete cradle, or unformed concrete shall be placed around pipes for bedding and encasement. Concrete cradles shall consist of a concrete mix classified as 2500 PSI concrete.

Concrete, built in trenches requiring forms to support pipes, shall conform dimensions shown on the Standard Details SW-1.1 and SW-1.2 or the Drawings or furnished by the Department. Concrete bedding and encasement shall be classified as 2500 PSI concrete.

Concrete, built in trenches without forms as pipe bedding, or encased around pipes shall conform to the dimensions as shown on the Standard Details SW-1.1

and SW-1.2, or as indicated on the Drawings and in the locations as directed by the Department.

In placing concrete cradles and encasements the methods used shall be as such as to prevent mud, earth, clay or other foreign materials from becoming mixed with the concrete.

In no case shall "Dry-Mix" concrete be placed in the trench without permission of the Department.

In cases where the 12 inch (12") clearance cannot be obtained between sewer and water lines, the sewer shall be encased in 2500 PSI concrete 10-feet (10') each side of water main.

Crades and Encasements

Where required by the inspector, pipes shall be placed on a formed concrete cradle, or unformed concrete shall be placed around pipes for bedding and encasement. Concrete for cradles shall have a minimum strength of 2500 PSI at 28 days (Class B)

Concrete shall be built in trenches to support pipes and to the dimensions shown on the Standard Details SW-1.1 and SW-1.2 or the Drawings. Concrete for bedding and encasement shall have a minimum strength of 2500 PSI at 28 days (Class B)

In placing concrete cradles and encasements, the methods used shall be such as to prevent mud, earth, clay or other foreign materials from becoming mixed with the concrete.

## H. Testing

All installed sewers shall be tested in the presence of the inspector together with a representative of the Contractor in the manner prescribed in the "testing" section of these standard specifications. It is the intent that the described testing procedures are to be systematically carried out as an integral part of the pipe-laying procedures. Failure to accomplish the testing will be considered as non-completion of construction.

If, at any time before the completion of the contract or warranty period any broken pipes or any defects are found in the sewers or in any of their appurtenances; the Contractor shall cause the same to be removed and replaced by proper material and workmanship, without compensation.

## Chapter 2, Section 213

## Restoration

## XIII. Restoration

### A. Scope

The Contractor shall furnish all plant, labor, materials and equipment to perform all operations required for removal of temporary surfaces, replacement of permanent surfaces and disposal of any excess or unsuitable material.

### B. Bituminous Asphalt Pavements

All asphalt paving placement shall be in accordance with Sections 504 and 505 and all referenced sections of the *"Standard Specifications for Construction and Materials"*, Maryland Department of Transportation – State Highway Administration, latest edition.

The materials and configuration of placement shall comply with the Standard Details pertaining to the application, i.e., State Highway, County Road, driveway, parking area, etc.

Cutting of existing pavements shall be by sawing in straight lines parallel with or transverse to the roadway edge. The limit of cuts shall extend to the most distant point of pavement damaged by the work, when beyond the required limits, at no additional cost to the Department.

When the distance from the repair cut is equal to or less than two (2) feet from the edge of the existing pavement, that swath of the existing pavement shall be removed to the full width and depth required, and included in the repair at the expense of the Contractor.

After the removal and disposal of existing pavement materials, the subgrade shall be prepared by repairing cracks and potholes, grading to a uniform plane and compacting to the density as specified in Chapter 2, Section II, "Excavation and Backfill."

Graded Aggregate for Sub-Base shall be placed, rolled, and screeded, subgrade and all cut edges of pavement cleaned, and tack coat applied.

Hot mixed asphalt shall be placed by paving machine upon approval of the subgrade by the County Representative. All paving restoration has to comply with the County's Division of Public Works or SHA, which ever has jurisdiction for the area being restored.

Finish by rolling to an in place density of 92 to 97 percent of Maximum Density prior to cooling to below 185 degrees F.

## C. Gravel and Granular Surfaces

After the removal and disposal of existing materials to the limits as detailed, the subgrade shall be prepared by repairing potholes, grading to a uniform plane and compacting to the density as specified in Chapter 2, Section II, "Excavation and Backfill".

Gravel, aggregate, or granular material shall match the material type, gradation, and texture of the existing materials, using commonly available materials, and shall be approved by the Department prior to placement.

Depth shall match existing with a minimum depth of two (2) inches in all areas and no less than eight (8) inches in the trench area.

Final grade shall be uniform and compacted by rolling or tamping with machinery that will produce a minimum of 5000 pounds per square inch bearing capacity.

## D. Concrete

Reinforced and non-reinforced concrete pavement materials and placement shall comply with Sections 520, 522, 523, and 902, and all referenced sections of the *"Standard Specifications for Construction and Materials"*, Maryland Department of Transportation – State Highway Administration, latest edition.

Concrete sidewalks and curbs shall be formed to be configured as per the Governing Authority's standard details and requirements, to match existing lines and grades. All curb and sidewalk replacement shall be extended to the nearest joint beyond the limits of the repair width.

## E. Lawn and Grassy Areas

Whenever the surface of the ground has been disturbed in the course of operation under the Contract, the final graded surface shall be stabilized with temporary and/or permanent topsoil, fertilizer, seeding and mulching as detailed and specified in the approved Erosion and Sediment Control Plan. All materials and practices shall also comply with the *"1994 Maryland Standards and Specifications for Soil Erosion and Sediment Control"*, Section G – Vegetative Practices, Article 20.0 and 21.0.

Seeding shall <u>not</u> be performed in cultivated field areas. Rather, restoration of cultivated areas shall take the form of seed crop equal to that planted or to be planted in the next season at the property owner's directions. Topsoil shall be replaced to match the pre-construction depth. In any case, restoration shall be as approved or directed by the Department.

Furnish and spread a minimum of four inches (4") of topsoil over areas to be seeded. Topsoil shall be spread only when prepared to follow up with fertilizing and seeding. Fine grade to finished lines, grades and contours, fertilize, seed, and mulch, all at such times as will meet with the approval of the Department. If adequate topsoil isn't available onsite, the Contractor may add amenities to the soil based upon recommendation from a soils lab.

Delay seeding until after a heavy rain or watering and not sooner than a week after applying fertilizer.

All seed must meet the requirements of the Maryland State Seed Law, and tagged. Seed which has become wet, moldy, or otherwise damaged in transit or in storage will not be acceptable. Seed shall have been tested within the six months immediately preceding the date of sowing.

## F. Stabilization of Delayed Seeding Areas

All areas shall be stabilized per Soil Conservation Requirements.

## G. Plant Materials

Provide sizes of plants as shown or scheduled, conforming to ANSI Z60.1 *"American Standard for Nursery Stock"* for shape and quality.

Furnish balled and burlapped (B&B) trees or shrubs, except container-grown plants may be furnished if indicated size is below limit established in ANSI Z60.1.

Deciduous shrubs may be furnished in bare root condition if adequately maintained and protected from drying through transplanting period.

Furnish ground cover plants in removable containers or integral peat pots.

Provide topsoil, as defined above in "Lawn and Grassy Areas", to supplement what is available for reuse at the site.

Provide fertilizer, humus and other soil amendments of a type, which are known to improve pH condition of the soil for particular plant material to be planted. Mix peat humus (FS Q-P-166) with topsoil in the ratio of 1:3 for use in planting. For basis of quantity, assume topsoil, which has not been stripped, is 4" in depth.

Fertilize topsoil for planting trees, shrubs and ground cover with 5-10-5 (5% Nitrogen, 10% phosphorus and 5% potash) commercial fertilizer, applied and mixed at a rate of not less than 0.25 lbs. Per cu. Ft. of soil and humus.

## H. Planting Trees

Excavate pit to 1-½ times diameter of tree ball and not less than 6" deeper. Compact layer of topsoil in pit to locate collar of plant properly in a slightly dished finish grade. Backfill around ball with topsoil, compacted to eliminate voids and air pockets, watering thoroughly as layers are placed. Build 3" high berm of topsoil beyond edge of excavation. Apply 3" mulch of shredded hardwood, bark chips, peat, or other recognized organic planting mulch.

Prune tree to remove damaged branches, improve natural shape, thin out structure and remove not more than 15% of branches. Do not prune back terminal leader.

Wrap trunk from ground to first branch with tree wrapping tape.

Guy and stake tree three directions with galvanized wire, through flexible hose chafing guards, with wooden stake anchors.

## I. Planting Shrubs

Excavate pits or trench to 1-½ times diameter of balls or containers, or 1'-0" wider than spread of roots, and 3" deeper than required for positioning at proper height. Lightly compact a layer of topsoil in the bottom before placing plants. Backfill around plants with topsoil compacted to eliminate voids and air pockets. Water thoroughly as layers are placed. Form grade slightly dished, and bermed at edges of excavation. Apply 2" mulch of peat, straw or other recognized organic planting mulch.

Prune shrubs to remove damaged branches, improve natural shape, thin out structure and remove not more than 15% of branches.

## J. Planting Ground Cover

Till soil to a depth of 8" in areas where topsoil has not been stripped.

Loosen subgrade to a depth of 4" in areas where topsoil has been stripped, and spread topsoil to a depth of 4", except as otherwise indicated.

Space plants 2'-0" apart both ways, except as otherwise indicated. Dig holes large enough to allow for spreading of roots. Compact backfill to eliminate voids, and leave grade slightly dished at each plant. Water thoroughly. Apply 2" mulch of shredded hardwood, bark chips, peat, straw or other recognized organic planting mulch over entire planting bed, lifting plant foliage above mulch.

During periods of hot sun and wind at time of planting, provide protective cover for several days.

## K. Maintenance of Planted Areas

Maintenance of planted areas shall include irrigation to establish growth in abnormally dry or hot seasons, or on adverse sites; and repairs, replacements, and replanting within a proper season.

All new fill areas with slopes steeper than four to one (4:1) shall be protected from livestock until the permanent seeding stand has become established.

The Contractor shall maintain the planted area until acceptance of the work. Prior to acceptance, of the work, the Department shall inspect all planted areas for failures, and direct the Contractor to make all necessary repairs, replacements, and replanting within the proper season, if possible.

If the seed stand is over 50% damaged, re-establish entire area, following the original fertilizer, seeding, and mulching procedure.

## L. Storm Water Drainage

The Contractor shall not change or alter the storm water drainage ways. The Contractor shall restore all surfaces disturbed during construction to the same contour as before construction

## M. Special Surfaces and Miscellaneous Items

Vegetable or flower gardens damaged during construction shall be brought to grade with topsoil. All weeds and debris shall be removed, transplanted or damaged plants replaced and the entire area restored as required to remove traces of damage.

Mailboxes, street lighting poles and fixtures, ornamental works, fencing, culverts, drains (both natural and man-made), catch basins, manholes, walks, driveways, walls, etc. shall be restored to the condition equal to, or better than existed prior to the start of the work.

**200-001**
**Sanitary Sewer Materials**

## A. Description

1. This section includes requirements for supply, delivery, installation and testing of piping materials and appurtenances as specified in the Contract Documents. Materials noted in this Specification shall be installed as shown on the Contract Drawings and as noted in Table 200-003-1. The Work includes furnishing all materials, supplies, supervision, equipment, and construction machinery that may be necessary to construct the project as described in the Contract Documents.

**Table 200-001-1**
**Location of Specified Materials**

| Specified Material | Location |
|---|---|
| 16-inch HDPE SDR11 DIPS | Forcemain |
| 8-inch HDPE SDR11 DIPS | Forcemain Laterals |
| 6-inch HDPE SDR11 DIPS | Forcemain Laterals |
| 15-inch PVC SDR26 Heavy Wall | Gravity Main |
| 8-inch PVC SDR26 Heavy Wall | Gravity Main Laterals |
| 6-inch PVC SDR26 Heavy Wall | Gravity Main Laterals |
| 24-inch Steel Casing Pipe | Jack and Bore Installation |

## B. Materials

1. Sewer Pipe and Fittings

   a. The forcemain and gravity main pipe and laterals shall be defined as that portion of the piping system as defined on the Contract Drawings.

   b. HDPE pipe and fittings shall be the diameter size(s) shown on the Contract Drawings. Wall thickness classification SDR11 HDPE ductile iron pipe size (DIPS) pipe material shall, at a minimum, conform to the requirements of ASTM 3350, PE 3408, AWWA 906, Cell Classification, 345464C. Pipe shall be DriscoPipe 4100 or approved equal. Molded fittings shall be manufactured in conformance with ASTM F-714.

   c. HDPE pipe shall be butt-welded to provide a watertight joint. All welding will be performed by a trained individual according to the pipe manufacturer's recommendations.

   d. Tie-ins to other HDPE piping systems and/or equipment where butt-fusion is not applicable shall be with HDPE flange adaptors and metal back-up rings, unless otherwise specified on the Contract Drawings or by the ENGINEER. Mechanical compression or clamp style fittings will not be

allowed under this HDPE specification. The CONTRACTOR shall submit proposed connection methods for approval by the ENGINEER for tie-ins to piping systems of material other than HDPE.

e. HDPE flange connectors shall be manufactured by Plexco, DriscoPipe, or approved equal. Fittings shall meet the pressure requirements of ASTM D2837 and molded fittings shall meet ASTM D3261.

f. PVC and Steel Casing Pipe shall be in accordance with Specification Section 203.

2. Rubber Flapper Swing Check Valve: 4-in and Smaller Pipe Size

a. Complete valve assembly shall meet or exceed the latest revision of AWWA C508 for Swing Check Valves for Waterworks Service.

b. Body shall be constructed of ASTM A536 ductile iron grade 65-45-12.

c. Body Seat shall be on a 45 degree angle to the centerline of the pipe, permitting horizontal or vertical (flow up) installation. The valve shall be rated to 175 psi (1210 kPa) cold working pressure.

d. Rubber Flapper shall have a steel disc encapsulated with Acrylonitrile-Butadiene (NBR), Chloroprene (CR), Terpolymer of Ethylene Propylene and A Diene (EPDM), or Fluoro Rubber (FKM). The flapper shall be captured between the body and valve cover to permit the disc to flex open and closed. An integral "o-ring" shall be molded onto the face of the rubber flapper for positive sealing. Hinge Section of the rubber flapper shall be designed to accelerate closing due to an elastic spring effect. High-strength fabric shall be integrally molded in the rubber over the disc and bar to form a flexible joint giving the flapper a high cycle life.

e. Valve shall be warranted by the manufacturer for defects in materials and workmanship for a period of two years (24 months) from date of shipment.

f. Valves to be APCO model CRF (Body Style 100) as manufactured by DeZURIK, Inc., or approved equal.

3. Check Valve: 4-in and Larger Pipe Size

a. Valve shall meet or exceed the latest revision of AWWA standard C508

b. Body shall be constructed of ASTM A536 ductile iron. End connections shall be flat faced, flanged per ASME/ANSI 125/150 lb. standard. The valve shall be rated for 250 psi CWP.

c. Body Seat shall be 316 stainless steel per ASTM A743, Grade CF-8M. All external fasteners shall be stainless steel.

d. Disc and Disc Arm shall be ASTM A536 ductile iron. For sizes 2”-24”, the disc shall be attached to the disc arm with a 304 stainless steel fastener.

e. Disc Seat shall be Acroylonitrile-Butadiene (NBR) and securely held in place by stainless steel screws.

f. Pivot Shaft shall be one-piece 303 stainless steel per ASTM A582. The Pivot shaft shall protrude through both sides of the body.

g. Air Cushion Cylinder shall be totally enclosed. It shall have an aluminum alloy cap, head and barrel. The bottom of the cylinder shall be hinged to follow the angular change as the lever rises and lowers. The primary closing speed shall be field adjustable by means of a speed control valve.

h. Lever & Spring or Lever & Weight Lever arm and adjustable counterweight are to be ductile iron A536 grade 65-45-12.

i. Lever & Spring Swing Check Valves shall be APCO model CVS-250A-LS/ CVS-250-LS as manufactured by DeZURIK, Inc., or approved equal.

4. Combination Air and Vacuum Pressure Release Valve

a. Air release shall be accomplished by dual-range venting designed to automatically provide varied and predictable air flow over a wide range of conditions. Air release shall have a 5/16” self- adjusting orifice. The fractional air release orifice must be capable of releasing 140 scfm of air at 150 psi differential pressure.

b. Valves shall close tightly at any pressure between 2 and 300 psi without leaking or spilling. The Air/Vacuum inlet and outlet areas shall meet the flow area requirements set forth in AWWA C512. The smallest cross-sectional area must define the size of the valve.

c. Valve shall have an upper body compression chamber to limit fluid level and solids interference. It shall also have a funnel shaped lower body to reduce solids buildup and allow for self-cleaning and maximum outflow.

d. A hydraulics-based float design shall be used to reduce the ballistic effect and instability of high speed fluid flow.

e. The guided float shaft shall provide smooth automatic Air Release and Air/Vacuum operation that will not foul and reduce performance on dirty service applications. To avoid loss of performance, the Air Release and Air/Vacuum seating action shall be direct driven by the shaft-mounted float. No linkages shall be used.

f. Flow deflector/splash reduction ring shall be used to restrict solids entry and minimize flow effect and splash that can cause float instability.

g. A 90 degree threaded side outlet shall be included with the valve with an extension pipe. Valves shall be capable of converting to optional vertical threaded outlet or mushroom cap without removing the valve from service and valve disassembly.

h. Materials of construction:

i. Body, float, float shaft and hardware shall be 316 stainless steel Piston stem and seat shall be 17-4 PH stainless steel Elastomer seals shall be Acrylonitrile-butadiene (NBR).

ii. Piston stem guides shall be Acetal (POM).

i. When using standard side outlet, the overall valve height and weight shall not exceed:

| | Threaded Inlet | | Flanged Inlet | |
|---|---|---|---|---|
| Size | Height | Weight | Height | Weight |
| 1-in., 2-in. | 22-in. | 42 lb | 23-in. | 47 lb |
| 3-in., 4-in. | 23-in | 48 lb | 26-in. | 62 lb |

j. End connections shall be NPT or ANSI 125/150 flanged. Valves shall have two lifting lugs for ease of valve installation.

k. Two Year Warranty shall be provided for all valves.

l. Combination Air Valves shall be APCO model ASU as manufactured by DeZURIK, Inc., or approved equal. Combination Air Valves in sizes 1-6" shall be single body design and shall provide both Air Release and Air/Vacuum valve functions.

5. Wet Well Aeration System

a. A wet well aeration system including control panel and fiberglass enclosure shall be installed at each pump station with air discharge piping in the wet well as shown on Contact Drawings.

b. Aeration system shall be Pro-Air Model 15FE3D, as manufactured by Envirep, Inc., Camp Hill, PA, or approved equal.

c. Aeration blower assembly:

i. 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-in. FNPT.

ii. 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 degrees F. The motor shall be 1.5 hp, 3 phase, 230/460 volt, 60 Hz with TEFC enclosure and Class B insulation.

iii. The following accessories shall be installed with the wet well aeration system:

1. (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.

2. (1) Inlet filter kit with replaceable filter element and shall be designed to protect the aerator from pre-mature wear.

3. (1) Spare filter element

4. (1) Discharge ball valve, full port, 1-1/2”

5. (1) Relief valve of adequate capacity to provide system protection

6. (1) Flexible mounting system

7. (1) Inlet muffler/silencer

iv. A set of dry contacts shall be provided in the pump control panel to interface with the aeration system to ensure coordination between systems.

v. The discharge piping for the aeration blower shall be installed as shown on Contract Drawings. Discharge piping to the wet well shall be minimum 2-in. diameter.

vi. Aeration system, including aeration blower, inlet filter, relief valve, gauges, muffler, ball valve and check valve, shall be pre-assembled using schedule 40 galvanized pipe and mounted on a fiberglass base using eight flexible vibration isolation mounts.

d. Fiberglass enclosure:

i. A fiberglass enclosure with exterior dimensions of 41-3/4" long x 24" wide x 33-3/4" tall shall be provided to protect the aeration blower assembly. The control panel shall not be mounted inside the fiberglass enclosure.

ii. 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.

iii. The enclosure shall be provided with a hinged lid with locking clasp for easy maintenance and service.

iv. Interior of enclosure shall have foam insulation for sound attenuation, 1-in. thick minimum.

v. Aeration blower assembly shall fit inside this fiberglass enclosure.

vi. The pressure relief valve shall discharge to the outside through the fiberglass enclosure at a height at least 24-in. min. above the concrete slab. In no case shall the pressure relief valve discharge inside or through the floor of the fiberglass enclosure.

e. Wet Well Aeration System Control Panel:

i. NEMA 4X stainless steel, wall mounted panel. Dimensions: 16" wide x 24" tall x 8" deep.

ii. Main connections to accept 3/60/460.

iii. Motor starter, FVNR (across the line), NEMA rated.

iv. Provide timer and repetitive cycle interval circuit, operator-selectable timing, operational mode selection device, and pump control panel interface. In the "Automatic" mode, the aerator shall operate in a coordinated manner with the sewage pumping system.

v. HOA switch.

vi. Control interface for use with pump control panel.

vii. Control transformer, 120 volt secondary for control circuit.

f. Wet Well Aeration Diffusers

i. Diffusers shall be installed within the wet well as shown on Contract Drawings. The wide band diffusers shall be manufactured by Aquarius Technologies, Inc., as supplied by the wet well aeration supplier.

ii. Diffuser shall be constructed of 316 SST, and shall be capable of 5-50 SCFM airflow.

iii. Diffuser shall have a full-length deflector, to prevent material from entering the diffuser body.

iv. Diffuser shall be connected to the header piping, using a ¾-in. NPT connection.

6. Flowmeter

a. Electromagnetic flow meter appropriate for measuring fluid flow of wastewater, or fluids which are highly corrosive, very viscous, contain a moderate amount of solids, or require special handling, shall be provided. Flowmeter shall have no moving parts in the flow stream. Transmitter shall be integrally mounted to the sensor or be remote-mounted. Unit shall ideally suited for measuring dynamic, non-continuous flow.

b. Flowmeter shall include metering tube, consisting of stainless steel tube lined with a non-conductive material, and transmitter, consisting of unit which receives, amplifies, and processes the sensor's analog signal.

c. The metering system shall operate over a flow range of 0.1 to 39.4 ft/s.

d. The accuracy for zero straight run with a single elbow up and/or a single elbow down stream shall be 1% or better in the flow range 0.5 ft/s (0.15 m/s) and up.

e. The metering system shall be capable of measuring the volumetric flow rate of liquids having an electrical conductivity as low as 5 µS/cm (demineralized water 20 µS/cm).

f. The system measuring repeatability shall be <0.1% of full scale.

g. The flowmeter shall provide a one (1) year warranty after installation; or one (1) year and six (6) months after shipment from manufacturer.

h. Flowmeter shall be a Badger Meter M2000 or approved equal.

## C. Execution

1. HDPE Pipe—HDPE pipe shall be tested prior to shipment to ensure that the physical properties are in accordance with this Specification. Copies of the manufacturer's quality assurance testing shall be submitted to the ENGINEER.

2. Delivery of pipe and related materials shall be coordinated with installation of the materials. Materials shall be unloaded with proper equipment and shall be properly wedged secure. They shall be stored outside of traffic and work areas in a reasonably level, well-drained area away from brush and poison oak or ivy. Individual pieces or bundles shall be stored with safe walking space and clearance between them to allow full view for inspection. Other materials shall not be placed over or against the stored pipe. Pipe shall be stored on a flat surface so that the barrel of the pipe is evenly supported and not piled more than 4 feet high. Bundles and containers shall not be stacked on one another.

3. Pipe, fittings, and appurtenances shall be unloaded and handled with crane, backhoe, or other equipment of adequate capacity with an appropriate sling to protect the materials from damage. Materials shall be handled in a manner that ensures delivery to installation location in sound, undamaged conditions. Pipe shall be carried to placement location, not dragged.

4. If damage occurs and is deemed repairable, it shall be repaired as directed by the ENGINEER in accordance with approved manufacturer's recommendations. If damage is not repairable in the opinion of the ENGINEER, such items will be rejected and shall be removed and replaced at the CONTRACTOR'S expense.

5. No precast unit shall be shipped in less than 7 days from the date of manufacturer, unless the unit has been tested and is shown to be in full compliance with the Contract Documents. Date of manufacture shall be stamped on each concrete unit.

6. Precast sections shall be transported and handled with proper equipment to protect the elements from damage. Sections shall be handled by means of lifting inserts

embedded in the concrete. Damaged sections shall be replaced with new unused materials.

7. HDPE Pipe Installation

a. Sections of HDPE shall be joined into continuous lengths on the job site following the guidelines of ASTM F 2620, using simultaneous butt fusion as the method of joining.

b. Manufacturer shall provide written butt fusion equipment requirements and pressure procedure as part of the submittal package. The butt fusion equipment used to join the pipe shall be capable of meeting all manufacturer requirements and standard butt fusion practices for alignment, heating, trimming, and fusion pressure.

c. Fused segments of pipe shall be moved to avoid damage to the pipe. Handle fused segments of the pipe with care. Limit bending of the pipe. Nylon slings are preferred.

d. A manufacturer's representative shall be onsite to train the CONTRACTOR'S personnel. Only the manufacturer or those personnel trained by the manufacturer are approved to weld pipe.

e. Modification to the system will be done only by a representative of the manufacturer or trained installer. This includes changes in lengths of pipe and special tie-in connections.

f. For HDPE pipe, clean joint surfaces immediately before joining, square (face) end of each pipe to be fused, then butt weld the pipe together according to the manufacturer's recommendations. Allow welds sufficient time to cool before working with the pipe.

g. Provide torque to bolt connections in accordance with manufacturer's recommendations.

h. Methods for jointing HDPE pipe to PVC pipe shall be approved by the ENGINEER.

**200-002**
**Excavation and Backfill**

## A. Description

1. This Section includes requirements for excavation and backfill to supplement specifications included in the Washington County Department of Water Quality (DWQ) Standard Specification Section 202 Excavation and Backfill.

## B. Removal of, Stockpiling of, and Replacement of Surface Material

REMOVE: The following sentence:

Upon completion and backfill the shrubs and trees shall be replanted, except over utility lines or within easement area, in which case they shall be relocated as approved by the OWNER.

## C. Removal of Water

ADD: The following paragraph:

Dewatering can be handled using conventional submersible pumps directly in the excavation or temporary trenches or French drains consisting of free draining granular stone wrapped in filter fabric to direct the flow of water and to remove water from the excavation. Temporary sump pits can be established at an elevations 3 to 5 feet below the bottom of the excavation subgrade of bottom of footing. Continuous dewatering of the excavations during construction may be required. Contractor to provide a dewatering plan for sewer pipe and wet well installation for review and approval of OWNER and ENGINEER prior to installation.

## D. Responsibility for Condition of Excavation

ADD: The following paragraph:

Excavation and Backfill shall only proceed under the observation of the CONTRACTOR'S third party geotechnical inspector. The Inspector shall be a registered professional engineer and a certified soils technician. Geotechnical Inspector shall observe, at a minimum, exposed subgrades to ensure adequate subgrade preparation has been achieved; approval of prepared subgrade prior to slab construction and piping placement; and observation of excavated surface in areas of rock removal, and in case of sinkhole formation.

## E. Backfilling of Trenches (General)

REPLACE: The following paragraph:

Compaction density shall be measured as specified by AASHTO T-180, and shall be as follows:

| LOCATION | LOOSE LIFT | MAX DENSITY | OPTIMUM MOISTURE |
|---|---|---|---|
| a. More than seven (7) ft off roadway or driveway edge (open area) | 8 in. | 95% | +/- 2% |
| b. Within seven (7) ft of roadway or driveway edge to one (1) ft below grade | 8 in. | 95% | +/- 2% |
| c. Within 7 ft of roadway or driveway edge top one (1) ft | 8 in. | 95% | +/- 2% |

**F. Tunneling, Jacking and Boring**

ADD: The following paragraphs:

All plans for jacking and boring operations must be reviewed and stamped by a Professional Engineer licensed in the State of Maryland.

A heavy timber shaft at either end of the jacking pit is required to prevent embankment failure and maintain access to the pit. This support shall be continuously maintained to prevent cave-ins. Pipes and sleeves shall have sufficient length to extend beyond the ditchline or shoulder edges as directed by the MDOT SHA, or as shown on Contract Drawings. Excavation in shoulder areas to push or install pipes or sleeves is prohibited. For jacked and bored pipe crossings under MDOT SHA roadways, the bore hole diameter is not to exceed the outside diameter of the pipe or sleeve.

The jetting of pipes or sleeves is not permitted.

The allowable jacking strength capacity of the casing pipe shall be capable of withstanding the maximum jacking forces imposed by the operation. Steel casing pipe shall have minimum yield strength of 35,000 psi. To prevent cave-ins, pipes and sleeves shall be installed simultaneously with augering. In the event of a false start, the void will be backfilled by grouting or other method approved by the MDOT SHA and OWNER.

The CONTRACTOR is responsible to repair or replace any pavement area or areas damaged as a result of jacking and boring operations. The extent of repairs or replacement shall be determined at the sole discretion of the MDOT SHA and OWNER. Repairs or replacement shall be performed immediately.

Jack and bore pits shall be protected at all times to prohibit unauthorized vehicular and pedestrian access.

The minimum allowable depth of a Jack and Bore installed casing pipe under the road and shoulder surface is five (5') feet. Any deviation shall require prior approval from MDOT SHA and OWNER. In locations where the road surface is super elevated, the minimum depth of the bore shall be measured from the lowest side of the pavement surface. In addition, a minimum three (3') foot depth shall be maintained in all other features including ditch bottoms unless otherwise directed by MDOT SHA and OWNER.

**200-003**
**Erosion and Sediment Controls**

## A. Description

1. This section includes requirements related to the CONTRACTOR'S responsibility to furnish all labor, equipment, and materials associated with erosion and sediment control required to complete the Work as shown on the Contract Drawings and specified herein.

## B. Materials

1. All erosion and sediment control materials shall conform to the requirements of the Maryland Department of the Environment, Water Management Administration, 2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control, and Maryland's Guidelines to Waterway Construction, latest edition, and subsequent updates; the Maryland Department of Transportation State Highway Administration Standard Specifications for Construction and Materials, and the Contract Drawings.

## C. Execution

1. All necessary notifications to COUNTY, ENGINEER and inspector shall be provided as required by Contract Drawings, prior to construction.

2. All erosion and sediment control work shall comply with applicable requirements of governing authorities having jurisdiction. The Specifications and Contract Drawings are not comprehensive, but rather convey the intent to provide complete erosion and sediment control for the project.

3. Erosion and sediment control measures shall be established at the beginning of construction and maintained during the entire period of construction. Onsite areas that are subject to severe erosion, and offsite areas that are especially vulnerable to damage from erosion and/or sedimentation, shall be identified and receive special attention.

4. All land-disturbing activities shall be planned and conducted to minimize the size of the area to be exposed at any one time and the length of the time of exposure.

5. Surface water runoff originating upgrade of exposed areas shall be controlled to reduce erosion and sediment loss during the period of exposure.

6. All land-disturbing activities shall be planned and conducted so as to minimize offsite sedimentation.

7. Extent of Work—CONTRACTOR shall implement additional erosion and sediment controls as required by the sediment control inspector, Washington Soil Conservation District, or ENGINEER to remain in compliance with applicable local and state regulations. Field changes and minor adjustments from the Contract Drawings are permissible as long as the installation functions and conforms to this Specification and any necessary approvals are obtained prior to installation.

8. The CONTRACTOR shall install new erosion and sediment control measures in accordance with the manufacturer's recommendations, the Contract Drawings, the Maryland Department of the Environment, Water Management Administration, 2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control, and Maryland's Guidelines to Waterway Construction, latest edition, and subsequent updates; and the Maryland Department of Transportation State Highway Administration Standard Specifications for Construction and Materials.

9. CONTRACTOR shall clean out, remove debris, or vegetation from existing swales, berms, sediment traps, or channels that are to be used for erosion and sediment control during construction prior to beginning any land clearing activities.

10. The CONTRACTOR shall be responsible for maintaining existing erosion and sediment controls, including sediment traps and basins as indicated in the Contract Drawings. This will include inspecting existing sediment traps and basins on a regular basis in conjunction with other erosion and sediment inspections, and maintaining clean out elevations by removing sediment, as necessary to the bottom elevations indicated.

11. This project will include, but is not limited to, use of silt fence or super silt fence, stabilized construction entrances, vegetative stabilization, and controls at stream crossings, in addition to same day stabilization for open trench work.

12. Sediment removed from erosion and sediment controls shall be placed in the onsite stockpile area.

13. Silt Fence and Super Silt Fence—Install silt fence and super silt fence as indicated on the Contract Drawings. Any repairs to fencing material shall be made promptly for any silt fence or super silt fence that is damaged, decomposed, or ineffective. Sediment deposits along fencing shall be removed before deposits reach one-third of the height of the barrier. The immediate area occupied by the fence and any sediment deposits shall be shaped to an acceptable grade.

14. Stabilized Construction Entrances (SCE)—Install stabilized construction entrances in accordance with the details shown on the Contract Drawings. Other perimeter erosion and sediment controls that extend to the SCE shall tie into the

mountable berm portion of the SCE as appropriate. SCE's shall be replenished as necessary throughout construction.

15. Vegetative Stabilization—All areas of disturbance related to construction shall be temporarily or permanently stabilized in accordance with Contract Documents.

16. Erosion and Sediment Control Inspections—The CONTRACTOR is responsible for inspecting the erosion and sediment control measures on a regular basis in order to maintain them in good working order and to comply with local, state and federal requirements. The inspection frequency shall be at least weekly and no less than the more restrictive of the requirements of the National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharge Associated with Construction Activities or the requirements of the local sediment control inspector.

17. Removal of Erosion and Sediment Controls—Erosion and sediment controls may not be removed until the site is adequately stabilized, approval is received by the sediment control inspector and approval is received from the COUNTY. Upon receiving the necessary approvals, all erosion and sediment control measures are to be removed and any areas of redisturbance are to be permanently stabilized, unless otherwise noted on Contract Drawings.

18. Dust Control

    a. CONTRACTOR shall be responsible for controlling objectionable dust caused by the operation of vehicles and equipment, clearing, or other source, and shall prevent dust from leaving the site. Dust shall be controlled when encountering visible and/or noticeable airborne dust in or surrounding the project areas, or at the request of the COUNTY, ENGINEER, or onsite construction inspector. Visible dust conditions are those where airborne dust is visible for greater than a 5-minute period.

    b. CONTRACTOR may apply water, or a commercial dust control agent subject to approval by ENGINEER and Maryland Department of the Environment, which will keep dust in the air to a minimum. The CONTRACTOR shall submit a plan outlining the dust control measures to be utilized on the project and identify any dust control agents to be used. The CONTRACTOR shall provide sufficient documentation from the manufacturer of the dust control agent(s) confirming their use is appropriate for the site and for the various potential application areas (slopes, roadways, etc.). The CONTRACTOR shall also demonstrate through documentation that the particular dust control agent(s) proposed for the project do not detrimentally impact the environment, including receiving waters. Approval of dust agent(s) proposed by the CONTRACTOR shall be obtained from the ENGINEER prior to use.

c. The COUNTY, ENGINEER or onsite construction inspector will require a temporary shutdown of all CONTRACTOR operations if dust is not controlled in accordance with these Specifications. Earth-moving activities occurring on unpaved surfaces shall be suspended when winds exceed 25 miles per hour and visible dust plumes occur. All earth-moving activities will be suspended when wind speeds are greater than 30 miles per hour regardless of presence or extent of dust plume. The COUNTY, ENGINEER, or onsite construction inspector reserve the right to restrict construction vehicle traffic to 15 miles per hour unless the road surface and surrounding area is sufficiently stabilized to prevent visible dust emissions. Any schedule delays or additional costs incurred by the CONTRACTOR due to temporary shutdown due to lack of dust control shall have no impact on the overall construction schedule or result in any additional cost to the COUNTY.

d. CONTRACTOR will be responsible for providing water.

19. Tracked Soil

a. CONTRACTOR shall be responsible for ensuring mud is not tracked onto County Roads. CONTRACTOR shall clean and maintain all roads free of mud and dirt during construction, including sweeping on a regular basis.

b. Mud and dirt shall not be washed off the roads with water.

**Chapter 3, Section 301**

**Architectural Building**

## I. Architectural Building

### A. Scope of Work

The work to be performed under this section shall include all architectural work required in connection with the construction of pump control building as shown on the construction drawings. The work shall be performed in accordance with these standard drawings and as herein specified, and shall include, but not necessarily be limited to, the following:

1. Masonry
2. Steel Decking
3. Roofing and Sheet Metal
4. Structural Steel and Miscellaneous Metal
5. Louvers / Exhaust Fan
6. Stainless Steel Doors and Frames
7. Hardware
8. Carpentry
9. Caulking
10. Painting
11. By-Pass Pumping Connection

The building shall be configured in such a manner that there is three (3) foot clear zone around all pumps and associated piping. In addition to the clear zone around the pumps, there shall be a minimum five (5) foot clear zone in front of the main electrical panels. The pumps clear zone may infringe upon the electrical panels clear zone.

The use of brand-names in this section is intended as a standard for quality of materials and is in no way exclusionary. Equal alternative products may be submitted and the Department shall make the decision of acceptability.

## B. Masonry

Scope

The Contractor shall furnish all materials, labor, scaffolding, equipment, and tools necessary to fully complete all masonry work as shown on the drawings and as specified herein. The work shall include, but not necessarily be limited to, the following:

1. Brick
2. Concrete Block
3. Split Face CMU
4. Mortar
5. Pour Type Insulation
6. Bed Reinforcing
7. Precast Concrete Lintels
8. Splash Blocks
9. Perimeter Insulation

Materials

1. Brick:

   a. Brick shall be of a color selected by the Department, standard 2-¼" x 3-5/8", and manufactured by the Victor Cushwa and Sons or Glen-Gery Shale Brick Corporation or approved equal.

2. Concrete Block:

   a. Hollow load-bearing units shall conform to ASTM C 90-70, Grade A.

   b. Solid concrete block units shall conform to ASTM C 145-71, Grade A.

c. All block shall come from the same plant, shall be at least 28 days old and at the time of setting shall not exceed 40% moisture content.

3. Split Face CMU

a. All Split Face Concrete Masonry Units shall conform to ASTM C90-99a.

b. All aggregates used shall conform to ASTM C33-99a.

c. All sampling and testing done in accordance with ASTM C140-99b.

d. All block shall come from the same plant, shall be at least 28 days old and at the time of setting shall not exceed 40% moisture content

4. Mortar:

Mortar for masonry units shall conform to ASTM C 270-68, Type N. The following standards shall be noted:

Portland Cement – ASTM C 150-71, Type I or II.

Masonry Cement – ASTM C 91-71, Type II.

Sand – Clean and conforming to ASTM C 144-70.

Proportion – 1:1:6.

5. Pour Type Insulation:

All concrete block cavities shall be filled with "Zonolite" as manufactured by W. R. Grace or Perlite by Perlite Institute Inc. or equal.

6. Bed Reinforcing:

a. Joint reinforcement for single wythe wall shall be #120 Lox Truss-Mesh and joint reinforcement for composite walls

shall be #130 Lox Truss-Mess, as manufactured by Hohmann & Barnard, Inc., or approved equal.

b. Reinforcement shall be fabricated from cold-drawn steel wire conforming to ASTM A82, with smooth cross rods butt welded not more than 16 inches O.C.

c. Joint reinforcement shall be installed in every other vertical joint.

7. Precast Concrete Lintels:

a. Unless noted, all openings shall be fitted with precast concrete lintels. Faces which are exposed to view shall be closely matched to the surrounding block in texture and aggregate.

b. Concrete mix shall be as to achieve 3,000 PSI strength. Steel bars shall be 20,000 PSI deformed billet steel conforming to ASTM A 615-70. Lintel bearing shall be minimum 6 inches.

8. Perimeter Insulation:

Around the foundation wall 1" "Styrofoam" insulation shall be adhered to the concrete block or poured concrete, as manufactured by the Dow Chemical Company or 1" Zonolite Polystyrene foam by W. R. Grace Co. or equal.

Laying Brick

1. Brick shall be laid in full beds, with solid vertical joints, 3/8" wide. Three brick courses shall equal one block course. Coursing shall be laid out to meet openings and provide uniform joints.

2. All joints shall be tooled slightly concave, using a tool 1/8" wider than the joints.

3. In order to improve the bond between mortar and brick, tooling shall not be performed until the mortar is "thumb print hard."

4. Brick shall be laid in running bond, that is, there shall be only stretchers.

5. Brick shall be thoroughly drenched, allowed to drain, and shall be damp when laid.

6. All loose lintels and thruwalls flashing shall be installed under this section.

Laying Block

1. Joints:

   Horizontal and vertical joints shall be 3/8 in. Joints in exposed walls, either painted or unpainted, shall be tooled slightly concave.

2. Insulation shall be poured into the cell as work progresses.

Storage

Units shall be stacked on platforms well above ground water and kept covered with waterproof sheeting.

Protection

The top of unfinished wall exposed to the weather shall be kept covered with waterproofing sheeting whenever work is not in progress.

Cold Weather Work

No masonry shall be laid when the temperature of the outside air is below 40 degrees F, unless suitable means are provided to heat the masonry materials and protect the work from freezing. Protection shall consist of heating the masonry materials to at least 40 degrees F, and maintaining an air temperature above 40 degrees F on both sides of the masonry, for a period of at least 48 hours.

Cleaning of Masonry

Mortar droppings shall be removed as the work proceeds. Upon completion the masonry shall be washed down with soap and water. If acid is needed, no more than one part hydrochloric to nine parts water shall be used. Before an acid solution is used, the surface shall be soaked thoroughly with water followed immediately with a thorough rinsing of clear water after the solution has been used.

## C. Roof Trusses

Scope

The Contractor shall furnish all labor, materials, and equipment necessary to install roof trusses as shown and specified herein. Roof trusses shall be designed by a Maryland registered professional engineer in accordance to all local building codes. The trusses shall be designed to have a 3:1 or 4:1 slope.

Materials

1. Trusses shall be manufactured utilizing kiln dried 2"X4" or 2"X6" lumber.

2. Connector plates shall be made of 20/18/16 gauge ASTM A653 grade 40/60 galvanized steel. Apply plates to each face of truss.

3. Trusses shall be secured to sill plate utilizing one Simpson H3 hurricane anchor to each side of each truss. One shall be installed on the inside of wall plate and one on outside of wall plate, so nails do not interfere.

4. Truss shall extend 1 foot beyond load bearing walls.

Erection

1. Trusses shall be installed according to manufacture's requirements and local building code requirements.

2. Trusses require extreme care in fabrication, handling, shipping, installation, and bracing. Refer to Building Component Safety Information, published by Truss Plate Institution, and Wood Truss Counsel of America for safety practice prior to performing these functions.

## D. Panel Metal Roof

Scope

The Contractor shall furnish all labor, materials, and equipment necessary to install all roofing, roof insulation, surfacing, flashings, gutters, and downspouts as shown on the drawings and as specified herein.

Materials

1. Contractor shall install purlins as specified by on the approved construction drawings. Purlins must be fastened to the roof trusses with a minimum #6 screws at 12" on-center, or two minimum 8d common or pneumatic nails. Purlins must be installed to support the entire width and length of ridge, eave, hip, valley, and gable-end trim.

2. If care is taken, metal roofing application can be aided by pre-drilling panels, allowing screws to go quickly and accurately into desired spacing. Pre-drilling will work provided that pilot holes are placed accurately in proper locations on panels.

3. Panel installation should begin at the gable end of roof opposite the prevailing rain-bearing wind (this will provide added assurance against wind-driven rain being forced under the laps).

4. An overhang of 2 to 3 inches is required to provide a drip edge, while only 1 inch overhang is necessary where gutters are used.

5. Panel roofing shall be 26 gauge steel with baked-on finish over Galvalume ASTM A792, & AZ50.

6. Install panel roofing per manufactures requirements.

7. Panel roofing shall be stored in a well ventilated, dry place where no moisture can contact them. Moisture (from rain, snow, condensation, etc) trapped between layer of material may cause water stains or white rust, which can affect the service life of the material and will detract from its appearance. If outdoor storage cannot be avoided, protect the panels with ventilated canvas or waterproof paper cover. Do not use plastic, which can cause condensation. Keep the material off the ground in an inclined position with an insulator such as wood. Protective film may degrade or become brittle with long term exposure to direct sunlight.

8. Roofing system shall have a 20 year warranty against leak or defects.

9. Flashing and ridge cap shall be manufacture by the same manufacture of the roofing panels. Flashing and ridge cap shall be installed per the manufactures requirements.

10. Flashing and ridge cap shall be considered to be part of the roofing system and shall have a 20 year warranty against leaks or defect.

11. Soffit shall be 12" Traplock 0.019 gauge aluminum soffit as manufactured by Berger or approved equal

12. Gutter and Downspouts – The hanging gutters shall be 5" Ogee Type, .032" thick. The downspouts shall be corrugated rectangular, .024" thick. Gutters and downspout shall be aluminum with a baked enamel finish in a color selected by the Owner. Finish all required hangers, end caps and fasteners.

Installation

1. Owing Corning R30 insulation shall be placed between the trusses.

2. After the insulation has been installed, 5/8 drywall shall be placed on the underside of the trusses. The drywall shall be fasten to the trusses utilizing 1-1/2" drywall screws. All joints shall have drywall tape and compound applied in such a manner to create a smooth surface.

**E. Pre Fabricated Buildings**

1. Meets IBC 2003 requirements or currently adopted version.

2. Shall be constructed using 5,000 psi steel-reinforced concrete.

3. The building shall be equipped with standard double doors, 6' X 6'-8"; insulated; tamper-proof hinges; deadbolt lock; adjustable mechanical door hold-open arm; door stop and holder; rain guard.

4. Extruded aluminum threshold with integral neoprene seal.

5. Intake and exhaust louvers.

6. Post tension roof and floor, each by a single continuous tendon, creating radial compression in the roof and floor. If floor slab is poured on-site, the slab isn't required to be post tension.

7. Sloped roof panel with prefabricated, architectural ribbed edge.

8. Exclusive turn-down roof with built-in drip edge.

9. Building's exterior shall be approved by the Department of Water Quality.

10. Wiring shall be done on-site.

11. Bullet tested to UL 752, Level 4 (30 caliber rifle fired at 15 feet).

12. Floor load: 250 psf standard.

13. Building shall be manufactured by EASI-SET or approved equal.

## F. Miscellaneous Metal

Scope

The Contractor shall furnish all labor, materials and equipment necessary to install all miscellaneous metals as shown on the drawings and as specified herein. The work to be performed shall include, but not necessarily be limited to, the following:

1. Bearing plates, bolts, anchors, loose lintels, checkered plates and connections.

Materials

1. All steel shall conform to the "Specification For Structural Steel," ASTM A 36-70A.

2. All steel shall be free of rust and scale and shall have one shop coat of rust inhibitive primer.

## G. Louvers

Scope

The Contractor shall furnish all labor, materials and equipment necessary to install all aluminum louvers as shown on the drawing and as specified herein.

Materials

The Contractor/Developer shall install 2 speed exhaust ventilators and dampers. On high speed, the exhaust fan and damper must provide a minimum of 30 ACH (air exchanges per hour). While operating on low speed, the exhaust fan and damper must provided a minimum of 6 ACH.

The exhaust fan shall have an all aluminum housing, backward inclined all aluminum wheel-mounting flange with keyslots and template, two piece top cap with stainless steel quick release latches, birdscreen, lifting lugs,

permanently lubricated ball bearings motors, static resistant belts, adjustable pitch drives thought 2 hp motor, corrosion resistant fasteners, regreasable bearings in a cast iron pillow block housing rated at 200,000 hours average life, all fans factory adjusted to specified fan RPM, transit tested packaging, and standard motors shipped factory installed.

The gravity backdraft dampers shall be constructed with .02 aluminum blades, .06 aluminum frame, aluminum hinge pins, and nylon bushings.

Square intake grille shall be all steel construction, face bars permanently fixed into heavy steel frame at a 40 degree angle, and shall have a white enamel finish.

Intake grille shall be sized to accommodate the minimum air exchange rate as specified in section 304.

Guarantee

All material furnished and installed shall be unconditionally guaranteed for one full year after installation has been accepted.

## H. Stainless Steel Doors and Frames

Scope

The Contractor shall furnish all materials, labor and equipment necessary to install all hollow metal doors and frames as shown on the drawing and specified herein.

Frames

1. Frames shall be 16 gauge type 316 stainless steel .
2. Finish shall be #4 satin.
3. Strike reinforcement tabs shall be 12 gauge.
4. Frame shall have a minimum opening width of 6'-4".
5. Frames shall be manufactured by Stainless Doors, Inc. or approved equal.

Doors

1. Doors shall be 16 gauge type 316 stainless steel, as manufactured by Stainless Doors, Inc. or approved equals.

2. All doors shall be reinforced for hardware.

3. Doors shall have no windows.

4. Finish shall be #4 satin.

5. Vertical hat stiffeners shall be installed 6" on center.

6. Polyurethane insulation shall be installed between the stiffeners.

7. Doors shall have no edge seams.

8. Lock reinforcement box shall be 14 gauge with tabs.

9. Door shall have an inverted18 gauge top and bottom channel.

10. Door shall have no visible weld marks on doors face skins.

11. Doors shall have a minimum height of 6'-8".

## I. Hardware

Scope

The Contractor shall furnish all labor, materials, and equipment necessary to install all hardware as shown, scheduled and specified herein.

Materials

The following hardware shall be furnished and installed:

1. Hinges – Shall be five knuckles constructed from brass with non-rising stainless steel pin (ANSI A5112), 2 ball bearing,.

2. Closer – Federal Spec. No. FFH-121C, gov't. series type no. 3009 with parallel arm and hold open. En finish, size IV.

3. Panic Device – Federal Spec. No. FFH-106A, dull chrome no. US 26 D finish, gov't. type no. 820 K.

4. Threshold – Abrasive aluminum, gov't. type 833.

5. Door handle shall be lever type and shall comply with all ADA requirements.

Keying

The lock shall be master keyed to the Department's system.

## J. Carpentry

Scope

The Contractor shall furnish all labor, material and equipment necessary to install all carpentry, lumber as shown and specified herein.

Materials

1. Pressure treated lumber shall be used for all required framing, blocking, and nailers.

2. All lumber shall be adequately nailed, anchored or bolted to adjacent surfaces for sufficient strength of the application.

3. Aluminum fascia shall be in a color as selected by the Department.

4. Transite sheet 3'-6" x 8'-8" x 3/8" shall be furnished and adequately fastened to the underside of the deck, above the generator muffler.

## K. Caulking

Caulking

The Contractor shall furnish all labor, materials and equipment necessary to complete all interior and exterior caulking required at the door frame, sills, threshold, louvers and other miscellaneous openings.

Materials

All caulking shall be Mono-Lasto-Meric as manufactured by Tremco Manufacturing Company, or by Pecora or approved equal.

Application

1. Joints and spaces to be caulked shall be free from dust, dirt and dampness.

2. Caulking compound shall be applied over 40 degrees F exterior temperature with a pressure gun having nozzles to fit into the joint. Joints shall be filled solidly and smoothly within thin edges, excess compound shall be removed, and adjoining surfaces shall be left clean. Caulking work shall be neat and straight.

## L. Painting

Scope

The Contractor shall provide labor, materials, scaffolds, tools, and equipment necessary to perform all painting work required as scheduled, noted and specified herein. The work shall include, but not necessarily be limited to, the following:

1. Interior concrete block walls or concrete poured wall

2. Drywall

3. Piping

Storage of Materials

Paint materials shall be stored in a separate structure furnished by the Contractor. In cold weather, the storage area shall be heated to maintain paint temperature of approximately 70 degrees F. Sufficient portable fire extinguishers shall be furnished and maintained in the storage structure. Paint rags and similar flammable items shall be kept in a closed container when not being used and shall be destroyed when of no further use.

Paint Materials

1. Glidden Protective Coating Systems are specified herein to established type and quality. Equal systems can be by Sherwin Williams or Pittsburgh Paints of approved equal.

2. Materials shall be furnished in unbroken containers, clearly labeled, and shall be used in strict accordance with the manufacturer's recommendations.

3. Colors generally will be stock colors, but certain items may require mixing to match continuous work.

Workmanship

Paint shall be brushed or rolled on in a workmanlike manner by skilled tradesman. Paint may be sprayed only upon specific approval of the inspector. Paint shall not be applied to wet, damp, or other unsuitable surfaces. Painting shall not be performed in cold weather unless the temperature is at least 40 degrees F, and rising. All work shall be to the entire satisfaction and approval of the inspector.

Protection

The Contractor shall protect all work, personnel, and equipment from paint drippings and spray clouds, by use of tarpaulins, drop cloths, masking, or other protective covering. All tarpauline and drop clothes shall be flameproofed by chemical treatment. During the course of work, all paint droppings and overflows shall be cleaned off as they occur.

Preparation of Surfaces to be Painted

1. Cleaning:

   All surfaces shall be thoroughly cleaned of all dust, dirt, mill scale, rust, oil, grease, weldburn, and other foreign matter which would affect the quality of the work, along with any loose or baggy paint that may be attached thereto.

2. Touch-Up:

   Wherever previously primed or painted surfaces have been destroyed, or defaced, they shall be restored with materials of like kind.

3. Incidental imperfections such as nail holes, gouges, scratches, etc., shall be spackled, sanded, and puttied after the first coat and reprimed as necessary.

4. Interior concrete block walls shall be primed with Ultra Hide PVA Masonry Block Filler #5317 or equal.

5. Aluminum and stainless steel items shall not be painted.

Paint Schedule

| | Item | Finish Coat (2) Color | Dry Millage |
|---|---|---|---|
| 1. | Concrete Block/ Concrete poured walls | To Be Selected By Department | 2.0 |

| | | | |
|---|---|---|---|
| 2. | Drywall | To Be Selected By Department | 2.0 |
| 3. | Piping | To Be Selected By Department | 2.0 |

**M. By-Pass Pumping Connection**

Each pump station shall be equipped with a 6 inch by-pass pumping connection. The by-pass pumping connection shall be installed in the force main after the pumps and prior to exiting the building underground.

The by-pass connection shall consist of install a 6 inch tee in the force main. Connected to the tee will be a 6 inch Dezurik plug valve. The piping will extend through the wall of the building terminating with a 6 inch quick cam lock connector and cap. The cap shall be secured to the wall of the building utilizing a chain.

**N. Miscellaneous Items**

1. The Contractor shall furnish and install, in each building, one (1) industrial sink and hose bib as shown on the drawings.

2. The Contractor shall furnish and install one (1) electric hoist in each building. The minimum lifting capacity for the hoist shall be one (1) ton. The hoist shall be a trolley hoist. The hoist shall be furnished with a minimum of thirty (30) feet of lifting chain and installed on a monorail. The monorail shall be installed along the centerline of the pumps to just inside the door.

3. Each building shall have 10 pound type ABC dry chemical fire extinguisher installed on the wall next to the entrance door.

4. Each facility shall be equipped with a right-to-know station. The right-to-know station shall consist of 14"Wx20"Hx5"D steel rack that is PVC coated for corrosion resistance and one three-ring MSDS binder 3" diameter with security chain. The rack is wall-mountable and has a 14"Wx20"H screen-printed, polypropylene sign for easy identification of reference material.

5. Each building shall be equipped with a 25 person first aid kit. The first aid kits can be purchased from Hantover, item # 260001 or approved equal.

6. If public water is available to the site, the Developer will be responsible for connecting the pump station to said public water

system. This includes paying water tap fee, installation of water meter, and installation of service line. If the pump station has public water, the station shall include a restroom and slop sink.

7. Each pump station shall be equipped with an emergency eye wash station. If public water is available, then the eye wash station shall be a combo emergency eye wash / shower.

**Chapter 3, Section 302**

**Base mounted Pumping System**

## II. Base Mounted Pumping System

### A. General

The contractor shall furnish and install one (1) factory built base mounted pumping system. The principal items of equipment shall include two self-priming, horizontal, centrifugal, v-belt motor driven sewage pumps, valves, piping, control panel, liquid level control system, and internal wiring.

Electrical power to be furnished to the site will be 3 phase, 60 hertz, 480 volts, maintained within plus or minus 10 percent. Phase to phase unbalance shall not exceed 1% average voltage as set forth in NEMA Standard MG-1. Control voltage shall not exceed 132 volts.

The pumping equipment shall be manufactured by The Gorman-Rupp Company, Mansfield, OH, or approved equal.

These specifications and accompanying drawings specify and show equipment and materials manufactured by The Gorman-Rupp Company, deemed most suitable for the service anticipated. This is not done, however, to eliminate other products equally as good and efficient. The contractor shall prepare his bid on the basis of the particular equipment and materials specified for the purpose of determining the low bid. The awarding of the contract shall constitute a contractual obligation to furnish the specified equipment and materials.

After execution of the contract, should the contractor desire to substitute equipment other than that specified in the contract, such substitution will be considered for one reason only: the equipment proposed for substitution is superior in construction and efficiency to that specified in the contract, and higher quality has been demonstrated by service in a similar installation.

In the event the contractor obtains Department's approval of equipment other than that for which the system was originally laid out, the contractor shall, at his own expense, make any changes in the structures, buildings or piping necessary to accommodate the equipment. The Contractor shall prepare and submit revised construction plans, to the Department for review and approval, showing the proposed modifications.

### B. Submittals

Product Data: Prior to fabrication, submit the following to the Department for approval:

1. Shop drawings providing layout of mechanical equipment and anchor bolt locations.
2. Electrical ladder logic drawings illustrating motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.
3. Catalog cut sheets for major items of equipment, materials of construction, major dimensions, motor and v-belt drive data, pump characteristics curves showing design duty point capacity (GPM), head (FT), net positive suction head (NPSHR), and hydraulic brake horsepower.
4. Pump Manufacturer's v-belt drive selection calculation summary sheet showing corrected H.P. Per Belt, total H.P. developed, pitch diameter of sheaves, center distance between driver and driven shafts and combined arc-length correction factor applied to theoretical horsepower transmission per v-belt, and all calculations to demonstrate a minimum Safety Factor of 1.5.
5. Certified dimensional drawings indicating size, location and the spherical solids passing capability of the primary recirculation port.
6. Sample of service agreement and service agreement checklist for the specified equipment.
7. Interconnection wiring diagram showing the field wiring between the Bihlertech Controller and pump manufacture's control cabinet.
8. Copy of certificate with course I.D. number for pump manufacturer's Maryland approved Startup/Training course that counts toward Maryland continuing education unit requirements.
9. Foundry certificates and results of Brinell hardness testing on similar components for hardened alloy steel and ADI (austempered ductile iron) pump components.

Certified Tests: Prior to shipment of the equipment from the manufacturer's facility, submit the following certified tests to the Department for approval.

1. Certified copies of factory run pump performance tests. Characteristics of pumps may have a tolerance of plus 10% of rated capacity at rated head or plus 8% at rated head capacity. No minus tolerance will be acceptable. The performance tests will substantiate the correct performance of the equipment at the design head, capacity, suction lift, speed and horsepower as herein specified.
2. Certified reprime performance test data in accordance with procedures herein specified.
3. Certified copies of air release valve closure performance test.
4. Tests shall be certified by a registered professional engineer.

Operation and Maintenance Manuals:

1. Operation shall be in accordance with written instructions provided by the pump system manufacturer. Comprehensive instructions supplied at the

time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.

2. Documentation shall be specific to the pumping equipment supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall system design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:

   a. Functional description of each major component, complete with operating instructions.

   b. Instructions for operating pumps and pump controls in all modes of operation.

   c. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.

   d. Support data for commercially available components not produced by the system manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.

   e. Electrical schematic diagram of the pump control circuits shall be in accordance with NFP A 70. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the system operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.

   f. Mechanical layout drawing of the pumping equipment and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.

3. Operation and maintenance instructions, which rely on vendor cut-sheets and literature, which include general configurations, or require operating personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

4. Gorman Rupp is to supply the Bihlertech Controller representative with a wiring schematic of the Gorman Rupp control panel. The Bihlertech representative will be responsible for preparing and submitting interconnection wiring diagram to the Department and Gorman Rupp for approval.

Manufacturer's Field Performance Test Report: The manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, instruct operating personnel in the proper operation and maintenance of the equipment. A written report covering the
equipment startup shall be mailed from the Manufacturer's startup technician directly to the Department. At a minimum, the report shall include:

1. Nameplate information.
2. Recordings of gauge readings, total dynamic head and operating speed for each pump.
3. Recordings of level control settings.
4. Certification that equipment has been properly installed and lubricated and is in accurate alignment.
5. Certification that the v-belt drive system has been properly aligned using a laser alignment instrument and v-belts tensioned using a belt-tensioning instrument.
6. Results of electrical tests including voltage readings and amperage readings of all motors.
7. Certification that the equipment has been operated fully loaded and that it operated satisfactorily.
8. Outline in detail any deficiencies noted, and proposed remedial corrections.
9. Fully test all of the alarms related to the Gorman Rupp control panel and verify the alarms are transmitted to the Bihlertech controller.

## C. Quality Assurance

Manufacturer's Qualifications: Upon request from the Department, the pumping equipment manufacturer shall demonstrate the following:

1. Proof of financial stability and ability to produce the pumping equipment within the specified delivery schedules.
2. Evidence of the facilities, equipment, and expertise to demonstrate the manufacturer's commitment to long-term customer service and project support.
3. Evidence of adequate local and factory spare parts inventory to provide timely delivery of spare parts.
4. Evidence that the pump manufacturer is an Underwriters Laboratories (UL) panel builder.
5. Evidence that the pumps and pumping equipment are constructed, assembled and tested in the United States. All pump parts including the casing shall be machined at a common facility located within the United States with demonstrated ability to fit Gorman-Rupp pump casings manufactured for the past 30 years.

6. Evidence that the pump manufacturer can provide operator training that counts toward Maryland experience and continuing education requirements.
7. Consideration will be given only to pump manufacturers meeting the following qualifications:
   a. Twenty-five years minimum experience successfully producing pumping equipment of the type specified herein.
   b. A minimum of twenty-five installations of pumping equipment of the type specified herein in successful operation for a minimum of ten years.
8. Pump manufacturer must be ISO 9001 :2000 certified, with scope of registration including design control and after sales activities.

Manufacturer's Representative Qualifications: Upon request from the Department, the equipment manufacturer's local representative shall demonstrate the following:

1. Evidence of adequate local spare parts inventory to provide timely delivery of spare parts.
2. Evidence of established locally based factory-trained service personnel.
3. Evidence that representative offers comprehensive equipment service agreements for the equipment specified.
4. List of at least ten local municipalities with installations similar to the specified equipment.
5. Evidence that the representative offers full-day operator training seminars on Centrifugal Pump Maintenance and Troubleshooting.
6. Evidence that the representative offers technical design assistance and hydraulic recommendations for pump station design.
7. Certification from manufacturer that the service technician has been factory-trained and is authorized for such duties by the manufacturer.

Pump Performance:

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.

Design the pumps designated as self-priming centrifugal to pump raw sewage containing solids up to ten percent and stringy materials with a minimum of clogging. Pumps may be protected by screening equipment, but materials passing through may combine by a felting or balling process.

Source Quality Control:

Obtain pumping equipment, motors, motor starters, pump controls and appurtenances from the pump manufacturer whose responsibility it is to insure that the pumping equipment is properly furnished, coordinated, and tested in accordance with these specifications.

The pump control panel including the level controls shall be constructed at the pump manufacturer's facilities. The pump manufacturer shall be an Underwriters Laboratories (UL) panel builder. The control panel shall meet all UL and Joint Industrial Council (JIC) standards.

Factory System Test:

All components including the pumps, motors, valves, piping and controls will be tested as a complete working system at the pump manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head, capacity, rated speed and horsepower. Factory operational tests shall simulate actual performance anticipated.

Upon request from the Department, the operational test may be witnessed by the Department and/or representatives of his choice at the manufacturer's facility.

**D. Manufacturer's Warranty**

All components of the pumping equipment shall be manufactured, assembled and tested as a unit by the pump manufacturer. The pumping equipment must be a standard catalog item with the manufacturer. The pump manufacturer must assume system responsibility, i.e. the pumping equipment must be warranted by the manufacturer as described herein. Individual component warranties are desirable. However, individual warranties honored solely by the manufacturers of each component will not be acceptable.

The pump manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.

1. All equipment, apparatus, and parts furnished shall be warranted for one (1) year, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, 0-rings, etc. The pump manufacturer shall be solely responsible for warranty of the pumping equipment components when installation is made and use and maintenance is performed in accordance with the manufacturer's recommendations.
2. The pump shall be warranted for five (5) years.
3. Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during

the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer without cost of parts labor to the Department.

It is not intended that the pump manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor supplied product or part which fails to properly operate, however caused. Consequential damages resulting from defects in design, or delays in delivery are also beyond the manufacturer's scope of liability.

The warranty shall become effective upon the acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment, whichever occurs first.

## E. Pumps

Pump Description:

Pumps shall be Gorman-Rupp Model Super T-Series, V-Series or VS-Series (Whichever is deemed more suitable for the application) horizontal, self-priming, centrifugal pumps, specifically designed for pumping raw, unscreened, domestic sanitary sewage.

All openings, internal passages, and internal recirculation ports shall be large enough to permit the passage of the specified spherical solids passing capacity, and any trash or stringy material which may pass through the average house collection system. Screens or any internal devices that create a maintenance nuisance or interfere with priming and performance of the pump shall not be permitted.

The pumps shall have the following characteristics:

| | | |
|---|---|---|
| 1. | Suction connection, flanged, in. | TBD |
| 2. | Discharge connection, flanged, in. | TBD |
| 3. | Minimum shutoff head, each pump, ft. | TBD |
| 4. | Pump speed, rpm | TBD |
| 5. | Maximum NPSH required at design point, ft. | TBD |
| 6. | Minimum reprime lift capacity, ft. | TBD |
| 7. | Spherical solids passing capability, in. | 3" |
| 8. | Motor horsepower | TBD |
| 9. | Motor speed, rpm | TBD |
| 10. | Impeller diameter, in. | TBD |

Pump Performance:

Each pump must have the necessary characteristics and be properly selected to perform under these operating conditions:

| | | Initial | Future |
|---|---|---|---|
| a. | Capacity, gpm | TBD | TBD |
| b. | Total dynamic head, ft. | TBD | TBD |
| c. | Total dynamic suction lift, ft. | TBD | TBD |
| d. | Maximum static suction lift, ft. | TBD | TBD |
| e. | Static discharge head, ft. | TBD | TBD |

Consideration shall be given to the sanitary sewage service anticipated, in which occasionally debris will lodge between the pump suction check valve and seat, resulting not only in loss of the suction leg, but also in the siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal with proper installation of air release line to atmosphere.

In consideration of such occurrence and of the unattended operation anticipated, each pump shall be so designed as to retain adequate liquid in the pump casing to insure unattended automatic repriming while operating at its rated speed in a completely open system without suction check valves and with a dry suction leg.

Reprime Performance:

Each pump must be capable of the specified reprime lift while operating at the selected speed and impeller diameter. Reprime lift is defined as the static height of pump suction centerline above liquid that the pump will prime; and delivery within five minutes on liquid remaining in the pump casing after a delivering pump is shut down with the suction check valve removed. Systems requiring ancillary vacuum generating devices shall not be acceptable. Additional standards under which reprime tests shall be run are:

1. Piping shall incorporate a discharge check valve down stream from the pump. Check valve size shall be equal (or greater than) the pump discharge diameter.

2. A ten-foot length of one-inch pipe shall be installed between pump and discharge check valve. This line shall be open to atmosphere at all times to duplicate the air displacement rate of a typical pump system fitted with an air release valve.
3. No restrictions shall be present in pump or suction piping that could serve to restrict the rate of siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a minimum horizontal run of 2 feet and one 90-degree elbow.
4. The pipe size used for the reprime performance test shall be the same size as the pump suction diameter.
5. Impeller shall be set at the clearances recommended by the manufacturer in the pump service manual.
6. Reprime lift repeatability shall be demonstrated by five sequential reprime cycles.
7. Liquid to be used for reprime test shall be water.

Serviceability:

The pump manufacturer shall demonstrate to the Department's satisfaction that due consideration has been given to reducing maintenance costs by incorporating the following features:

1. No special tools shall be required for replacement of any components within the pump.
2. The mechanical seal shall be a one-piece cartridge type to allow for easy replacement. Mechanical seals requiring assembly of individual components shall not be acceptable.
3. The pump must be equipped with a removable cover plate, allowing access for service and repair without removing suction or discharge piping.
4. The pump shall be fitted with a replaceable wear plate. Replacement of the wear plate, impeller, seal, and suction check valve shall be accomplished through the removable cover plate without removing suction or discharge piping.
5. The entire rotating assembly, which includes bearings, shaft, seal, and impeller, shall be removable as a unit without removing the pump volute or piping.
6. Each pump shall incorporate a suction flap valve that can be removed or installed through the removable cover plate opening, without disturbing the suction piping. Sole function of the suction flap valve shall be to eliminate re-priming with each cycle. Pumps requiring suction flap valves to prime or reprime will not be acceptable.
7. Atmospheric isolation: The shaft bearings shall be isolated from the seal cavity with an air gap to provide positive protection of the

bearings in the event of a seal leak and to provide for external monitoring of the seal integrity.

8. Adjustment of the impeller face clearance (distance between impeller and wearplate) shall be accomplished by external means.
9. Clearances shall be maintained by a 4 point external shimless coverplate adjustment system with four collar and adjusting screws. Provide 4-point incremental clearance adjustment. Each of the 4 points shall be lockable to prevent inadvertent clearance increases or decreases due to equipment vibration. The 4 point system shall provide equal clearance gaps at all points between the impeller and wear plate. Systems that require realignment of belts, couplings, sheaves, etc., each time a clearance adjustment is performed shall not be acceptable. Coverplate shall be capable of being removed and reinstalled without disturbing the clearance settings. Clearance adjustment systems that utilize less than 4 point system will not be considered.
10. There shall be provisions for additional clearance adjustment in the event that adjustment tolerances have been depleted from the coverplate side of the pump. The removal of stainless steel shims from the rotating assembly side of the pump shall allow for further adjustment as described above
11. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.

Construction:

1. Pump design: Pumps shall be the original design of the pump manufacturer. Products violating intellectual property regulations shall not be allowed, as they may violate domestic or international law and expose the user or engineer to unintended liabilities. Reverse-engineered products fabricated to imitate the design of original products shall not be allowed as they may contain substantial differences in tolerances and material applications that may contribute to product failure.
2. Pump casing: Made of gray iron no. 30, shall be foot supported, and shall have a horizontal centerline suction and vertical discharge.
    a. The casing shall have a top mounted 3-1/2 inch priming fill port with a safety lock bar cover. In consideration for safety, hand nut threads must provide slow release of pressure, and the clamp bar shall be retained by detent lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.
    b. Casing shall have no openings of smaller diameter than the specified sphere size.

c. Casing shall be designed to retain sufficient liquid to ensure automatic repriming and unattended operation.

d. A minimum 1-1/4 inch diameter drain hole shall be provided for attachment of the pump drain kit and to ensure complete and rapid draining.

e. Suction flap valve: Molded neoprene with integral steel and nylon reinforcement. A blow-out center shall protect the pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished through the cover plate opening without disturbing the suction piping. Sole function of the suction flap valve shall be to save energy by eliminating need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.

f. Pump shall be provided with a separate capped threaded port for use of an optional casing heater.

3. Cover plate: Cover plate shall be cast iron Class 30.

a. Retained by four (4) hand nuts for complete access to pump interior. Cover plate removal must provide ample clearance for removal of stoppages, and the allow removal or service to the impeller, seal, wear plate or suction flap valve.

b. Replaceable wear plate: Secured to the cover plate by four (4) welded studs and nuts. The wear plate shall be hardened steel with a minimum Brinell Hardness of 400. The wear plate shall be of sufficient width to maintain the manufacturer's recommended clearance between the entire edge of each impeller vane and the wear plate. Wear plate attachment hardware shall be located out of the direct flow path of the liquid into the impeller. Two (2) Buna-N o-rings shall seal cover plate to the pump casing.

c. O-ring Seals: Two (2) Buna-N o-rings shall seal cover plate to the pump casing. The inner cover plate o-rings shall provide a seal between the suction chamber and the discharge chamber of the pump casing to eliminate the possibility of recirculation at the wear plate.

d. In consideration for safety, a pressure relief valve shall be supplied in the cover plate. Relief valve shall open at 75 PSI.

e. Pusher bolt capability to assist in removal of coverplate. Threaded pusher boltholes shall be sized to accept same retaining capscrews as used in rotating assembly.

f. Easy-grip handle shall be mounted to face of coverplate.

4. Rotating assembly:

a. Impeller (ADI): Two-vaned, semi-open, non-clog, cast in Austempered Ductile Iron with a minimum Brinell Hardness of 400 with integral pump out vanes on the back shroud.

Impeller shall thread onto the pump shaft and be secured with a lockscrew.

b. Shaft: Shaft shall be constructed of Alloy Steel No. 4140 and shall employ an Alloy Steel No. 4130 shaft sleeve.

c. Mechanical seal: A mechanical cartridge seal shall seal the pump shaft against leakage. The stationary sealing member and the mated rotating face shall be tungsten titanium carbide. Each of the mated surfaces shall be lapped to a flatness of three light bands (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating so that faces will not lose alignment during periods of shock loads that will cause deflection, vibration, and axial movement of the pump shaft. The seal shall be warranted for five (5) years from date of shipment.

d. Lubrication: Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Oil cavities must be cooled by the liquid pumped. Three lip seals will prevent leakage of oil.

   1) The bearing cavity shall have an oil level sight gauge and fill plug with check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.

   2) The seal cavity shall have an oil level sight gauge and fill plug with vent. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the vented fill plug.

   3) Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.

e. Atmospheric isolation: The shaft bearings shall be isolated from the seal cavity with an air gap to provide positive protection of the bearings in the event of a seal leak and to provide for external monitoring of the seal integrity.

f. Seal plate (ADI): Replaceable seal plate shall be constructed of Austempered Ductile Iron with a minimum Brinell Hardness of 400, and shall be bolted to the bearing housing.

g. Shaft bearings: Shall be anti-friction ball or tapered roller bearings, of ample size and proper design to withstand all radial and thrust loads which can reasonably be expected during normal operation. Pump designs in which the same oil lubricates both the shaft bearings and the shaft seal shall not be acceptable.

h. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same capscrews as used for retaining rotating assembly.

5. Suction and discharge spools: Each pump shall be equipped with one-piece, cast iron spools, flanged on each end. Each spool shall have one 1 1/4-inch NPT and one 1/4-inch NPT tapped hole with pipe plugs for mounting of gauges or other instrumentation.

**F. Pump Accessories**

Spare Parts:

There shall be furnished with the following minimum spare parts:

1. Two (2) Spare Parts Kit(s) each including one (1) mechanical cartridge seal, one (1) set of rotating assembly adjustment shims, one (1) cover plate "o"-ring, one (1) rotating assembly "o"-ring
2. One (1) complete rotating assembly (with austempered ductile iron impeller, and seal plate)
3. Four (4) suction flap valve assembly(s)
4. One (1) belt tensioning gauge(s) – spring loaded
5. Two (2) quart(s) of seal lubricant
6. Two (2) air pump repair kits for bubbler level control system
7. Two (2) discharge check valve springs

Gauge Kit With Vibration Isolation Frame:

1. Each pump shall be equipped with a glycerin-filled compound gauge to monitor suction pressures, and a glycerin-filled pressure gauge to monitor discharge pressures. Gauges shall be a minimum of 4-inches in diameter, and shall be graduated in feet water column. Rated accuracy shall be 1 percent of full-scale reading. Compound gauges shall be graduated -34 feet to +34 feet water column minimum. Pressure gauges shall be graduated 0 to 140 feet water column minimum.
2. Gauges shall be mounted on a vibration isolation frame assembly with resilient panel, frame, and adjustable brackets which shall be firmly secured to pumps or piping. Gauge installations shall be complete with all hoses and fittings, and shall include a shutoff valve installed in each

gauge inlet at the point of connection to suction and discharge pipes.

3. Gauge kit shall be supplied with stainless steel fittings.

Pump Drain Kit:

1. Each pump shall be equipped with a pump drain kit shall consist of a 10' length of plastic hose with a quick connect female Kamlock fitting on one end of hose and two sets of fittings for pump drains. Each set of fittings for pump drain includes a pipe nipple, bushing, bronze ball valve and quick connect male Kamlock fitting.
2. Pump drain kit shall be supplied with stainless steel fittings.

Self Cleaning Wear Plate:

The wear plate shall be constructed with a minimum of six (6) semi-circular machined channels and a tapered face designed to provide self-cleaning action and ensure that debris is cleared away from and does not collect between the impeller and the wear plate.

## G. Valves and Piping

Check Valves:

***4-inch and 6-inch check valves***

Each pump shall be equipped with a full flow type check valve, each capable of passing a 3" spherical solid, with flanged ends and be fitted with an external lever and spring. The valve seat shall be constructed of stainless steel and shall be replaceable. The valve body shall be cast iron. The valve shall be equipped with a removable cover plate to permit entry for complete removal and replacement of internal components without removing the valve from the line. Valve clapper shall have a molded neoprene seating surface incorporating low pressure sealing rings. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings, sealing bushing shall have double o-rings. O-rings shall be easily replaceable without requiring access to interior of valve body. Valve shall be rated at 175-PSI water working pressure, 350-PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable.

**OR**

***8-inch or larger check valves***

Each pump shall be equipped with a full flow type check valve, capable of passing a 3" spherical solid, with flanged ends and be fitted with an external lever and spring. 316 stainless steel body ring shall be threaded into the valve port. Valve clapper shall be cast iron, rubber face, and shall swing completely clear of waterway when valve is full open. Hinge pin shall be of 18-8 stainless steel construction and shall be utilized with bronze bushings and packing type seal. Valves shall be equipped with removable cover plate to permit entry or for complete removal of internal components without removing the valve from the line. Valve shall be rated at 175-PSI water working pressure, 350-PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable.

Plug Valve:

Each pump shall be equipped with a 2-way plug valve to allow for isolation of the pump from the force main. Plug valves shall be of the non-lubricated, eccentric plug type, as manufactured by Dezurik, or approved equal. Minimum full-open flow area through the cast iron (ASTM A-126, Grade 'B') body shall be 100% of full pipe, and shall not drip when closed. Valve shall have nickel seat, neoprene plug facing, stainless steel bolts, and stainless steel bearings. Packing shall be nitrile butadiene (buna vee).

Valve shall be operated with a single lever acturator providing lift, turn, and reseat action. The lever shall have a locking device to hold the plug in the desired position.

All valves shall have 2 coats of Tnemec Series 141 Pota-Pox 80 applied to all surfaces by the factory prior to shipping.

Air Release Valves (High-Impact Composite Polyester):

1. Each pump shall be equipped with an automatic air release valve to vent air to atmosphere during initial priming or unattended repriming cycles. The valve shall automatically close operating solely on discharge pressure to prevent recirculation. A visible indication of valve closure shall be evident.
2. Air release valve piping must discharge directly into wet well. ARV piping shall not discharge to a sump.
3. The air release valve shall be constructed of high-impact composite polyester containing not less than 30% glass-filler. The valve body shall incorporate an internal passageway that allows all debris to pass through the valve chamber between operational cycles. The

diaphragms shall be Buna-N, Fluorocarbon or EPDM, with a polyester mesh rated for 250 PSI of pressure.

4. The vertical plunger shall be constructed of Acetal and PTFE fluorocarbon filler. The independent, dual diaphragms and single, vertical valve plunger shall incorporate a media fluid that passes through an orifice and separates the actions of each.
5. The valve shall employ an externally-adjustable restrictor for applications below four feet of static discharge head.
6. The valve body shall incorporate passageways having minimal constrictions and no directional course changes integral to the body of the valve. The inlet shall be 1 inch NPT female and the discharge outlet shall be 1-1/4 inch NPT female. The valve shall be mounted horizontally, at 90 degrees to the vertical plunger.
7. The valve shall be capable of operation on applications ranging from four to 400 feet of water column without the need for adjustment or change of springs or other parts.
8. Air release valves shall be connected to pump station piping using stainless steel pipe fittings.
9. Each air release valve shall be provided with an isolation ball valve.

Piping:

1. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C11 5 and Class 53 thickness. Flanges shall be cast iron Class 125 and comply with ANSI B16.1. All piping pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.
2. Boltholes shall be in angular alignment within ½-degree between flanges. Flanges shall be faced and a gasket finish applied that shall have concentric grooves a minimum of 0.01 inch deep by approximately 0.03 inch wide, with a minimum of three grooves on any given surface spaced a maximum of ¼ inch apart.

Supports and thrust blocks:

1. Contractor must insure all pipes connected to the pumping system are supported to prevent piping loads from being transmitted to pumps or system piping.
2. Pump station discharge force main piping shall be anchored with thrust blocks by the contractor where shown on the contract drawings.

Gauge Connection Assembly:

1. The header piping shall be equipped with a gauge connection assembly located between the discharge check valve and force main isolation plug valve allowing the operator to easily attach a discharge gauge on any pump for troubleshooting.

2. The gauge assembly shall consist of a 1/4" stainless steel pipe nipple, 1/4" brass full port ball valve and a quick connect fitting.
3. The gauge connection assembly shall be installed in the discharge header piping such that the static and dynamic pressure in the force main can be read at all times unless the force main isolation plug valve is closed for that particular pump.

## H. Fabricated Steel Base

One fabricated steel base shall be provided for the duplex pump and motor assembly. The base shall comprise a base plate, perimeter flange, and reinforcements. Base plate shall be fabricated of steel not less than ¼" thick, and shall incorporate openings for access to all internal cavities to permit complete grouting of unit base after installation. Perimeter flange and reinforcements shall be designed to prevent flexing or warping under operating conditions. Base plate and/or flange shall be drilled for hardware used to secure unit base to concrete pad as shown on the contract drawings. Unit base shall contain provisions for lifting the complete pump unit during shipping and installation.

Contractor shall provide and install high-grade commercial neoprene material under the fabricated steel pump bases to isolate the skid assembly from the concrete floor. Neoprene material shall be 1/2-inch thick with the following properties: Tensile Strength: 800 psi, Ultimate Elongation: 350%, and a durometer hardness of 50 (+/-5).

## I. Drive Unit

Motors:

1. The pump motors shall be horizontal, totally enclosed fan cooled for motors 10 HP and less and open drip-proof for motors 15HP and higher, induction type, with normal starting torque and low starting current characteristics. The motors shall not be overloaded at the design condition or at any head in the operating range as specified.
2. Motors shall be tested in accordance with provisions of ANSI/IEEE Std. 112.
3. Each motor shall be in current NEMA design B cast iron frame with copper windings.

Drive Transmission:

1. Power shall be transmitted from motors to pumps by means of v-belt drive assemblies. The drive assemblies must be selected to establish proper pump speed to meet the specified operating conditions.

2. Each drive assembly shall have a minimum of two v-belts. In no case will a single belt drive be acceptable. Each v-belt drive assembly shall be selected on the basis that adequate power will be transmitted from driver to pump. Drive systems with a safety factor of less than 1.5 shall not be considered sufficient for the service intended. Computation of safety factors shall be based on performance data published by the drive manufacturer.
3. Kevlar V-belts shall be the corded type.

Belt Guards:

1. Pump drive transmissions shall be enclosed on all sides in a guard constructed of any one or combination of materials consisting of expanded, perforated, or solid sheet metal, except that maximum perforated or expanded openings shall not exceed ½ inch.
2. Guards shall be manufactured to permit complete removal from the pump unit without interference with any unit component, and shall be securely fastened to the unit base.
3. All metal shall be free of burrs and sharp edges. Structural joints shall be continuously welded. Panels may be riveted to frames with not more than five-inch spacing. Tack welds shall not exceed four-inch spacing.
4. The guard shall be finished with one coat of gray W.R. non-lift primer and one coat of orange acrylic alkyd W.R. enamel in accordance with section 3, Color Definitions of ANSI 253.1; Safety Color Code for Marking Physical Hazards.

**J. Finish**

Surface Preparation:

1. Pumps, piping and exposed steel framework shall be prepared utilizing a six-stage surface preparation system including the application of iron phosphate and sealer/rust inhibitor.
2. The method shall provide excellent removal of substrate contaminants and very effectively etch pores in the metal resulting in a superior adhesion of primer and paint.
3. Surface preparation shall be in accordance with United States Government mil spec # MIL-T-704J. Sandblasting shall not be acceptable.

Paint:

1. Pumps, piping and exposed steel framework shall be coated with one coat gray W.R. non-lift primer and one coat white acrylic alkyd W.R. enamel. Paint shall be low VOC, alkyd based, high solids, semi-gloss white enamel for optimum illumination enhancement and incorporate rust inhibitive additives.

2. The finish coat shall be 1.0 to 1.5 MIL dry film thickness (minimum), resistant to oil mist exposure, solvent contact and salt spray.
3. The factory finish shall allow for over-coating and touch up after final installation.
4. All flanged connections including pumps, valves, piping and fittings shall be painted prior to assembly.

## K. Pump Control System

General:

1. This specification covers a pump control system for the duplex pumping system including motor circuit breakers, starters, thermal overload relays, door mounted operator controls, and liquid level controls.
2. The liquid level control will include an air bubbler level control, electronic pressure switch, pump sequence control, alarms and pump safety shutdowns.

UL Listing:

1. The pump controls shall be manufactured by the pump manufacturer who shall be a UL panel builder and each assembly shall bear a serialized UL label listed for "Enclosed Industrial Control Panels."
2. The enclosure and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures. Listing for open style industrial control panels or an assembly of listed or recognized components shall not be acceptable.

Panel Enclosure:

1. Enclosure shall be constructed in conformance with applicable section of national electrical manufacturers' association (NEMA) standards for Type 1 electrical enclosures. Enclosure shall be fabricated of stainless steel having a minimum thickness of not less than 0.075 inch (14 gauge).
2. Door shall be hinged and sealed with a neoprene gasket and shall be held closed with clamps that are quick and easy to operate. The door shall accommodate the mounting of switches and indicators.
3. Enclosure shall be furnished with a removable back panel, fabricated of steel having a thickness of not less than 0.106 inch (12 gauge), which shall be secured to the enclosure with collar studs. Such panel shall be of adequate size to accommodate all basic components.
4. All control components shall be securely fastened to a removable back panel with screws and lock washers. Switches, indicators and

instruments shall be mounted through the control panel door. Self-tapping screws shall not be used to mount any components.

5. Each control assembly shall be furnished with main terminals and ground lug for field connection of the electrical supply. The connections shall be designed to accept copper conductors of sufficient size to serve the loads. The main terminals shall be mounted to allow incoming wire bending space in accordance with article 373 of the National Electric Code (NEC). A separate terminal strip shall be provided for 115 volt, single-phase control power and shall be segregated from the main terminals. Ten percent of the control terminals shall be furnished as spares.

Motor Branch Components:

1. All motor branch components shall be of the highest industrial quality. Operating coils of all AC control devices shall be rated for 120 volts, and shall be suitable for use in a voltage range of 108 to 132 volts, 60 hertz.
2. Circuit Breakers and Operating Mechanisms:
   a. A properly sized heavy duty air circuit breaker shall be furnished for each pump motor, and shall have a symmetrical RMS interrupting rating of _____ __ amperes at ____ volts (to be determined by the power company and/or electrical engineer). All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering.
   b. A padlocking operating mechanism shall be installed on each motor circuit breaker. Operator handles for the mechanisms shall be located on the exterior of the control compartment door, with interlocks which permit the door to be opened only when circuit breakers are in the "off" position.
3. Motor Starters (for Motors 15 HP and less):
   a. An open frame, across-the-line, NEMA rated magnetic motor starter shall be furnished for each pump motor. Starters of NEMA size 1 and above shall be designed for addition of at least two auxiliary contacts. Starters rated "0", "00", or fractional sizes shall not be acceptable. Power contacts shall be double-break and made of cadmium oxide silver. All motor starters shall be equipped to provide undervoltage release and overload protection on all three phases.
   b. Motor starter contacts shall be easily replaceable without removing the motor starter from its mounted position.
4. Overload Relays:
   a. Overload relays shall be of the thermal block-type and shall have visual trip indication with trip-free operation.

Pressing of the overload reset lever shall not actuate the control contact until such time as the overload thermal element is reset. Resetting of the overload reset lever will cause a snap-action control contact to reset, thus re-establishing a control circuit.

b. Overload reset pushbuttons shall be mounted through the door of the control panel in such a manner as to permit resetting the overload relays without opening the control panel door.

***For Motors 20 HP and greater, delete above paragraphs "Motor Starters" and "Overload Relays" and add the following:***

1. Reduced Voltage Starters:
   a. A reduced voltage, solid state motor starter shall be furnished for each pump motor. The power section shall consist of six back-to-back SCRs rated 208 to 480 volts, 50/60 hertz. The power section shall be capable of 300% rated current for 30 seconds. The SCRs shall have a minimum repetitive peak inverse voltage rating of 1400 volts at 480 volts. Operating temperature range shall be 0 to 50 degrees C at altitudes up to 2000 meters without derating.
   b. The starter shall be capable of soft starting the pump and be adjustable from 2 to 30 seconds. Ramp time is load dependent. Fault diagnostics shall be displayed on the starter and shall include stalled motor, start fault, temperature fault and line fault.
   c. Pump Control option: The starter shall provide smooth acceleration and deceleration using an algorithm, which approximates the torque requirements of a centrifugal pump. The starter's microcomputer shall analyze motor variables and generate control commands, which will minimize surges in the system. Pump stop time shall be adjustable from 0 to 120 seconds.
   d. Protective features
      1) The starter shall be equipped with the following protective features:
      a) Built in Overload relay, Class 10, 15, 20 or 30 trip, Ambient insensitive, Thermal Memory
      b) Stall protection-0-10s after start ramp
      c) Jam protection-0-10s after up-to-speed
      d) Phase rebalance
      e) Underload-0-99%, 0-99s
      f) Undervoltage-0-99%, 0-99s
      g) Overvoltage-0-99%, 0-99s

h) Voltage Unbalance-0-25%
i) Excessive starts per hour

e. Operator Interface

The starter shall be equipped with a digital display and data entry terminal mounted on the exterior of the starter enclosure door. The operator interface shall be an English language display and include the following data:

a) Volts Phase to Phase
b) Current each Phase
c) Watts
d) KWh
e) Elapsed Time
f) Motor Thermal Usage
g) Power Factor
h) Fault Display
i) Fault Buffer (last five faults in code)
j) Set-up Parameters

2. Bypass contactors
   a. Each solid-state reduced voltage motor starter shall be provided with a bypass contactor.
   b. When the pump motor is up to speed, the bypass contactor shall be "pulled in" for "run" in order to reduce the amount of heat produced by the reduced voltage starter.
   c. When the pump motor is called to "Stop", the bypass contactor shall "drop out" and allow for the reduced voltage starter to take over in order to provide for smooth deceleration of the pump motor.
3. Converter modules
   a. Each motor branch circuit shall include a control module.
   b. Control module shall provide three-phase current feedback to the solid-state reduced voltage starter for metering and overload protection during phase rebalance and bypass operation.

Indicators:

1. Indicating lights shall be oil tight type and equipped with integral step-down transformers for long lamp life. Lamps shall be incandescent type rated 14 volts or less with a minimum life of 15,000 hours. Lamps shall be replaceable from the front without opening the control panel door and without the use of tools.
2. Indicating lights will be furnished for the following functions:
   a. Pump No. 1 run
   b. Pump No. 2 run

Switch Controls:

1. A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.
2. Pump mode selector switches shall be connected to permit manual start and manual stop of each pump individually or permit automatic operation under control of the liquid level control system. Manual operation shall override shutdown systems except motor overload and phase failure relays. Selector switches shall be oil-tight design with contacts rated NEMA A-300.
3. Pump sequence selector switch shall permit selection of automatic pump alternation, or selection of either pump to run as lead pump for each cycle. Pump alternator relay shall be electro-mechanical industrial design. Relay contacts shall be rated 10 amperes minimum at 120 volts non-inductive.
4. Override switches shall be connected to bypass the level control system and all shutdown systems supplied with it, to provide manual start and manual stop of each pump individually in the event of level control system malfunction.
5. A selector switch shall provide manual alternation of the air pumps in the bubbler system. The switch shall be connected in such a manner that either pump may be selected to operate continuously.
6. A pushbutton switch shall be provided to silence the 115-volt AC alarm circuits while corrective actions are underway. Depressing the alarm silence pushbutton shall also cause the high water alarm circuit to reset when the liquid level has been lowered.

High Pump Temperature Shutdown:

1. The control panel shall be equipped with circuitry to override the level control system and shut down the pump motor(s) when required to protect the pump from damage caused by excessive temperature.
2. A thermostat shall be mounted on each pump to detect its temperature. If the pump temperature should rise to a level that could cause pump damage, the thermostat shall cause the pump motor to shut down. A visual mechanical indicator shall indicate that the pump motor has been stopped because of a high temperature condition.
3. The pump shall remain locked out until the pump has cooled and the circuit has been manually reset. Automatic reset of such a circuit shall not be acceptable.

Elapsed Time Meters:

Six-digit elapsed time meters (non-reset type) shall be connected to each motor starter to indicate the total running time of each pump in "hours" and "tenths of hours".

Pump Start Delay:

The lag pump will be equipped with a time delay to prevent simultaneous motor starts.

Alarm Contacts:

1. Provide separate alarm contacts for the following alarm conditions:
   a. High water – normally open
   b. Phase failure – normally open
   c. High pump temperature, #1 – normally open
   d. High pump temperature, #2 – normally open
   e. Station low temperature – normally closed
   f. Pump run, #1 – normally open
   g. Pump run, #2 – normally open
   h. Dry well flood – normally open
   i. Pump run, #1 – normally closed
   j. Pump run, #2 – normally closed

Three Phase Voltage Monitor:

The control panel shall be equipped to monitor the incoming power and shut down the pump when required to protect the motor(s) from damage caused by phase-reversal, phase loss and voltage. The motor(s) shall automatically restart when power conditions return to normal.

Secondary Surge Arrestor:

The control panel shall be equipped with a surge arrestor to minimize damage to the pump motors and control from transient voltage surges. The arrestor shall utilize metal-oxide varistors encapsulated in a non-conductive housing. The arrestor shall have a current rating of 60,000 Amps and a Joule rating of 1,500.

Receptacle:

A duplex ground fault interrupter utility receptacle providing 115 VAC, 60 hertz, single-phase current shall be provided. Receptacle circuit shall be protected by a 15-ampere thermal-magnetic circuit breaker.

Auxiliary Power Transformer:

The control panel shall be equipped with a 3 KVA step-down transformer to supply 115 volt, AC, single phase for the control and auxiliary circuits. The primary side of the transformer shall be protected by a thermal-magnetic air circuit breaker, specifically sized to meet the power requirements of the transformer. A mechanical operating mechanism shall

be installed on the circuit breaker to provide a means of disconnecting power to the transformer.

The padlockable operator handle for the operating mechanism shall be located on the exterior of the control panel with interlocks which prevent opening the door until primary circuit breaker is in the "OFF" position.

**L. Wiring**

General:

1. The pump control as furnished by the manufacturer shall be completely wired except for the power feeder lines to the branch circuit breakers and final connections to remote alarm devices and between control assemblies.
2. All wiring, workmanship, and schematic wiring diagrams shall be in compliance with applicable standards and specifications set forth by the National Electric Code (NEC).
3. All user serviceable wiring shall be type MTW or THW, 600 volts, and shall be color-coded as follows:

| | | |
|---|---|---|
| a. | Line and load circuits, AC or DC power | Black |
| b. | AC control circuit less than line voltage | Red |
| c. | DC control circuit | Blue |
| d. | Interlock control circuit, from external source | Yellow |
| e. | Equipment grounding conductor | Green |
| f. | Current carrying ground | White |
| g. | Hot with circuit breaker open | Orange |

Wire Identification and Sizing:

1. Control circuit wiring inside the panel, with the exception of internal wiring of individual components, shall be 16-gauge minimum, type MTW or THW, 600 volts. Motor branch wiring shall be 10-gauge minimum.
2. Motor branch conductors and other power conductors shall not be loaded above 60-degree C temperature rating, on circuits of 100 amperes or less, nor above 75-degree C on circuits over 100 amperes. Wires shall be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be of the ring tongue type with nylon insulated shanks. All wires on the subplate shall be bundled and tied or installed in duct. All wires extending from components mounted on door shall be terminated on a terminal block mounted on the back panel. All wiring outside the panel shall be installed in conduit.

Wire Bundles:

Control conductors connecting components mounted on the enclosure door shall be bundled and tied in accordance with good commercial

practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall be allowed so that the door can swing to its full open position without undue mechanical stress or abrasion on the conductors or insulation. Bundles shall be clamped and held in place with mechanical fastening devices on each side of the hinge.

Conduit:

1. All conduit and fittings shall be UL listed.
2. Liquid tight flexible metal conduit shall be constructed of a smooth, flexible, galvanized steel core with a smooth abrasion resistant, liquid tight, polyvinyl chloride cover.
3. Conduit shall be supported in accordance with Articles 346, 347, and 350 of the National Electric Code.
4. Conduit shall be sized according to the National Electric Code.

Grounding:

The pump control manufacturer shall ground all electrical equipment to the enclosure back panel. The mounting surface of all ground connections shall have any paint removed before making final connections.

The contractor shall provide an earth driven ground connection to the control panel at the main ground lug in accordance with the National Electric Code (NEC).

**M. Level Control System**

Liquid Level Control:

1. The manufacturer of the liquid level control system must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.
2. The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.
3. The level control system shall be furnished as an air bubbler type level control system; however, it must be capable of being operated as a submersible transducer type system or ultrasonic transmitter type system.
4. The level control system shall incorporate automatic alternation to select first one pump, then the second pump, to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle.
5. The level control system shall utilize an electronic pressure switch, which shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, the electronic pressure switch shall start the motor for one pump

when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "lead pump stop level", the electronic pressure switch shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the electronic pressure switch shall start the second pump when the liquid reaches the "lag pump start level" so that both pumps are operating. These levels shall be adjustable as described below.

a. The electronic pressure switch shall include integral components to perform all pressure sensing, signal conditioning, EMI and RFI suppression, DC power supply and 120 volt outputs. Comparators shall be solid state, and shall be integrated with other components to perform as described below.

b. The electronic pressure switch shall be capable of operating on a supply voltage of 12VDC in an ambient temperature range of -10 degrees C (14 degrees F) through 55 degrees C (131 degrees F). Control range shall be 0 to 12.0 feet of water with an overall repeat accuracy of (plus/minus) 0.1 feet of water. Memory shall be
retained using a non-volatile lithium battery back-up.

c. The electronic pressure switch shall consist of the following integral components: pressure sensor, display, electronic comparators and output relays.

1) The internal pressure sensor shall be a strain gauge transducer and shall receive an input pressure from the air bubbler system. The transducer shall convert the input to a proportional electrical signal for distribution to the display and electronic comparators. The transducer output shall be filtered to prevent control response to level pulsations or surges. The transducer range shall be 0-15 PSI, temperature compensated from -40 degrees C (-40 degrees F) through 85 degrees C (185 degrees F), with a repeat accuracyof (plus/minus) 0.25% full scale about a fixed temperature. Transducer overpressure rating shall be 3 times full scale.

2) The electronic pressure switch shall incorporate a digital back lighted LCD panel display which, upon operator selection, shall indicate liquid level in the wet well, and the preset start and stop level for both lead and lag pump. The display shall include twenty (20), 0.19" high alpha-numeric characters calibrated to read out directly in feet of water, accurate to within one-tenth foot (0.1 foot), with a full-scale indication of not less than 12 feet. The display shall be easily convertible to indicate English or metric units.

3) Level adjustments shall be electronic comparator set points to control the levels at which the lead and lag pumps start and stop. Each of the level settings shall be easily adjustable with the use of membrane type switches, and

accessible to the operator without opening any cover panel on the electronic pressure switch. Controls shall be provided to permit the operator to read the selected levels on the display. Such adjustments shall not require hard wiring, the use of electronic test equipment, artificial level simulation or introduction of pressure to the electronic pressure switch.

4) Each output relay in the electronic pressure switch shall be solid state. Each relay input shall be optically isolated from its output and shall incorporate zero crossover switching to provide high immunity to electrical noise. The "ON" state of each relay shall be indicated by illumination of a light emitting diode. The output of each relay shall be individually fused providing overload and short circuit protection. Each output relay shall have an inductive load rating equivalent to one NEMA size 4 contactor. A pilot relay shall be incorporated for loads greater than a size 4 contactor.

d. The electronic pressure switch shall be equipped with an output board, which shall include LED status indicators and a connector with cable for connection to the main unit.

e. Circuit design in which application of power to the lag pump motor starter is contingent upon completion of the lead pump circuit shall not be acceptable.

f. The electronic pressure switch shall be equipped with a simulator system capable of performing system cycle testing functions.

g. The electronic pressure switch shall be capable of controlling liquid levels in either a pump up or pump down application.

h. The electronic pressure switch shall be equipped with one (1) 0-33 ft. W.C. input, one (1) scalable analog input of either 0-5VDC, 1-10VDC, or 4-20mA, and one (1) 4-20mA scalable output. Output is powered by 10VDC supply. Load resistance for 4-20mA output shall be 100-400 ohms.

i. The electronic pressure switch shall include a DC power supply to convert 120 VAC control power to 12VDC EPS power. The power supply shall be 500-mA (6W) minimum and be UL listed Class II power limited power supply.

j. The electronic pressure switch shall be contained within a NEMA 4X enclosure including a polycarbonate face and stainless steel case.

k. The electronic pressure switch shall be equipped with an electronic comparator and solid state output relay to alert maintenance personnel to a high liquid level in the wet well. An indicator, visible on the front of the control panel, shall indicate that a high wet well level exists. The alarm signal shall be maintained until the wet well level has been lowered and the circuit has been

manually reset. High water alarm shall be furnished with a dry contact wired to terminal blocks.

6. An alarm silence pushbutton and relay shall be provided to permit maintenance personnel to de-energize the audible alarm device while corrective actions are under way. After silencing the alarm device, manual reset of the alarm condition shall clear the alarm silence relay automatically. The pushbutton shall be oil tight design with contacts rated NEMA A300 minimum.

Air Bubbler System:

The level control system shall be the air bubbler type, containing air bubbler piping, which extends into the wet well. A pressure sensor contained within the electronic pressure switch shall sense the air pressure in this piping to provide wet well level signals for the remainder of the level control system.

Two vibrating reeds, industrial rated, air pumps shall be furnished to deliver free air at a rate of approximately 5 cubic feet per hour and a pressure not to exceed 7 psi. Liquid level control systems utilizing air compressors delivering greater quantities of air at higher pressures, requiring pressure-reducing valves, air storage reservoirs, and other maintenance nuisance items will not be acceptable. A selector switch shall be furnished to provide manual alternation of the air pumps. The switch shall be connected in such a manner that either pump may be selected to operate continuously. The selector switch shall be oil-tight design with contacts rated NEMA A300 minimum.

An air bell constructed of PVC 3 inches in diameter shall be provided for installation at the outlet of the air bubbler line in the wet well. The air bell shall have a 3/8" NPT tapped fitting for connection to the bubbler line.

An air flow indicator gauge shall be provided and connected to the air bubbler piping to provide a visual indication of rate of flow in standard cubic feet per hour.

## N. Independent High Water and All Stop Alarm Float

Float switches shall be mounted in the wet well and wired to the Gorman-Rupp and Bihlertech Controllers to serve as an independent high water alarm (all pumps on) and an all stop alarm (all pump off). Float switches shall be non-intrinsically safe.

## O. Examination

Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Pumping equipment manufacturer shall provide written instructions for proper handling. Immediately after off-loading, contractor shall inspect pumping equipment and appurtenances for shipping damage or missing parts.

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 manufacturers representative of any unacceptable conditions noted with shipper.

## P. Installation

Install, level, and align pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.

Suction pipe connections must be vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump system piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well.

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.

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.

After all anchor bolts, piping connections are installed, seal all openings between wet well and pump enclosure.

## Q. Protection

The pumping equipment should be placed into service soon after delivery of the equipment. If installation is delayed, the pumping equipment and motor control center shall be stored indoors, free of excessive dust, in a low humidity, heated environment.

During installation and after the pumping equipment is placed into operation the motor control center shall operate in an environment free of excessive dust, in a low humidity, heated environment.

## R. Field Quality Control

Prior to acceptance by the owner, an operational test of all pumps drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

Prior to start-up, clean wet well by removing construction debris and foreign material.

## S. Manufacturer's Pre-startup Inspection

Coordinate system pre-startup with manufacturers factory-trained service technician. The factory-trained service technician will inspect the installation and answer any installation questions by the Contractor, Engineer, or Department.

Verify that operations and maintenance manual is on site and installation instructions contained in the manual have been followed.

Verify that all pumping equipment, piping, level control system, alarms and ancillary equipment has been properly installed and all wiring is complete.

Verify that all spare parts for the pumping equipment are on site.

Pre-startup inspection shall be a separate trip and shall not be less than two weeks prior to the startup of the equipment.

## T. Manufacture's Field Performance Testing

Coordinate system start-up with manufacturers 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 Department.

Equipment startup shall be tested under both utility power and emergency power.

Contractor shall supply clear water of adequate volume to operate the system including the force main through several pumping cycles.

Observe and record operation of pumps, suction and discharge gage readings, voltage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment. Test manual and automatic control systems. Test all alarms. Report any undue noise, vibration or other operational problems.

Startup shall be a separate trip.

## U. Manufacturer's Operation and Maintenance Training

The manufacturer shall furnish the services of a qualified, factory-trained operations and maintenance serviceman to instruct and train Department's personnel in the proper care, operation and maintenance of the equipment. The training shall include, but not be limited to, the following:

1. Theory of operation
2. Actual operation
3. Mechanical maintenance
4. Hydraulic troubleshooting
5. Electrical maintenance
6. Instrumentation and level controls
7. Optimization of the system
8. Alarm circuits
9. Safe operating and working practices and operation of safety devices

One (1) training session is required. Training shall be completed after startup services have been performed. Training shall be a separate trip and shall not be less than two weeks after the startup of the equipment. Time, location, and duration of all training sessions shall be coordinated with Department's personnel.

Hands-on training and demonstrations shall use the installed equipment.

Supplier shall provide all materials for training and shall provide training manuals to all personnel being trained.

## V. Manufacturer's Equipment Re-Certification

The Contractor shall require, and cover the cost in his bid, for the manufacturer's factory-trained service technician to return to the site six (6) month's after initial startup of the equipment to perform a final re-certification of the equipment.

The re-certification shall consist of demonstrating and certifying that the equipment is meeting the performance requirements of the specifications. Equipment service technician shall perform field-testing of the equipment in the presence of the Department. Results of all field-testing shall be submitted to the Engineer and the Department.

## W. Cleaning and Housekeeping

Prior to acceptance, inspect interior and exterior of pump station for dirt, splashed material or damaged paint. Clean or repair accordingly. Remove from the job site all tools, surplus materials, scrap and debris.

## Chapter 3, Section 303

## Electrical

## III. Electrical

### A. General

The work covered by this portion of the specification shall include furnishing all labor, materials, tools, equipment and services to construct and install complete electrical systems as shown on the plans and specified herein for the sewage pumping station and the associated controls and instrumentation.

Reference shall be made to all sections of the specifications for items and materials for all trades required for a complete and functional electrical installation. The Contractor shall be responsible for coordination of all electrical equipment furnished or installed under this portion of the specification.

All electrical materials and equipment shall be furnished under this section of the specification except as specified in other sections of the specification. Certain equipment will be furnished under other sections of these specifications, but installed and wired under this section of the specifications.

### B. Electrical Scope

The Contractor shall furnish all labor, materials, electrical equipment and services to construct and install complete electrical systems as shown on the drawings and specified herein. This work shall include, but not be limited to, the following:

1. Utility Company Electrical Services
2. Standby Facilities
3. All wire and wiring materials
4. Instrumentation, alarm and controls
5. Grounding
6. Lighting and power systems including all electrical apparatus and equipment
7. Certain electrical equipment and devices furnished under other portions of the specifications
8. Receiving, handling, storing, setting and connecting all electrical equipment, machinery, devices and controls unless specifically noted otherwise.
9. All excavation, backfill, forming and concrete involved with embedded conduit

10. All anchors, inserts supports, sleeves, fasteners, conduit and equipment racks, equipment and floor steel, etc... necessary for a complete electrical Installation
11. Opening and closing all necessary floor, wall and ceiling penetrations
12. Temporary lighting and power services necessary for construction

## C. Regulations

1. Other Specifications

Any reference to other specifications shall always imply the latest edition of the specifications, at time of bidding, unless otherwise stated.

Abbreviations for various organizations issuing standards used in these specifications are as follows:

| ABBREVIATION | ORGANIZATION |
|---|---|
| IEEE | Institute of Electrical and Electronic Engineers |
| ANSI | American National Standards Institute |
| IPCEA | Insulated Power Cable Engineers Association |
| NEC | National Electric Code |
| NEMA | National Electric Manufacturers Association |
| UL | Underwriters Laboratories |
| CBM | Certified Ballast Manufacturers |
| ASME | American Society of Mechanical Engineers |
| NFPA | National Fire Protection Association |
| RLM | Reflector Lighting Manufacturers |
| IES | Illuminating Engineering Society |

2. Site Visitation

The Contractor shall visit the site of the work in order to satisfy himself as to its condition and the progress to be anticipated.

The Construction Drawings show the existing conditions and it shall be the responsibility of the Contractors to verify all conditions, distances and locations in the field. The construction schedule shall be in accordance with the schedule outlined in a previous section.

3. Permits

The Contractor shall give all necessary notices, obtain all permits and pay all costs in connection with his work, file all necessary plans and obtain all necessary approvals with the departments having jurisdiction, obtain all required certificates of inspection for his work and deliver same to the Department.

4. Materials

All materials furnished and all work installed shall comply with the applicable requirements of NEC, NEMA, IEEE, UL, and ANSI standards. All requirements of utility companies, local, state, and federal governmental departments having jurisdiction shall be supported and secured in place. All work shall be installed in first class neat workmanlike manner. All materials shall be new and protected from the elements prior to installation. The Department reserves the right to approve all electrical work, equipment, and materials.

5. Elevations

All elevations indicated on the drawings or specified refer to mean sea level, as established by the U.S. Coast and Geodetic Survey NAVD 88 survey.

6. Protection

The Contractor shall protect, at his own expense, all of his work, materials and equipment that may be liable to injury during the construction period.

Any materials, controls and devices obviously a part of the electrical systems and necessary for a complete installation and its satisfactory operation although not specifically called for in the specifications nor shown on the drawings, shall be furnished and installed by the Contractor.

All equipment shall be completely tested at the factory and meet the applicable standards of NEMA, IEEE, and ANSI requirements.

7. Service

The manufacturer of all electrical equipment, including the emergency generator, shall provide the services of a competent service engineer to provide assistance during the installation and testing and shall instruct the owner's operation and maintenance personnel in the operation and maintenance of the equipment and generator unit. Service time shall be as required for proper start-up.

It will be the responsibility of the Contractor to contact the manufacturer's representative and/or the supplying contractor, as to the alignment, direction

of rotation and condition of the machine or piece of equipment after all wiring to the unit is complete.

No unit shall be rotated, even for test, without written consent from the manufacturer's representative and/or the supplying contractor. The written consent must be given to the Contractor prior to energizing the equipment. This is to prevent injury to personnel as well as damage to the machine or unit.

## D. Conduit System

1. General

The Contractor shall furnish all labor, material and equipment necessary to install a complete coordinated raceway system as described on the drawings, including all necessary hangers, brackets and supports. Spare conduits, cleaned and plugged or capped, are required as shown on the drawings.

2. Material

All conduit and fittings shall be new, rigid, or intermediate metallic conduit. All conduits shall be hot dipped galvanized steel with a smooth protective internal coating.

3. Sizes

Conduit sizes shown on the drawings are based upon the use of the specified conductors. If there are any substitutions it shall be the contractor's responsibility to resize the associated conduit. Minimum size conduit for this project shall be ¾" except for conduit embedded in concrete or earth for which the minimum size conduit shall be one (1") inch. Where specifically noted on drawings, such as fixture pendants or mountings, ½" conduit may be used.

4. Fittings - Exposed

Conduit fittings on exposed systems shall be the cast metal, threaded hub type suitable for the wiring device to be installed. All pull boxes, junction boxes and device enclosures shall have screw covers and gaskets. Sheet metal enclosures shall be of code gage steel without knockouts and have all seams welded closed. Conduit entrance to these boxes shall be by means of threaded and gasketed hubs with insulated throat. Rigid conduit shall be connected with galvanized conduit couplings or threaded galvanized electrical conduit unions only.

5. Boxes

Where junction or pull boxes of unusual proportion or size are noted on the drawings, they shall be fabricated according to the latest edition of the NEC, be of code gauge steel, have all seams tight and shall be screw covered and gasketed. All pull or junction box covers shall be permanently fastened to the box by means of a chain welded to both the box and the cover. Chain shall be of sufficient strength to adequately support the cover.

6. Installation

The conduit shall be installed in accordance with the manufacturer's instructions and the applicable provisions of the NEC by qualified and experienced personnel to assure a safe, neat and functional system.

Conduit shall be supported by approved hangers, brackets or other devices specifically designed and constructed for this purpose. Spacing between conduit supports shall be no more than eight (8') feet and all conduits shall be supported within three (3') feet of every box, cabinet, fixture or other terminating enclosure.

Hangers shall be fabricated of durable material suitable for the application involved. The use of perforated strap for conduit support will not be permitted. Support brackets and hangers shall be of sufficient strength and size to adequately support the conduit load including cables. Vertical conduits shall be fastened to supports by means of U bolts.

Field bends shall be made only with approved hickey or hydraulic bending machine and shall be of sufficient radius that conduit will not be flattened, distorted or have the interior or exterior coatings damaged. The use of heat to facilitate bending will not be permitted.

Exposed conduit shall be installed with a minimum number of joints and shall be run parallel or perpendicular to building column lines. Multiple conduit runs shall be straight and parallel; offsets shall be uniform and symmetrical. Insofar as practical, conduit runs shall be as shown on the drawings. Minor deviations may be made to avoid interference with other trades or with openings or passageways as directed by the engineer.

All threaded conduits must be wrench tight and correctly aligned to provide a sound electrically continuous conduit system.

Embedded conduit shall be encased in concrete envelopes which shall have three (3") inch minimum dimensions between conduit and earth. Where embedded conduit passes under roadways the concrete envelope shall be reinforced per typical detail on drawings.

All embedded conduit shall be plugged or capped before pouring concrete envelopes and backfilling. These plugs or caps shall remain in place until

conduit is ready for cleaning prior to cable installation. All excavation, concrete, and backfill for concrete envelopes shall be the responsibility of the contractor.

All conduits shall be free of foreign materials, thoroughly swabbed and lubricated before installation of wire or cable. All conduit shall be identified with non-ferrous metallic tags on which the conduit number, as obtained from the conduit schedule, has been permanently embossed.

Where conduits terminate in sheet metal, NEMA 1 enclosures, double locknuts, and insulated bushings shall be used.

All conduit connections to motors or equipment having an appreciable amount of vibration shall be made with liquid tight, flexible steel conduit. Flexible liquid tight conduit shall be used only with approved connectors and flexible connections shall not exceed twenty-four (24") inches in length.

The conduit shall be furnished in standard ten (10') foot lengths complete with thread protectors. Condulets shall be furnished with stainless steel fasteners or screws to provide for accessibility.

All conduit installed in the wet wells shall be installed according to requirements of the NEC for Class 1, and Division 1, Group D Hazardous Installation. All fixtures and devices installed in this area shall be approved by the Underwriters' Laboratories for Class 1, Division 1, Group D installation.

## E. Conductors

1. General

The Contractor shall furnish all labor, material, and equipment necessary to install all conductors as shown on the drawings, or called for in this specification. The sizes of individual conductors shall be indicated on the drawings.

2. Material

All wire and cable shall be new, standard, and conform to the applicable requirements of NEC, IPCEA, the Utility Company, and the Local, State, and Federal Departments having jurisdiction. Conductor insulation shall be type THW, rated for 600 volts and 75 degrees C or equal.

Conductors, when used for control, instrumentation, lighting and receptacles shall be stranded copper and conform to, or exceed requirements or ICPEA, NEMA, and NEC. Grounding conductors, when laid in earth or run bare within two (2") inches of masonry type construction, shall be copper.

3. Size

Wire sizes shall be shown on the drawings. All wire will be tagged or marked with the appropriate wire and circuit numbers as determined from the diagrams. Minimum wire size shall be #12 AWG.

4. Installation

Conductors shall be installed in a manner which will not injure their insulation or covering. Raceways shall be complete before any wire is installed. Only pulling lubricants approved for this purpose shall be used.

All connections shall be made with either bolted pressure type or high compression crimp-on type terminations. Solder connections will not be permitted.

All conductors shall be continuous from origin to panel or equipment termination with no splices in intermediate pull or junction boxes unless specifically shown on the drawings.

Running splices in conduit or tray are not acceptable. Each wire shall be permanently marked with the appropriate wire number. Each conductor group shall be identified with a fibrous tag embossed with the appropriate circuit number.

## F. Lighting System

1. General

The Contractor shall furnish and install a complete lighting system as shown on the drawings and as described herein.

2. Lighting Fixtures

All lighting fixtures shall be as outlined in the fixture schedule shown on the drawings. The fixtures and lamps shall be installed as shown on the drawings, in place, wired, connected, tested, and left in satisfactory operating conditions. Fluorescent lighting fixtures shall utilize either T8 or T5 bulbs.

3. Outlet, switch, and junction box

Outlet, switch and junction boxes shall be of the type and size as required at locations shown on the drawing. The boxes shall be secured firmly in place and set true and square with the finished surface.

Where required, boxes for light outlets shall be provided with fixture studs of a size suitable for the weight of this fixture to be supported. Studs shall be an integral part of the box.

Outlet boxes for exterior lights subject to the weather shall be cast aluminum with gasketed covers.

Type FS cast boxes shall be used for all surface mounted switches and convenience outlets.

Junction and splice boxes shall be made of code gauge galvanized steel without knockouts and sized in accordance with standards set forth in the National Electric Code. Covers shall be of the screw-on and gasketed type.

4. Switches and convenience outlets

All switches and for-control of branch circuit lighting shall be heavy duty, toggle type, rated at 20 amperes, 120 volt AC unless otherwise specifically noted herein.

Switches shall be single pole, three-way, or four-way as shown on the drawings.

Receptacles shall be duplex, 3-wire, grounding type, rated at 20 amperes, 120 volt AC unless noted otherwise.

All receptacles and switch cover plates shall be metal with a clear, anodized aluminum finish except where a weatherproof device is indicated. Weatherproof cover plates for receptacles shall be equipped with hinged gasketed lids.

Special receptacles for use in hazardous areas such as wet well area shall be explosion proof type for Class I, group D locations.

5. Standard Occupancy & Vacancy Light Switch Controls
   a. Occupancy sensors provide up to 150 degree field of view and 900 sq. ft. of major motion coverage.
   b. Vacancy sensors provide up to to 180 degree field of view and 450 sq. ft. of major motion coverage.
   c. Selectable time delay of 5 seconds to 20 minutes for lights to remain on after room is vacated.
   d. Occupancy sensor provides a selectable ambient light override preventing lights from switching ON when there is acceptable natural light.
   e. Occupancy sensor version allows to toggle between Auto-On/Auto-OFF or manual ON/Auto-OFF mode.

f. Occupancy sensor provides for a bypass feature to allow the sensor to perform as a traditional switch (Manual ON/Manual OFF).
g. Walk-in-delay feature allows sensor to turn lights off without time delay when motion detected briefly in room.
h. Electrostatic discharge protection.
i. No leakage to load in off mode.
j. Switch shall be a Cooper Wiring VSIRO4W or approved equal.

## G. Panel Boards

1. General

Furnish and install, where shown on the drawings, panel boards for control of light and power circuits. Panels shall be dead front with protective devices of the number, rating, and type shown on the drawings. Panels shall be NEMA 1 general purpose enclosures and shall be surface mounted. Panels shall be rated 120-240 volts, 1 phase, 60 hertz or 120Y-208 volts, 3 phase, 4 wire as shown on the drawings.

All panels shall be rated in accordance with the Underwriters' Laboratories, Inc., standards for cabinets and boxes and shall be so labeled. Panels shall also comply with NEMA standards and the national Electric Code.

All panel interiors shall be completely factory assembled with the specified protective devices, wire connectors, and terminals for copper or aluminum conductors of the sizes indicated.

Panel interiors shall be designed so that protective devices can be replaced without disturbing adjacent units and without removing the main bus connections.

Branch circuits shall be arranged using double row construction as shown on the drawings. Each panel shall have a name plate, which shall include panel type, number, and size of protective devices.

Bus bars shall be plated aluminum sized in accordance with Underwriters' Laboratories standards. Neutral shall be full-size, and have a suitable lug for each outgoing feeder requiring a neutral connection. The ground bus shall NOT be connected to the insulated neutral bus.

Boxes shall be made of unpainted galvanized code gauge steel having multiple knockouts except where noted. The boxes shall have a minimum gutter space of four 4" inches on all sides where main feeder cables supplying a panel are carried through the box, to supply other panels, the box shall be so sized as to include this wiring space, which shall be in addition to the minimum gutter space required by code.

The box shall be provided with at least four (4) interior mounting studs. The box identification number shall be on the box.

2. Box Trim

On all lighting panels the front shall include door and have flush, brushed stainless steel, cylinder tumbler type locks with catches and spring loaded door pulls. The flush lock shall not protrude beyond the front of the door. All panel locks shall be keyed alike, two (2) for each panel shall be furnished. A typed circuit directory frame and card shall be provided on the inside of the door. All panels shall be similar in appearance. All trims shall be painted to match the surrounding décor.

All panels for lighting or power shall be the circuit breaker type and rate 100% for continuous duty.

3. Panels – Surface type

Lighting and/or receptacles, all must be 100% rated, factory assembled with fastrim fronts and minimum size cabinet gutters. Boxes to be code gauge galvanized steel with knockouts. All with main circuit breakers and bus sized as shown on drawings. Main breaker to be at top of panel. The panels shall be:

a. 120/240 Volt AC 10,000 A.I.C.
Singe Phase, 3 Wire, 60 Hertz
Branch Breakers – 1 Pole or 2 Pole – Rating
And number of Breakers as shown on the drawings

b. 120/208 Volts AC 10,000 A.I.C.
Three Phase, 4 Wire, 60 Hertz
Branch Breakers – 1 Pole, 2 Pole, or 3 Pole - Rating
And number of Breakers as shown on the drawings

Panels shall be, Square D or approved equal.

## H. Vendor's Drawings

1. Installation

Manufacturer's (Vendor's) drawings shall be submitted for approval. Vendor's drawings or Catalog Data Sheets shall be submitted for the following equipment by this Contractor:

a. Emergency Generators

b. Lighting Fixtures

b. Panel Boards

c. Automatic Transfer Switches

d. Conduit and Wire

e. Ground Rods

f. Service Circuit Breakers

2. Wiring

The Contractor shall also be responsible for furnishing wiring diagrams for all equipment whether supplied by him or by other contractors. These wiring diagrams shall be furnished for the following categories:

a. Elementary or schematic wiring diagrams which show the complete scheme or logic for all equipment other than covered on the schematic wiring provided by the engineer.

b. Connection wiring diagrams which show all wiring between terminals and devices located within the equipment.

c. Interconnection wiring diagrams which show the wiring between terminal boards, connection points, studs, etc...and all remote devices. These drawings shall indicate the cable numbers as shown on the cable schedules, issued as part of this specification.

3. Type of Drawings Acceptable

a. Reproducible drawings of elementary and connection wiring diagrams of the type normally furnished by the equipment suppliers shall be considered acceptable. Prints of these drawings shall be submitted to the Department for approval, and it shall be the responsibility of the contractor to make or have made all additions or corrections. Any necessary revision to these drawings as a result of field changes shall be given to the Department at the time of plant acceptance by the owner.

b. Interconnection diagrams shall be furnished by the Contractor on suitable, or Mylar. The size of the drawings shall be 24" X 36" and shall contain all information as previously specified. Prints of the drawings shall be submitted to the Department for approval and they shall be maintained in "As Built" condition at all times. The original reproducible will be given to the Department at the time of plant acceptance by the Department.

The above drawing requirements apply, but are not necessarily limited to the following equipment in the plant:

1. Standby Facilities
2. Automatic Transfer Switches

## I. Tests

The Contractor shall notify the Department, in writing, when the electrical installation is complete and ready for acceptance and test. These tests shall be made by the Contractor in the presence of the engineer to determine whether the installation complies with the specification and drawings.

To prevent injury to personnel and damage to equipment, no equipment should be tested until it is approved by the Contractor.

The Contractor shall furnish all lubricating oils, greases, etc...for the rotating equipment and machinery installed by any contractor.

The Contractor shall furnish all labor and supervision, necessary to properly lubricate all machinery, equipment, and rotating units installed by him.

It shall be the duty of the Contractor to obtain proper written certification from the general contractor that all driven equipment (coupled to motors) and not a part of the Contractor's work, shall have been lubricated and in running condition before tests are made.

All equipment, motors, control centers, and wiring must be tested for proper phasing, motor, and equipment rotation. Power continuity of circuitry grounding, lighting, and switching shall also be tested.

The Contractor shall at once remedy any and all noted defects. After defects are corrected, the Contractor shall make any additional tests that may be required. Testing shall be furnished by the Contractor. The entire installation shall have an insulation resistance in accordance with the requirements and recommendations of the national electric code.

## J. Guarantee

All electrical equipment, wiring, fixtures, and control must be guaranteed, new and of the latest design. All wiring, materials, and workmanship shall be guaranteed for a period of one year after acceptance as detailed in the general and special conditions unless noted otherwise in these specifications.

## K. Louvers

Electrically closed, spring opened louvers shall be furnished and installed under other sections of these specifications. The Contractor shall under this section of the specifications furnish, install and connect the required conduit and cable to connect the louvers where and as shown on the drawings.

## L. Standby Facilities

1. Scope

The Contractor shall furnish, install and connect, where shown on the drawings, complete diesel engine driven generator set. Each engine generator set shall consist of but not be limited to the following:

1 - Engine
1 - Generator
1 – Automatic start and transfer panel complete with battery and battery charger

The entire assembly of engine, generator and transfer switch shall be the products of a single supplier.

Each engine generator set shall be sized as shown on the drawings or as specified and rated at 80% power factor. Each set shall be capable of supplying the rated load with no more than 50 degrees centigrade rise above 40 degrees centigrade ambient.

Each engine generator set shall be mounted on a welded steel base which shall be mounted on vibration isolators. Steel base design shall permit installation of the unit on any level surface. Vibration isolators shall be sized and furnished by generator set manufacturer for installation by the Contractor.

The equipment will automatically start the set upon power failure and then transfer the load to the generator. After return of power the equipment will automatically transfer the load back to the normal power source. However, in the event power outage is less than 30 minutes, time delay shall be provided to allow load to remain on generator set for 30 minutes before transferring back to normal power. An emergency stop switch must also be provided for mounting at generator control panel. Each engine generator set must be capable of assuming the required load in the following sequence:

a. Control Power, Lighting, heating, ventilation, and building power

b. All Raw Sewage Pumps. Sized as follows:

RVNR starting is accomplished by means of auto transformer type starters connected on the 65% Tap.

2. Engine Construction

Each unit shall be constructed, arranged, and guarded to minimize the danger of accidents to operating or maintenance personnel. Contact with hot components or rotating parts shall be prevented.

Lubrication shall be by means of gear type oil pumps providing full positive oil pressure lubrication to bearings. Engines shall be furnished with oil pressure gauge, oil filter, oil cooler, high water temperature cut-off, high oil temperature cut-off, block heater and all other equipment necessary for satisfactory operation. All gauges and indicators shall be located on front of unit mounted control panel.

3. Each engine shall be provided with a hydraulic or electric governor capable of maintaining generator output frequency between 58 and 62 Hertz from no load to 110% load. A trickle charger shall be provided for each battery.

4. Engine Cooling

Engine shall be supplied with a unit mounted, radiator type, cooling system where required or specified. Each cooling system shall include a radiator cooling fan, suitable circulating water pump, water temperature thermostat control and high water temperature cut-off.

Cooling system shall be capable of maintaining proper engine temperature under rated load at 80% power failure and 40 degrees centigrade ambient temperature.

Each radiator and engine cooling system shall be filled with a solution of 50% Ethylene Glycol.

All radiators shall be equipped with a one (1") inch wide duct adapter flange and fire resistant, flexible neoprene collar suitable for connection to exhaust air duct which will not restrict the flow of air through the radiator core.

Where required or specified, engine generator set shall be supplied and arranged with the proper fans and shrouds for direct air cooling, as contract design.

5. Fuel System

Engine shall be diesel fueled, spark ignition, with appropriate number of single action cylinders. Each engine shall be equipped with reliable lube oil

cooler, fuel regulator, and any attachment required for continued, dependable operation. Flexible fuel connections shall be provided with each engine.

Diesel fueled generator set shall be installed at pump station site.

6. Weather Housing

Each stationary generator set shall be protected from rain, snow, and sleet.

a. Rust-inhibiting primer protects the inside and outside surfaces of these rugged 14 to 18 gauge steel construction weather housings. The weather housing outside surface has a top coat of Kohler cream beige and black enamel. Field-installed kits shipped with electro-coat gray primer.

b. Easy-to-remove side panels allow convenient access for generator set service. Lockable latch panels prevent tampering. The skid end cap kit protects the generator set from weather and deters entry by animals.

c. Louvers at the generator and radiator ends supply ample cooling air flow, elimination the need to remove the side panels for additional air circulation.

d. Weather housing shall include a silencer mounting kit for mounting the silencer on top of the weather housing.

7. Generators

Each generator shall be rated as shown on the drawings at 80% power factor, with Class F insulation but sized for 80 degree Centigrade temperature rise above 40 degree Centigrade Ambient on continuous duty. Each generator shall be close coupled to a diesel engine and housed in drip proof enclosure. Each generator shall be equipped with a brushless type exciter and solid state voltage regulator capable of plus or minus one (1%) percent regulation and commercial grade radio frequency suppression. Generators shall be capable of supplying the loads specified previously with no more than twenty (20%) percent voltage drop anywhere on the loading curve. The loads shall be applied to the generator in sequence as specified.

8. Generator Auxiliaries

Each generator voltage regulator and voltage adjusting Rheostat shall be housed in the unit mounted control panel. Each Rheostat shall be capable of adjusting voltage plus or minus five (5%) percent of rated voltage.

Each generator shall be equipped with a factory installed engine block heater.

Each generator shall be equipped with a sub-base fuel tank. The fuel tank shall have a UL 142 listed double-wall construction equipped with fuel level gauge, low level alarm, and fuel-in-rupture-basin-alarm. Each fuel tank shall have a minimum capacity equal to that required to operate the generator for 24 hours under maximum loading.

9. Control and Starting Panel

The Contractor shall furnish, install and connect one (1) unit mounted control and starting panel complete, for the generator set. Each panel shall house all instruments or meters called for in the specifications, shown on the drawings or necessary for the proper, and satisfactory automatic operation of the standby generator unit as specified unless noted otherwise.

Each control and starting panel shall be unit mounted and shall contain the following instruments, controls or devices:

a. Oil Pressure Gauge

b. Water Temperature Gauge, where applicable

c. Low Oil Pressure Shut-Down and Indicating Light

d. High Water Temperature Shut-Down and Indicating Light, where applicable

e. Over-speed Shut-Down and Indicating Light

f. Manual Start and Stop Switches

g. Automatic Battery Charging Control and Charging Current Ampmeter

h. All Devices and Timers necessary for automatic starting of engine upon loss of normal power.

i. Automatic Shut-Down Timer to shut down engine if engine does not start after three twenty (20) second cranking cycles and Indicating Light

j. Device to provide positive protection against engaging starting motor while engine is turning

k. A 6-Digit Elapsed Time Meter graduated in Hours and Tenths of Hours

l. Two (2) Isolated Contacts shall be provided for Remote Alarm if generator should shut down for any reason when called on to operate

10. Exhaust System

a. Critical grade silencer will be mounted on the roof of the outdoor enclosure.

b. All exhaust connections will be completed prior to shipment to the job site, unless shipping height prohibits it.

c. Exhaust outlets shall be equipped with tail pipe and rain cap.

11. Tests & Warranty

All equipment furnished under this section shall be guaranteed against defective parts and workmanship for a period of eighteen (18) months from date of shipment or one (1) year from date of field testing and acceptance by the owner, whichever comes last.

Each electric generator set shall receive the manufacturer's standard testing. Prior to acceptance of installation, the complete unit shall be subjected to full load test for two (2) hours. The Contractor shall be responsible for furnishing all necessary equipment to load test the generators including load banks, temporary cables and other required equipment. Any defects which become evident during test shall be corrected at no expense to owner.

On completion of the factor authorized installation, each initial startup shall be performed by a factory trained representative of the generator set manufacturer. At the time of startup, operating instructions and maintenance procedures shall be thoroughly explained to owner's operating personnel. Six (6) copies of operating and maintenance instructions shall be supplied for each generator set and its auxiliary equipment.

The generator set shall be as manufactured by Kohler, or approved equal, sized and located according to the following:

| LOCATION | MODEL # |
|---|---|
| AS PER CONTRACT DESIGN | |

The Contractor shall furnish a listing showing manufacturer's Model Number, overall dimensions and weight for each electric set and auxiliary equipment.

## M. Automatic Transfer Switch

1. Scope

The Contractor shall provide and install, where shown on the drawings, six 3-Phase and one single-phase fully rated automatic transfer switches capable of protecting both inductive and resistive loads from loss of continuity of power. Each switch shall be sized as shown on the drawings. Each switch shall provide complete protection (loss of any one phase shall initiate transfer from normal to emergency power) and be rated as shown on the drawings, on

normal power. Each switch shall be enclosed and rated for all classes of loads without de-rating.

Each switch shall automatically transfer the load circuit to an emergency power supply upon failure of its normal supply. Upon restoration of the normal supply, each switch shall automatically re-transfer its load circuit to the normal supply and then initiate shut down of the emergency generator set.

2. Mechanism

Each common transfer mechanism shall be electrically operated by a single BI-Directional motor, with all parts in positive contact at all times. It shall be capable of being operated manually. Each transfer switch shall be mechanically and electrically interlocked so that it shall not be possible for load circuits to be connected to normal and emergency sources simultaneously, regardless of whether switch is electrically or manually operated, or if any part should malfunction.

3. Protection

Close differential voltage sensing relays shall be provided to monitor each phase of the normal supply. A drop in voltage in any phase below 70% shall initiate transfer of load. The relays shall initiate retransfer of load to the normal supply as soon as the voltage is restored in all phases, to 90% of rated voltage.

The voltage sensing relays shall be of the completely solid state type and have temper proof field adjustable pick-up and drop out valves.

Each transfer switch shall obtain its operating current from the source to which the load is being transferred.

4. Accessories

All accessories and equipment shall be front mounted. All pilot devices or relays shall be industrial type, rated for 10 amperes, with self-cleaning contacts. Components of operating mechanism shall be electrically installed during transfer.

The following accessories in addition to standard equipment shall be supplied as part of each automatic transfer switch:

a. Time Delay normal to emergency adjustable 0.2 seconds to 60 seconds.

b. Time Delay emergency to normal adjustable motor driven 0-30 minutes.

c. Time Delay engine cool-off adjustable motor driven 0-30 minutes.

d. Frequency Relay-Prevent transfer until generator has reached operating speed.

e. Four (4) position Selector switch – "Off", "Test", "Auto", and "Engine Start".

f. Provision for Remote Pilot Lights – Green (normal), Red (emergency).

g. Contractors shall be "Below On" type.

h. Overlapped, switched neutral.

i. Plant Exerciser to run engine once a week, under load, without interrupting utility company service.

j. Programmed transition On Transfer and Retransfer to provide variable Time Delay with load connected to neither source.

k. Two-position Selector Switch with "Hand-Auto" nameplate for control of Generator Inlet Louver. In hand position louver will open. In "Auto" position louver will be closed unless generator is running.

l. Two (2) isolated contacts which will close on generator set failure for use on Alarm System.

m. Time Delay Engine start adjustable 0.2 second to 60 seconds.

n. Two (2) isolated normally open contacts for remote indication of power failure.

o. Front panel mount Red and Green pilot Lights.

5. Arrangement

Each transfer switch shall be housed in a NEMA 1 enclosure arranged for wall mounting and shall contain all accessories and devices listed above. Each transfer switch shall be series OT as manufactured by Onan Company or Russelectric Inc. or approved equal.

## N. Heating

The Contractor shall furnish and install complete one 5 kw electric suspension heater.

Each heater shall be a complete self contained unit complete with integral thermostat, fan, motor assembly and contactor for heating element. Control voltage for all heaters shall be 120 volts, single phase. An optical "Fan Only" switch shall be built into the electric suspension heater.

Each heater shall include a cast aluminum heating grid and shall be manufactured by Qmark.

The electrical work required for the electric heaters shall be covered under this section of these specifications.

## O. Service Entrance

The electrical supply voltage for each pump station shall be 3-phase, 4-wire, 277Y/480 Volts, or 120/240 Volts single-phase 60 cycles, or as shown on the drawings. The service entrance for the diesel generator stations, as well as the main feed to each respective pump station, shall be as shown on the drawings.

In addition to the phase conductors, the service entrance shall include a grounded conductor connected to the utility company service at the pole and the ground bar in the main service entrance switch in the diesel station building.

The installation shall meet NEC and Potomac Edison Power Company requirements. It shall be the responsibility of the Contractor to coordinate the service entrance installation with the utility company. For information contact Potomac Edison Power Company, Hagerstown, Maryland.

There shall be furnished, installed, and connected on the line side of each service entrance disconnect, one (1) each, low voltage lightning arrestor at the Pumping Stations. Where required the 3-phase, 4-wire, or single-phase, 4-wire lightning arrestors, shall be Westinghouse type MV Catalog # 632A392A01, or equal.

The Contractor shall include in his bid all fees, aid to construction and other charges levied by Potomac Edison Company for providing electric service.

## P. Grounding

A complete grounding system shall be installed in accordance with these specifications, the applicable drawings, and in accordance with provisions of the National Electric Code.

1. Equipment Grounds

   Conductor enclosures, structures, motors, equipment, generators, transformers, switch gear, panels, motor control centers, and portable equipment shall be adequately grounded for both normal and fault current.

   Equipment ground conductor shall be connected by bolting to the motor terminal box and the other end shall connect to the ground bus in the motor control center.

   Although neutral conductors are grounded at the source they shall not be used for equipment grounding.

Equipment grounding conductors, if insulated, shall be identified with green color code as specified by the National Electric Code. Care must be taken that only the green conductor is connected to the parts to be grounded.

All branch circuits for receptacles shall include a grounding conductor to provide effective grounding for the receptacle and cord connectors.

Where ground cables are run underground, they shall be laid with a reasonable amount of slack to reduce the possibility of breakage.

All ground conductors shall be made of copper.

## Q. Temporary Electrical Power

During the entire construction period, from date of ground breaking until accepted by the Department, the Contractor shall under this portion of the specifications, provide any and all temporary construction and/or maintenance electrical power required by the project to maintain all equipment properly until accepted by the Department.

Any damage to Pump Station equipment because sump pumps or dehumidifiers or other devices are not connected to electrical power because permanent electric is not on the site will be repaired or replaced, by the Contractor, at no cost to the Department.

## R. Service Entrance Breakers

Furnish, install, and connect 600 Volt 3-pole thermal magnetic, molded case circuit breaker, where and as shown on the drawings or as required. Circuit breaker shall be sized as shown on the drawing and rated 30,000 RMS amperes interrupting capacity. The breaker shall be U.L. listed for service entrance equipment, meet NEC and NEMS standards, and shall meet Federal Specification W-C-375A.

The Contractor shall furnish, install and connect 3-pole service entrance circuit breakers and pole service entrance circuit breaker as shown on the drawings or as required. The circuit breakers shall be rated for 10,000 symmetrical A.T.C. at 240 volts. The circuit breakers shall be rated as shown on the drawings.

Circuit breaker enclosures shall be NEMA 1A, for surface mounting and shall be furnished with provisions for surface mounting and shall be furnished with provisions for three (3) padlocks in the off position. Circuit breakers shall have dual interlocks to prevent unauthorized opening of the breaker door in the "ON" position or closing the breaker with the door open. Defector mechanism shall be provided to allow intentional opening of doors with breakers closed or intentionally closing breakers with doors open.

In addition, each service entrance breaker shall be supplied with a U.L. approved lightning arrestor rated at 480 volts or 240 volts as required and suitable for use on services as rated on the drawings, Westinghouse Type MV, or General Electric, or approved equal. Lightning arrestor shall be installed on line side of service entrance breaker.

U.L. listed line and load terminals shall be provided on the circuit breaker for cables as shown on drawings. Service entrance breaker shall be provided with insulated groundable neutral bar.

A 4" X 3" nameplate with ¾" letters shall be mounted on enclosure door reading:

**SERVICE ENTRANCE BREAKER**

**S. Emergency Generator Breakers**

Furnish, install, and connect complete 3-480 Volt, 3-pole, 1-240 Volt, 2-pole and 3-600 Volt, 3-pole thermal magnetic molded case circuit breakers in NEMA 1 enclosures for surface mounting where and as shown on the drawings. The circuit breakers shall meet Federal Specifications W-C-375A.

Emergency generator breakers shall be provided with insulated solid neutral bar. Line and load lugs shall be suitable for use with copper cables as shown on drawings. Neutral bars shall have lugs suitable for conductors as shown on the drawings. Circuit breakers interrupting capacity shall be sized to handle the maximum short circuit available from the generators plus the full load current of raw sewage pump motors. Circuit breakers shall have their continuous rating as shown or as recommended by the generator set manufacturer.

**T. Comminutor**

Comminutors shall be supplied and installed where and as shown on the drawings, as specified in another section of these specifications. Combination magnetic starters shall be supplied, installed and connected where and as shown on the drawings, under this section. Each combination starter shall be NEMS size one with motor circuit protector (MCP) type molded case circuit breakers in NEMA 1 enclosure. Overload heaters, one (1) for each power conductor, shall be sized from motor nameplate full load amps. Starters will be for use on 277V/480. Control voltage shall be 120 Volts. Momentary contact Stop-Start push buttons, hand-off-auto selector switch and Red and Greed indicating lights shall be supplied in cover of each starter. Stop-Start push buttons shall be connected in "hand" side of selector switch. Overload reset push button shall extend through cover. Defeatable interlocks to prevent opening or closing door with circuit breaker closed or closing breaker with door open shall be provided. Circuit breaker shall be capable of being pad locked in Open or Closed

position. Comminutor and associated devices shall be connected as shown on the drawings.

## U. Alarm status System

Under this portion of these specifications the Contractor shall furnish, install and connect the pump station into an alarm status reporting system, as specified by the Department.

The following alarm functions shall be monitored:

1. Pump Failure
2. Seal Water Failure
3. Station Flooding
4. Comminutor Failure
5. Normal Power Fail
6. Stand By Power Fail
7. Check Valve Failure
8. High Wet Well Level
9. Low Wet Well Level

In the pump station building the Contractor shall furnish and install a station flooding sensor. The station flooding sensor shall consist of a sonic type level switch which shall output a high frequency sonic signal from its probe mounted 1" above the pump station floor. A ½" depth of water buildup on the pump station floor will cause an interruption of the sonic signal which will in turn open a contact contained within the sensor. The sensor contact will be inter-wired with the RTU. Opening of the contact will trigger a station flooding alarm.

## V. Pump Station Control Panels

Pump station control panel for pump station shall be furnished under other sections of the specifications. The Contractor shall, under this section of the specifications, install and connect the control panel where and as shown on the drawings.

## W. Electrical Outlets

One double electrical outlet shall be installed on the interior of every wall within the pump station building. In addition to the internal electrical outlets, an outlet shall be placed on the exterior of the building adjacent to the entrance door.

**300-001**
**Wastewater Pump Station**

## A. Description

1. This Section includes requirements for upgrades to the duplex pumping system at the Farm Lane Pump Station. Pump station direction included in this specification shall supersede the Washington County Department of Water Quality (DWQ) Standard Specification Section related to Wastewater Pump Stations.

2. This section also includes requirements for a duplex pumping system with fiberglass enclosure at the Maugansville Road Pump Station and New Regional Pump Station. Pump station direction included in this specification shall supersede the DWQ Standard Specification Section related to Wastewater Pump Stations. CONTRACTOR shall furnish one factory built above ground duplex pumping system in a fiberglass-reinforced enclosure. The station shall be complete with all equipment specified herein factory installed in a fiberglass-reinforced polyester resin enclosure.

3. Submittals

   a. Product Data: Prior to fabrication, submit the following to the ENGINEER for approval:

      (1) Shop drawings providing layout of the mechanical equipment and anchor bolt locations, and indicating the use of Unified National Standard bolts and fasteners.

      (2) Electrical ladder logic drawings illustrating motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.

      (3) Catalog cut sheets for major items of equipment, materials of construction, major dimensions, motor and v-belt drive data, pump characteristics curves showing design duty point capacity (GPM), head (FT), net positive suction head (NPSHR) if applicable, and hydraulic brake horsepower.

      (4) Pump Manufacturer's v-belt drive selection calculation summary sheet showing corrected H.P. Per Belt, total H.P. developed, pitch diameter of sheaves, center distance between driver and driven shafts and combined arc-length correction factor applied to theoretical horsepower transmission per v-belt, and all calculations to demonstrate a minimum Safety Factor of 1.5.

(5) Certified dimensional drawings indicating size, locations and the spherical solids passing capability of the primary recirculation port.

(6) Pre-startup checklist to be completed by the CONTRACTOR prior to pre-startup inspection.

(7) Sample of service agreement and service agreement checklist for the specified equipment.

(8) Letter from pump manufacturer certifying that the pump(s), exclusive of the motor, base, drive, controls, or other associated components are constructed with cast iron, ductile iron, and steel that has been mined, melted, cast, machined, and assembled in the United States.

(9) Copy of certificate with course I.D. number for pump manufacturer's Wastewater Operator training Program in Pump Maintenance and Troubleshooting course that counts toward Maryland continuing education unit requirements.

b. Certified Tests: Prior to shipment of the equipment from the pump manufacturer's facility, submit the following certified tests to the ENGINEER for approval.

(1) Certified copies of factory run pump performance tests.

(a) For suction lift pumps, tests shall be conducted in accordance with Hydraulic Institute Standards 14.6.3.4 Acceptance Grade 2B, or 14.6.3.4.1 for input power below 13 HP, at the specified head, capacity, rated speed and horsepower

(b) For submersible pumps, tests shall be conducted in accordance with Hydraulic Institute Standards 11.6-2012 Acceptance Grade 2B.

(c) The performance tests will validate the performance of the equipment at the design head, capacity and speed.

(2) Certified reprime performance test data in accordance with procedures herein specified (for suction lift pumps only).

(3) Certified copies of air release valve closure performance test.

(4) Tests shall be certified by a registered professional engineer.

c. Certified System Performance Tests: All components, including the pumps, motors, and controls, will be tested as a complete working system at the pump manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head, capacity, rated speed and horsepower. Factory operational tests shall simulate actual performance anticipated. Submit certified test data to the ENGINEER for review and approval.

d. Operation and Maintenance Manuals:

(1) Operation shall be in accordance with written instructions provided by the pump system manufacturer. Comprehensive instructions supplied at the time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.

(2) Documentation shall be specific to the pumping equipment supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall system design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum.

(a) Functional description of each major component, complete with operating instructions.

(b) Instructions for operating pumps and pump controls in all modes of operation.

(c) Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.

(d) Support data for commercially available components not produced by the system manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.

(e) Electrical schematic diagram of the pump control circuits shall be in accordance with branch, control, and alarm

system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the system operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of overall system diagram.

(f) Mechanical layout drawing of the pumping equipment and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.

(3) Operation and maintenance instructions, which rely on vendor cut-sheets and literature, which include general configurations, or require operating personnel to selectively read portions of a manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

e. Manufacturer's Field Performance Test Report: The manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, instruct operating personnel in the proper operation and maintenance of the equipment. A written report covering the equipment startup shall be mailed from the manufacturer's startup technician directly to the COUNTY and ENGINEER. At a minimum, the report shall include:

(1) Nameplate information.

(2) Recordings of gauge readings, static discharge head, and total dynamic head for each pump.

(3) Recordings of operating speed for each pump, measured with a tachometer.

(4) Recordings of level control settings

(5) Certification that equipment has been properly installed and lubricated and is in accurate alignment.

(6) For suction lift pumps, certification that the v-belt drive system has been properly aligned using a laser alignment instrument and that v-belts have been tensioned using a belt tensioning instrument.

(7) Results of electrical test include voltage readings and amperage readings of all motors.

(8) Certification that the equipment has been operated fully loaded and that it operated satisfactorily.

(9) Outline in detail any deficiencies noted, and proposed remedial corrections.

(10) Confirm proper installation and operation of telephone dialer including actual tripping of each alarm input device, telephone reception, message programming, call out list, proper wiring, and instruction of operating personnel.

(11) Confirm that all spare parts are on site. Include photographs of spare parts in startup report.

(12) Include the following photographs in the startup report:

(a) Overall pump station job site
(b) Pumps and motors
(c) Discharge header piping
(d) Pump control panel – closed door
(e) Pump control panel – open door
(f) Wet well

4. Quality Assurance

a. Manufacturer's Qualifications: Upon request from the ENGINEER, the pumping equipment manufacturer shall demonstrate the following:

(1) Proof of financial stability and ability to produce the pumping equipment within the specified delivery schedules.

(2) Evidence of the facilities, equipment, and expertise to demonstrate the manufacturer's commitment to long-term customer service and project support.

(3) Evidence of adequate local and factory spare parts inventory to provide timely delivery of spare parts

(4) Evidence that the pump manufacturer is an Underwriters Laboratories (UL) panel builder.

(5) Evidence that the pumps and pumping equipment are constructed, assembled and tested in the United States by the pump

manufacturer. All pump parts including the casing shall be machined at the pump manufacturer's facility located within the United States.

(6) To ensure compatibility to existing tools and equipment, all pump internal and external nuts, bolts, and hardware, shall be Unified Thread Standard (UNC) per ASME/ANSI standards.

(7) Evidence that the pump manufacturer can provide operator training that counts toward Maryland continuing education requirements.

(8) Consideration will be given only to pump manufacturer's meeting the following qualifications:

(a) Twenty-five years minimum experience successfully producing pumping equipment of the type specified herein.

(b) A minimum of twenty-five installations of pumping equipment of the type specified herein in successful operation for a minimum of ten years

(9) Pump manufacturer must be ISO 9001:2000 certified, with scope of registration including design control and after sales activities.

b. Manufacturer's Representative Qualifications: Upon request from the ENGINEER, the equipment manufacturer's local representative shall demonstrate the following:

(1) Evidence of adequate local spare parts inventory to provide timely delivery of spare parts.

(2) Evidence of established locally based factory-trained service personnel.

(3) Evidence that representative offers comprehensive equipment service agreements for the equipment specified.

(4) List of at least ten local municipalities with installations similar to the specified equipment.

(5) Evidence that the representative offers full-day operator training seminars on Centrifugal Pump Maintenance and Troubleshooting.

(6) Evidence that the representative offers technical design assistance and hydraulic recommendations for pump station design.

(7) Certification from manufacturer that the service technician has been factory-trained and is authorized for such duties by the manufacturer.

c. Pump Performance:

(1) 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.

(2) Design the pumps designated as self-priming centrifugal to pump raw sewage containing solids up to ten percent and stringy materials with a minimum of clogging. Pumps may be protected by screening equipment, but materials passing through may combine by a felting or balling process.

ci. Source Quality Control:

(1) Obtain pumping equipment, motors, motor starters, pump controls and appurtenances from the pump manufacturer whose responsibility it is to ensure that the pumping equipment is properly furnished, coordinated, and tested in accordance with these specifications. The products of third party packagers, assemblers or distributors shall neither be considered equal, not shall they be acceptable.

(2) Pump station components and controls shall conform to third party safety certification. The station shall bear a UL label listed for "Packaged Pumping System". The pump station components, panel enclosure, and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures.

(3) The pump control panel including the level controls shall be constructed at the pump manufacturer's facilities. The pump manufacturer shall be an Underwriters Laboratories (UL) panel builder. The control panel shall meet all UL and Joint Industrial Council (JIC) standards.

(4) The manufacturer of the pumping equipment shall provide a listing of similar self-priming suction lift and submersible sewage pumping systems located in the State of Maryland, for review by the ENGINEER. This listing shall include locations and contract names. Project references provided should include similar size self-priming pumps utilized with FVNR starters, reduced voltage solid state starters, variable speed drives and PLC based logic

control. These references must serve to demonstrate the pump manufacturer's ability to design complete, fully integrated pumping systems with similar flow rate, total dynamic head, and suction lift requirements.

e. Factory System Test:

(1) All components including the pumps, motors, valves, piping and controls will be tested as a complete working system at the pump manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head, capacity, rated speed and horsepower. Factory operational tests shall simulate actual performance anticipated.

(2) Upon request from the ENGINEER, the operational test may be witnessed by the ENGINEER and/or representatives of his choice at the manufacturer's facility.

5. Manufacturer's Warranty

a. All components of the pumping equipment shall be manufactured, assembled and tested as a unit by the pump manufacturer. The pumping equipment must be a standard catalog item with the manufacturer. The pump manufacturer must assume system responsibility, i.e. the pumping equipment must be warranted by the manufacturer as described herein. Individual component warranties are desirable. However, individual warranties honored solely by the manufacturers of each component will not be acceptable.

b. The pump manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.

(1) All equipment, apparatus, and parts furnished shall be warranted for one (1) year, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O-rings, etc. The pump manufacturer shall be solely responsible for warranty of the pumping equipment components when installation is made and use and maintenance is performed in accordance with the manufacturer's recommendation.

(2) The pump shall be warranted for five (5) years from date of shipment.

(3) Components failing to perform as specified by the ENGINEER, or as represented by the manufacturer, or as proven defective in

service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer without cost of parts to the COUNTY.

c. It is not intended that the pump manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor supplied product or part which fails to properly operate, however caused. Consequential damages resulting from defects in design, or delays in delivery are also beyond the manufacturer's scope of liability.

d. The warranty shall become effective upon the acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment, whichever occurs first.

6. Manufacturer

a. These specifications and accompanying drawings specify and show equipment and materials manufactured by The Gorman-Rupp Company, deemed most suitable for the services anticipated. The CONTRACTOR shall prepare his bid on the basis of the particular equipment and materials specified for the purpose of determining the low bid. The awarding of the contract shall constitute a contractual obligation to furnish the specified equipment and materials.

b. After execution of the contract, the CONTRACTOR may request to substitute equipment other than that specified in the contract. Substitutions will only be considered in the event that the equipment proposed for substitution is superior in construction and efficiency to that specified in the contract, and higher quality has been demonstrated by service in a sufficient number of similar installations.

c. In the event the CONTRACTOR obtains ENGINEER'S approval of equipment other than that for which the system was originally designed, the CONTRACTOR shall, at his own expense, make any changes in the structures, buildings or piping necessary to accommodate the equipment, and shall provide as-built drawings to the ENGINEER.

d. It will be assumed that the cost to the CONTRACTOR of the equipment proposed to be substituted is less than that of the equipment specified in the contract and, if substitution is approved, the contract price shall be reduced by an amount equal to the savings.

**B. Materials**

1. Farm Lane Pump Station

a. Existing Farm Lane Pump Station wet well will remain, and duplex pumping system will be installed within wet well in accordance with equipment requirements listed in this section.

b. Principal items of equipment shall include two explosion-proof submersible, horizontal, centrifugal, sewage pumps, electric motors, valves, internal piping, control panel, liquid level control system, fiberglass enclosure and internal wiring. Factory built pump station design, including materials of construction, pump features, valves and piping, and motor controls shall be in accordance with requirements listed in this section.

c. The pumping equipment shall be manufactured by The Gorman-Rupp Company, Mansfield, OH as supplied by Envirep, Inc., Camp Hill, PA (717-761-7884), or approved equal.

d. Pumps

(1) Pump Description:

(a) Pumps shall be Gorman-Rupp Model SF4C-X explosion-proof submersible, horizontal, centrifugal pumps, specifically designed for pumping raw, unscreened, domestic sanitary sewage.

(b) All openings and internal passages shall be large enough to permit the passage of the specified spherical solids passing capacity, and any trash or stringy material which may pass through the average house collection system. Screens or any internal devices that create a maintenance nuisance or interfere with priming and performance of the pump shall not be permitted.

(c) The pumps shall have the following characteristics:

| | | Design |
|---|---|---|
| a. | Discharge connection, flanged, in | 4 |
| b. | Minimum shutoff head, each pump, ft | 142 |
| c. | Pump speed, rpm | 1750 |
| d. | Spherical solids passing capability, in. diameter | 3 |
| e. | Motor horsepower, hp | 50 |
| f. | Motor speed, rpm | 1750 |
| g. | Impeller diameter, in | 11.00 |

(2) Pump Performance:

(a) Each pump must have the necessary characteristics and be properly selected to perform under these operating conditions:

| | | Design |
|---|---|---|
| a. | Capacity, gpm | 625 |
| b. | Total dynamic head, ft | 108 |
| e. | Total static head, ft | 11.78 |

(3) Hydraulic Components and Solids Handling:

(a) The pump casing shall be of Gray Iron 30. Casing shall be easily removable from the motor for full inspection of impeller.

(b) All pump openings and passages shall be of adequate size to pass any trash or stringy material, which can pass through an average house collection system.

(c) The impeller shall be enclosed non-clog channel design, incorporating multiple vanes with wide flow channels. It shall be ductile iron, Class 65-45-12, with designed counter weight mass for dynamic balancing to eliminate vibration. Balancing shall not deform or weaken the impeller. The impeller shall be driven by means of a key slotted into the shaft. Impeller fasteners shall be non-corroding. The axial suction clearance between the impeller and pump casing shall be fully adjustable to maintain peak operating efficiency of the pump. The adjustment shall be easily accomplished using four external adjusting screws.

(4) Hoisting Bail:

(a) A hoisting bail shall provide for proper balance of pump when lifted using a single lift cable.

(5) Components:

(a) All other major pump components such as motor housing, seal housing, and bearing brackets shall be of Gray Iron 30. All external surfaces coming into contact with pumped media shall be protected by water-based epoxy primer and a waterborne enamel top coat with a minimum 8 mil

thickness. All exposed fasteners and lock washers shall be of 300 series stainless steel.

(6) Shaft Seal:

(a) Two separate mechanical seals shall be provided, arranged in tandem, to protect against leakage. The upper seal shall have a carbon rotating face and ceramic stationary face. The lower seal shall incorporate silicon carbide on both the rotating and stationary faces. Cage and springs shall be of stainless steel and elastomers of Viton or Buna-N.

(b) The rotating seal faces shall be lubricated from an oil filled reservoir between pump and motor; the oil serving as both lubricating and a cooling media. The reservoir shall have two oil fill and drain plugs to ensure accuracy when measuring lubricant level and for ease of maintenance.

(c) Seal shall require no special maintenance or routine adjustment; however, shall be easily inspected or replaced. No seal damage shall result from operating the pump for short periods of time without liquid.

(d) A seal failure electric probe sensor shall be installed in the seal chamber. The sensor shall be capable of sensing leakage into the seal chamber and the sensitivity level shall be set in the control panel.

e. Pump Motor

(1) Motor Description:

(a) The submersible pump motor shall operate in accordance with the electrical power indicated above. The motor and pump must be connected to form an integral unit. Motor shall be a squirrel-cage, induction type in an air-filled watertight enclosure. The motor shall conform to NEMA design standards, and incorporate Class H insulation materials to withstand a continuous operating temperature of 180° C (356° F). The pump and motor shall be capable of handling liquids with a maximum temperature of 40° C (104° F).

(b) Motor shall be capable of sustaining a minimum of 10 starts per hour and shall be inverter duty rated in accordance with NEMA MG1. The motor shall not require

a cooling jacket or any other means of auxiliary cooling during normal continuous operation.

(c) Motor housing shall be of Gray Iron 30. The stator shall consist of copper windings with copper connectors applied to high-grade electrical steel laminations. The stator shall be held securely in place by a heat-shrink fit into the motor housing. Any other means of securing the stator which would require penetration of the motor housing shall not be considered acceptable.

(d) Combined rotor and shaft assembly shall be dynamically balanced for vibration-free operation. Rotor end bars and short circuit rings shall be of aluminum. The pump shaft shall be of 17-4 PH stainless steel. The shaft shall be machined with shoulders or snap ring grooves for positive placement of bearings.

(e) The upper and lower bearing shall be of heavy duty design, capable of supporting the shaft and rotor while under maximum radial and thrust loads. The bearings shall be permanently grease lubricated and sealed at the time of installation. The minimum B-10 bearing life shall be 50,000 hours over the normal operating range of the curve.

(f) Power/control cable shall have a neoprene jacket and shall be 32 feet long.

(2) Watertight Integrity:

(a) All static seals at water tight mating surfaces shall be of Buna-N or Viton rubber O-ring type. Use of auxiliary sealing compounds shall not be required.

(b) The power and control cables shall enter the motor through a terminal housing. The entrance shall be sealed with a rubber grommet and clamp set which when compressed longitudinally causes a radial water tight seal. The individual leads of the power and control cables shall be separated by a compressible grommet, which shall provide protection from wicking through the cable. Any other cable entrance design requiring use of epoxies, silicones, or similar caulking materials shall be considered unacceptable.

(c) The motor and sensor leads shall be mated to the cable leads through a group of quick-connect, color-coded cable connectors.

(d) The pump and electrical cables shall be capable of continuous submergence without loss of waterproof integrity to a depth of 65 feet.

(e) The watertight integrity of the motor housing and shaft seal shall be tested during manufacture vacuum testing the completed pump assembly.

(3) Thermal and Moisture Motor Protection:

(a) The motor shall be protected from thermal damage by a group of three separate thermostatic switches embedded into the stator windings, one per stator phase. Each switch shall open independently and terminate motor operation if temperature of the protected winding reaches the high temperature set point of 160°C (320°F) and shall automatically reset upon cooling of the winding. The thermal sensing device shall be connected to the pump control panel by the CONTRACTOR.

(b) The pump shall utilize a single probe to monitor both the motor and seal chambers for moisture intrusion. The detection of moisture in either chamber shall send a signal to the control panel which shall be used to notify the user of the need for an inspection.

f. Automatic Discharge Connection

(1) Description:

(a) Each pump shall be furnished with a submersible discharge connection system to permit removal and installation of the pump without the necessity of an operator entering the wet well. The design must ensure an automatic and firm connection of the pump to the discharge piping when lowered into place.

(2) Baseplate:

(a) A gray iron cast base with integral guide rail pilots shall be provided along with all hardware and anchor bolts required for permanent installation to the wet well floor. The base

shall be designed with an integral 90 degree elbow, or adapt to a commercially available elbow for connection to the vertical discharge piping utilizing standard ANSI 125 lbs. flanges. The base shall be coated with coal tar epoxy for corrosion resistance. The manufacturer shall provide all necessary drawings to ensure proper installation and alignment of baseplate within the sump.

(3) Non-Leaking Discharge Connection:

(a) Each pump shall be provided with a replaceable ductile iron slide rail guide shoe attached to pump discharge flange. A replaceable neoprene seal shall be provided as an integral part of the guide shoe to form a seal with the base plate connection and eliminate the possibility of leakage and erosive wear during operation. The seal shall contact mating faces in a static position and shall have adequate flexibility to flex under pumping pressure to increase seal efficiency. Metal-to-metal contact at the discharge connection shall not be acceptable.

(4) Guide Rail System and Method of Operation:

(a) The guide shoe shall direct the pump down two vertical guide rails and onto the discharge connection in a simple lineal movement. The buildup of sludge and grease on guide rails shall not present problems during the lifting operation. The guide shoe shall be designed with integral hooks at the top to transmit full weight of the pump to the base plate flange. No portion of the pump shall be supported directly on the bottom of the wet well, guide rails, or lifting cable.

(b) The lifting cable shall consist of a stainless steel braided wire cable attached to the pump lifting bail. An eyelet shall be provided at the upper end of this cable for attaching to the wet well access frame and hoist winch.

(c) All bolts, machine screws, nuts, washers, and lock washers for complete assembly of access cover, guide rails, and discharge elbow shall be 304 stainless steel.

(d) The CONTRACTOR shall provide two lengths of 2-inch diameter Schedule 40 stainless steel guide rail pipe for each pump.

(e) Upper guide rail pilots, and a lifting cable shall be furnished for each pump. Bottom pilots shall be an integral part of the base plate for ease of installation and proper alignment. Upper guide rail support brackets shall be constructed of 304 stainless steel.

(f) Guide Rail Splice Kit

a. Each pump shall be equipped with a welded stainless steel assembly to provide guide rail splicing and support.

b. Guide rail splice kit shall be required when wet well depth exceeds 20 feet.

g. Spare Parts

(1) Spare Parts: Furnish the following spare parts:

(a) One (1) impeller

(b) One (1) impeller socket head capscrew

(c) One (1) impeller washer

(d) Two (2) replaceable neoprene seals for discharge connection

(e) Two (2) air pump repair kits for bubbler level control system

(f) One (1) gallon seal lubricant

h. Valves and Piping

(1) Check Valves, 8-inch:

(a) Each pump shall be equipped with a resilient seated check valve. The check valve shall be manufactured from ductile iron. Valves shall be rated for 250 psig cold water working pressure, and shall comply with ANSI/AWWA C508. Valves shall have a ductile iron disc fully encapsulated with rubber. Disc travel to closure shall not be more than 35 degrees, and shall seal drop tight at pressures above 5 psig. Valves shall be coated with fusion-bonded epoxy on all internal and external ferrous surfaces. Bronze seat rings

are not permitted. The disc shall be the only allowable moving part. No O-rings, pivot pins, or other bearings are allowed. Disc must be reversible such that either side will seal equally.

(b) Each check valve shall be provided with a 3/8-inch threaded tap with plug on the downstream side of the valve for installation of a pressure gauge.

(c) Check valves shall be American Flow Control Series 2100.

(2) Plug Valve, 8-inch:

(a) A three way plug valve must allow either or both pumps to be isolated from the force main. The plug valve shall be non-lubricated, tapered type. Valve body shall be semi-steel with flanged end connections drilled to 125-pound standard. The drip-tight shutoff plug shall be mounted in stainless steel bearings and shall have a resilient facing bonded to the sealing surface. Valve shall be operated with a lever actuator. The lever shall have a locking device to hold the plug in the desired position.

(b) Three way plug valve shall include an upper journal grease fitting and a lower journal grease fitting for lubrication of the shaft.

(c) Plug valves shall be DeZurik, Inc.

(3) Header Piping:

(a) Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and Class 53 thickness. Flanges shall be cast iron Class 125 and comply with ANSI B16.1. All piping pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.

(b) Bolt holes shall be in angular alignment within ½-degree between flanges. Flanges shall be faced and a gasket finish applied that shall have concentric grooves a minimum of 0.01 inch deep by approximately 0.03 inch wide, with a minimum of three grooves on any given surface spaced a maximum of ¼ inch apart.

(4) Supports and Thrust Blocks:

(a) CONTRACTOR must ensure all pipes connected to the pumping system are supported to prevent piping loads from being transmitted to pumps or system piping.

(b) Pump station discharge force main piping shall be anchored with thrust blocks by the CONTRACTOR where shown on the contract drawings.

(5) Discharge Gauge:

(a) The station shall be equipped with a 4-inch diameter glycerin filled "no shock" pressure gauge graduated 0-230 feet of water column. The gauge kit shall be mounted and complete with all hoses and fittings. In addition to the gauge the kit shall include a shut off valve installed in each connection to discharge piping, a three-way valve to monitor either pump and all hoses and fittings.

(6) Gauge Connection Assembly:

(a) The header piping shall be equipped with a gauge connection assembly located between the discharge check valve and force main isolation plug valve allowing the operator to easily attach a discharge gauge on any pump for troubleshooting.

(b) The gauge assembly shall consist of a ¼-inch brass pipe nipple, ¼-inch brass full port ball valve and a quick connect fitting.

(c) The gauge connection assembly shall be installed in the discharge header piping such that the static and dynamic pressure in the force main can be read at all times unless the force main isolation plug valve is closed for that particular pump.

i. Pump Control System

(1) General:

(a) This specification covers a pump control system for the duplex pumping system including motor circuit breakers, variable frequency drives, thermal overload relays, door mounted operator controls, and liquid level controls.

(b) The liquid level control will include an air bubbler level control system, electronic pressure switch, pump sequence control, alarms and pump safety shutdowns.

(2) UL Listing:

(a) The pump controls shall be manufactured by the pump manufacturer who shall be a UL panel builder and each assembly shall bear a serialized UL label listed for "Enclosed Industrial Control Panels."

(b) The enclosure and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures. Listing for open style industrial control panels or an assembly of listed or recognized components shall not be acceptable.

(3) Panel Enclosure:

(a) Enclosure shall be constructed in conformance with applicable section of national electrical manufacturers' association (NEMA) standards for Type 1 electrical enclosures. Enclosure shall be fabricated of stainless steel having a minimum thickness of not less than 0.075 inch (14 gauge).

(b) Door shall be hinged and sealed with a neoprene gasket and shall be held closed with clamps that are quick and easy to operate. The door shall accommodate the mounting of switches and indicators.

(c) Enclosure shall be furnished with a removable back panel, fabricated of steel having a thickness of not less than 0.106 inch (12 gauge), which shall be secured to the enclosure with collar studs. Such panel shall be of adequate size to accommodate all basic components.

(d) All control components shall be securely fastened to a removable back panel with screws and lock washers. Switches, indicators and instruments shall be mounted through the control panel door. Self-tapping screws shall not be used to mount any components.

(e) Each control assembly shall be furnished with main terminals and ground lug for field connection of the

electrical supply. The connections shall be designed to accept copper conductors of sufficient size to serve the loads. The main terminals shall be mounted to allow incoming wire bending space in accordance with article 373 of the National Electric Code (NEC). A separate terminal strip shall be provided for 115 volt, single-phase control power and shall be segregated from the main terminals. Ten percent of the control terminals shall be furnished as spares.

(4) Motor Branch Components:

(a) Three-phase Circuit Breakers:

a. Pump #1 VFD
b. Pump #2 VFD
c. Pump #1 RVSS Bypass
d. Pump #2 RVSS Bypass
e. Station Heater
f. Grinder

(b) All motor branch components shall be of the highest industrial quality. Operating coils of all AC control devices shall be rated for 120 volts, and shall be suitable for use in a voltage range of 108 to 132 volts, 60 hertz. The short circuit rating of all power circuit devices shall be a tested combination or evaluated per the National Electric Code Article 409. The lowest rated power circuit component shall be the overall control panel short circuit rating and shall not be less than the fault current available. The minimum control panel rating shall not be less than 10 kA, rms symmetrical. Control assemblies operating at 120 volts nominal or less may be provided with transformers which limit that fault current and may be rated less than the minimum required short circuit rating.

(c) Circuit Breakers and Operating Mechanisms:

a. A properly sized heavy duty air circuit breaker shall be furnished for each pump motor and shall have a symmetrical RMS interrupting rating to be determined by the power company. All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering.

b. A padlocking operating mechanism shall be installed on each motor circuit breaker. Operator handles for the mechanisms shall be located on the exterior of the control compartment door, with interlocks which permit the door to be opened only when circuit breakers are in the "off" position.

(5) Variable Frequency Drives:

(a) The inverter shall be suitable for operation of NEMA Design B, 4 pole motors. The inverter will have a diode bridge rectifier on the input to minimize the generation of electrical noise back into the line and provide near unity power factor. Output devices shall be transistors.

(b) Environment Conditions: The inverter shall be capable of operation under any combination of the following conditions without mechanical or electrical damage.

| | |
|---|---|
| Ambient Temperature: | 0 to +40 degrees C |
| Relative Humidity: | Less than 95% non-condensing |
| Altitude: | Less than 1,000M (3,300 ft) above sea level |
| Vibration: | 0.006 inches displacement, 1G peak |
| Shock: | 15G peak for 11mS (±1.0mS) |

(c) Control Specification:

| | |
|---|---|
| Control System: | Sinusoidal pulse width modulated voltage waveform |
| Frequency Accuracy: | ±0.4% of max. frequency |
| Volts/Hertz Ratio: | V/Hz user programmable |
| Operation Frequency: | 0 to 400 Hz |
| Overload Capacity: | 110% Overload capability for up to 1 minute<br>150% Overload capability for up to 3 seconds |

(d) Digital Readout and Monitor:

a. Interface to the drive is provided via a module with integral LCD display. Unit is a 7 line by 21 character backlit LCD display with graphics capability. It is used to display drive operating conditions, fault / alarm indications and programming information with full text support in multiple languages, including but not limited to

English, German, French, Italian, Spanish, Portuguese and Dutch. The unit will display standby status (power on, not running), output frequency (drive run), set-up parameters and fault. With keypad, user can monitor current, voltage, frequency, acceleration and deceleration time, minimum frequency and maximum frequency. Readout also provides inverter status and protective circuits status.

(e) Protection

a. The variable speed drive system shall include a diode or fully gated bridge rectifier, capacitor filter, and transistorized inverter section. Base driver signals to control firing of the power transistors will be designed with optically coupled isolators for maximum protection of the control circuits from high voltage and noise. The output will be a sinusoidal, pulse width modulated, voltage waveform for reduced harmonic heating in the motor.

b. The system protection will provide the following:

1) Intermittent overload - 50 to 150%
2) Current limit - 50 to 115%
3) Overcurrent - 220-300% of rated output current
4) Inverse time overload - 50 to 100%
5) Short circuit - Phase to phase or phase to ground
6) Overvoltage - 10% above input line or DC bus voltage
7) Undervoltage - 10% below line voltage
8) Power loss ride-through - 500mS

c. When the inverter trips out on a fault, the fault relay shall activate and the display shall indicate the reason for the trip as follows:

1) Overcurrent
2) Short circuit
3) Overload
4) Overvoltage
5) Undervoltage
6) Overheat
7) Ground fault

8) Motor stalled
9) Power supply fault

d. Auto restart shall occur when the inverter faults. Auto restart shall be adjustable up to 9 attempts with 0.5 to 30 second intervals. Auto restart will not be attempted for ground fault, output shorted, transistor shorted or internal microprocessor fault but will trip out immediately, activate the fault relay and make the appropriate indication on the display.

e. In the event of a fault trip, the microprocessor shall save the status of the inverter at the time of the fault and make that information available on the digital display. Information regarding the last 4 faults is maintained in event of a power loss.

(f) Operational Functions:

a. Acceleration and deceleration time independently adjustable from 0.1 to 3600.0 seconds (selectable ranges).

b. Volts/Hertz patterns user selectable.

c. Maximum and minimum frequency limit adjustments.

(6) Line Reactors:

(a) Each drive assembly will be furnished with a 3% input line reactor. The line reactor shall provide circuit inductance to slow the rate of rapid current changes and to act as a buffer between the drive and the electrical distribution system. The line reactor is designed to minimize nuisance tripping, line notching, cross talk, harmonic current demand and voltage distortion.

(b) The line reactor shall be constructed of copper wire or foil wound on steel cores. Reactors will be sized for the total connected load and shall be rated for 150% of nominal 60 Hz current for 5 minutes. Reactors shall be UL recognized and suitable for use in UL 508 applications.

(c) The line reactor shall be mounted inside each drive unit and connected between the circuit breaker and drive input.

(7) Bypass Contactors:

(a) Each pump motor shall be furnished with a reduced voltage solid-state (RVSS) bypass system. Each system shall include a separate circuit breaker, a RVSS motor starter, and an isolation contactor for the VFD.

(b) The control system shall include a Bypass-Off-VFD (BOV) switch and a bypass run light. The BOV switch shall include three positions: Bypass, Off and VFD. The BOV switch shall be mounted in the door of the pump control panel.

(c) A bypass elapsed time (ET) meter and pilot light shall be provided for each pump motor and shall be mounted in the door of the control panel.

(d) A RVSS motor starter, circuit breaker and bypass contactor shall be provided for each pump motor and shall be mounted in the pump control panel. The isolation contactor for each VFD shall be mechanically interlocked with the RVSS bypass motor starter to prevent simultaneous operation.

(e) In the event of a drive fault, the BOV switch shall be manually set to the Bypass position to operate the pump motors using the full voltage starters. When set to the Bypass position by the operator, the pump control panel shall be configured to operate the pumps at full speed and full voltage either manually or automatically through the level control.

(8) Indicators:

(a) Physical indicating light operators shall be made of an industrial grade thermoplastic and chemical-resistant for harsh environments. Lights shall have a protection rating of IP 65/66 (type 3/3R/4/4X/12/13). Lights shall include an easily replaceable, integrated LED power module for long lamp life. Indicating lights shall be push-to-test.

(b) Indicating lights will be furnished for the following functions:

a. General alarm (Integrinex) - Red

b. Pump No. 1 run - Green
c. Pump No. 2 run - Green
d. Pump Fault, No. 1 - Red
e. Pump Fault, No. 2 - Red
f. Drive Fault, No. 1 - Red
g. Drive Fault, No. 2 – Red
h. Pump No. 1 Bypass Run – Green
i. Pump No. 2 Bypass Run – Green
j. High Water Alarm - Red

(9) Control Circuit Components:

(a) Single Phase Circuit Breakers

a. Outlet
b. Fan
c. Station Light
d. Security Light

(b) A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.

(c) Pump mode selector switches shall permit manual start or stop of each pump individually, or permit automatic operation under control of the liquid level control system. Manual operation shall override all shutdown systems, except the drive fault. Selector switches to be heavy duty, oil-tight design with contacts rated NEMA A300 minimum.

(d) Six digit elapsed time meter (non-reset type) shall be connected to each motor starter to indicate total running time of each pump in “hours” and “tenths of hours.”

(e) The PLC shall be an Allen-Bradley CompacLogix Model L2. The PLC shall be equipped with a CPU and Ethernet communication ports.

(f) The PLC shall operate on 120vac power and be equipped with the communication devices, digital and analog I/O necessary to accomplish the specified operation. A minimum of 10% spare of the I/O used shall be supplied.

(g) The program logic shall be stored in battery backed random access memory, as well as on a programmable, read only memory module. The memory module shall auto load and run when installed in the programmable control processor

and is included to facilitate field repair or replacement of the programmable control hardware without the use of programming terminals or personal computers.

(h) The PLC shall communicate with the drive using Ethernet. The PLC shall issue drive start/stop and speed commands. Drive status shall also be communicated using Ethernet. The drive shall be configured to operate manually without the use of the PLC.

(i) An Allen-Bradley Panelview 1000C color electronic operator interface shall be provided for data entry and display. The operator interface shall be mounted on the front of the control panel with other operator controls and shall be compatible with the PLC DFI communication protocol. The operator interface shall be a backlit, touch-screen terminal.

(j) Electromechanical relays and timers, when used shall be equipped with 120vac coils and contacts rated NEMA A-300 minimum. Timers shall be pneumatic or synchronous motor driven.

(k) A duplex ground fault receptacle providing 115 VAC, 60 Hz, single-phase current, will be mounted on the control enclosure. Receptacle circuit shall be protected by a 15-ampere thermal-magnetic circuit breaker.

(10) Control Logic:

(a) Control logic shall be accomplished using programmable controllers. Electromechanical relays may be used when necessary. However, the primary control logic shall be performed by the PLC.

(b) The O&M manual shall be provided with complete ladder logic program documentation including English names, rung comments, and coil/contact cross-references.

(c) The control shall be pre-programmed or wired to provide the following routines:

a. Pump alternation at lead stop
b. Excessive pump run time alternation
c. Jump to next pump on lead failure
d. Duplex pump operation

e. Start/stop pumps at normal level settings
f. Pump start delays when called to run simultaneously
g. General alarm pilot light activation: Quick flashing alarm/slow flashing acknowledge/ steady on reset/off when clear
h. Station trouble alarm (115vac and normally open dry contact)
i. High and low level alarms
j. Pump start/stop level control
k. Drive speed/level control
l. Drive fault alarm

(d) The operator interface shall be equipped with the following displays and functions:

a. Main Menu
b. Wet Well Level
c. Wet Well Level Simulation
d. Low Water Alarm Status
e. High Water Alarm Status
f. Drive Fault Status #1, #2
g. Pump Sequence Selection
h. Alarm Silence
i. Alarm Reset
j. General Alarm Lamp Test
k. Lead Level Start/Stop Setpoints
l. Lag Level Start/Stop Setpoints
m. Low Water Alarm Setpoints
n. High Water Alarm Setpoints
o. Speed/Level Setpoints (1 pump running)
p. Speed/Level Setpoints (2 pumps running)
q. Power-up Delay Setpoint
r. Alarm Delay Setpoint
s. Pump Start Delay Setpoint
t. Alternation Time Interval Setpoint
u. Level Transmitter Calibration
v. Alarm History (minimum 20 events)

(11) Elapsed Time Meters:

(a) Six-digit elapsed time meters (non-reset type) shall be connected to each motor starter to indicate the total running time of each pump in “hours” and “tenths of hours.”

(12) Elapsed Time Meter for Two Pump Operation:

(a) A Six-digit elapsed time meter (non-reset type) shall be connected to both motor starters to indicate the total running time of both pumps operating simultaneously. Activation of ETM for two pump operation shall not disable individual ETMs.

(13) Pump Start Delay:

(a) The lag pump will be equipped with a time delay to prevent simultaneous motor starts.

(14) Alarm Contacts:

(a) Provide separate alarm contacts for the following alarm conditions:

a. High water
b. Phase failure
c. Pump fault, #1
d. Pump fault, #2
e. VFD Fault, #1
f. VFD Fault, #2
g. Station low temperature
h. Pump run, #1 – normally open
i. Pump run, #2 – normally open
j. Pump run, #1 – normally closed
k. Pump run, #2 – normally closed
l. Simultaneous pump run – normally open (Activation of simultaneous run contact shall deactivate individual pump run contacts.)
m. Backup level control active

(15) Three Phase Voltage Monitor:

(a) The control panel shall be equipped to monitor the incoming power and shut down the pump when required to protect the motor(s) from damage caused by phase-reversal, phase loss and voltage. The motor(s) shall automatically restart when power conditions return to normal.

(16) Secondary Surge Arrestor:

(a) All Control Panels shall have Surge Protective Devices installed immediately after the main overcurrent device or immediately after the supply conductors to the panel have

been terminated. The Surge Protective Device(s) shall follow IEEE C62.41 recommendation for cascading to protect all voltage levels to and including 24 volts AC/ DC and shall be as follows:

(b) Be UL 1449 3rd Edition Recognized for UL Type 2 applications except at 48 volts AC/DC and below may be UL 1449 3rd Edition for Type 3 applications.

(c) Provide suppression for both normal mode (L-N [Wye]) and common mode (L+N-G [Wye] or L-G [Delta]).

(d) Have a Surge Current Capacity (Imax) of at least 40kA.

(e) Have a Nominal Surge Current Rating (In) of 20kA.

(f) Have SCCRs of 200kA, except that 347Y/600V, 240/480V High leg Delta and 347V single-phase SPDs shall have a minimum SCCR of 125kA.

(g) Use MOV technology with thermal disconnect.

(h) Be RoHS compliant.

(i) SPD status monitoring shall be provided by local visual indication and, if needed, by remote contact signaling using an optional Form C contact relay.

(j) Hardwired Listed Type 1 or Type 2 Surge Protective Devices Shall:

a. All Type 1 or Type 2 surge protective devices shall be manufactured by a single ISO-9001 registered company normally engaged in the design, development and manufacture of such devices for electrical distribution system/ equipment protection. Surge protective devices shall be UL Listed with a Short-Circuit Current Rating of 200kA, Nominal Discharge Current (In) of 20kA, and Surge Current Capacity (Imax) of120kA, 200kA, 300kA or 400kA. These SPDs shall be installed in accordance with the NEC® and/or local code requirements. The said manufacturer shall offer a minimum five (5) year warranty for its Type 1 and Type 2 surge protective devices.

b. The hardwired surge protective device shall have specifications as shown below:

c. The Maximum Continuous Operating Voltage (MCOV) shall not exceed 25% on Wye and 40% on Delta systems of the nominal voltage (system voltage) in the configuration being used

d. Prewired NEMA 1 or NEMA 4X factory sealed enclosure suitable for the intended installation location

e. Shall have a two color LED status indicator per phase

f. Have an operating temperature range of at least -40˚C to +50˚C

g. Only use thermally protected MOV technology, such as Bussmann SurgePOD™.

h. Surge Protective Device Agency Information: SPDs shall be "Listed" by Underwriters Laboratories, Inc. to UL 1449 3rd Edition as a Type 1 or Type 2 device and shall exhibit the UL Listing mark for the UL category VZCA for USA and/or VZCA2 for Canada; and must have CSA certification.

i. Manufacturers must provide verification of performance data for UL and CSA standards.

j. All SPDs must be RoHS compliant.

k. Surge protective devices shall be installed and located in accordance with the all applicable agency, NEC® and local code requirements. The SPDs must be suitable for the particular installation, be it on the upstream side (Type 1) or downstream side (Type 1 or Type 2) of service entrance Overcurrent Protective Device (OCPD).

l. All SPDs shall match voltage and system specific requirements as provided by the manufacturer.

m. All SPDs shall provide surge protection for both normal mode (L-N [Wye], L-L [Delta]) and common mode (L+N-G [Wye] or L-G [Delta]).

n. Surge protective device shall be clearly marked with specifications as required by UL 1449 3rd Edition along with UL holographic label on the SPD.

o. Each surge protective device should be serial numbered along with barcode for easy identification and traceability.

(17) Receptacle:

(a) A duplex ground fault interrupter utility receptacle providing 115 VAC, 60 hertz, single-phase current shall be provided. Receptacle circuit shall be protected by a 15-ampere thermal-magnetic circuit breaker.

(18) Auxiliary Power Transformer:

(a) A 5 KVA step-down transformer shall be provided to supply 115 volt, AC, single phase for the control and auxiliary circuits. The primary side of the transformer shall be protected by a thermal-magnetic air circuit breaker,

specifically sized to meet the power requirements of the transformer. A mechanical operating mechanism shall be installed on the circuit breaker to provide a means of disconnecting power to the transformer.

(b) A padlockable operator handle for the operating mechanism shall be located on the exterior of the control panel with interlocks which prevent opening the door until primary circuit breaker is in the "OFF" position.

k. Wiring

(1) General:

(a) The pump control as furnished by the manufacturer shall be completely wired except for the power feeder lines to the branch circuit breakers and final connections to remote alarm devices and between control assemblies.

(b) All wiring, workmanship, and schematic wiring diagrams shall be in compliance with applicable standards and specifications set forth by the National Electric Code (NEC).

(c) All user serviceable wiring shall be type MTW or THW, 600 volts, and shall be color-coded as follows:

a. Line and load circuits, AC or DC power: Black
b. AC control circuit less than line voltage: Red
c. DC control circuit: Blue
d. Interlock control circuit, from external source: Yellow
e. Equipment grounding conductor: Green
f. Current carrying ground: White
g. Hot with circuit breaker open: Orange

(2) Wire Identification and Sizing:

(a) Control circuit wiring inside the panel, with the exception of internal wiring of individual components, shall be 16-gauge minimum, type MTW or THW, 600 volts. Motor branch wiring shall be 10-gauge minimum.

(b) Motor branch conductors and other power conductors shall not be loaded above 60-degree C temperature rating, on circuits of 100 amperes or less, nor above 75-degree C on

circuits over 100 amperes. Wires shall be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be of the ring tongue type with nylon insulated shanks. All wires on the subplate shall be bundled and tied or installed in duct. All wires extending from components mounted on door shall be terminated on a terminal block mounted on the back panel. All wiring outside the panel shall be installed in conduit.

(3) Wire Bundles:

(a) Control conductors connecting components mounted on the enclosure door shall be bundled and tied in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall be allowed so that the door can swing to its full open position without undue mechanical stress or abrasion on the conductors or insulation. Bundles shall be clamped and held in place with mechanical fastening devices on each side of the hinge.

(4) Conduit:

(a) All conduit and fittings shall be UL listed.

(b) Liquid tight flexible metal conduit shall be constructed of a smooth, flexible, galvanized steel core with a smooth abrasion resistant, liquid tight, polyvinyl chloride cover.

(c) Conduit shall be supported in accordance with Articles 346, 347, and 350 of the National Electric Code.

(d) Conduit shall be sized according to the National Electric Code.

(5) Grounding:

(a) The pump control manufacturer shall ground all electrical equipment to the enclosure back panel. The mounting surface of all ground connections shall have any paint removed before making final connections.

(b) The CONTRACTOR shall provide an earth driven ground connection to the control panel at the main ground lug in accordance with the National Electric Code (NEC).

l. Level Control System

(1) Liquid Level Control:

(a) The manufacturer of the liquid level control system must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

(b) The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.

(c) The level control system shall be an air bubbler type level control system.

(d) The level control system shall utilize the PLC sequencer to select first one pump, then the second pump for a pumping cycle. The control system shall alternate between the pumps to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle or if one pump runs as the lead pump for an excessive time. The time interval shall be adjustable via the operator interface.

(e) Level and speed controls shall include logical comparator setpoints. Settings shall be provided to control the levels at which the pumps start and stop as well as level endpoints for minimum and maximum speed. Two sets of speed setpoints shall be provided. The first set will be enabled when a single pump is running. The second set shall be enabled when two pumps are running. Each of the settings shall be adjustable and accessible to the operator without opening the control panel. Controls shall be provided to permit the operator to read and adjust the selected levels and speeds on the operator interface. Setpoint adjustments that require hard wiring, the use of electronic test equipment or artificial level simulation are not acceptable.

(f) Upon operator selection of automatic operation, the PLC shall start and stop the motors for each pump in response to changes in the liquid level in the wet well.

(g) Upon rising wet well level, the lead pump set will start at the “Lead Pump ON” level and shall ramp up and down from maximum speed to minimum speed proportional to wet well level using the lead pump proportional 4 to 20 ma

band. Should the wet well level continue to rise to the "Lag Pump ON" level, the lag pump will start and shall ramp up and down from maximum speed to minimum speed with the lead pump using a separate lag pump proportional 4 to 20 ma band.

(h) Each pump shall shut down at its own independent "OFF" level.

(i) In the manual mode, the operator shall be able to manually set the pump(s) speed on the VFD human interface module. The pump(s) shall operate at that speed until the operator either manually changes speed or shuts off the pump(s). Manual controls shall override all automatic controls, with the exception of the drive fault.

(j) Level control range shall be 0 to 12.0 feet of water. Speed control range shall be 20.0 to 60.0 hertz. Overall repeat accuracy shall be (plus/minus) 0.1 feet of water or hertz.

(2) Air Bubbler System:

(a) The level control system shall be the air bubbler type, containing air bubbler piping, which extends into the wet well. A pressure sensor contained within the electronic pressure switch shall sense the air pressure in this piping to provide wet well level signals for the remainder of the level control system.

(b) Two vibrating reeds, industrial rated, air pumps shall be furnished to deliver free air at a rate of approximately 5 cubic feet per hour and a pressure not to exceed 7 psi. Liquid level control systems utilizing air compressors delivering greater quantities of air at higher pressures, requiring pressure-reducing valves, air storage reservoirs, and other maintenance nuisance items will not be acceptable. A selector switch shall be furnished to provide manual alternation of the air pumps. The switch shall be connected in such a manner that either pump may be selected to operate continuously. The selector switch shall be oil-tight design with contacts rated NEMA A300 minimum.

(c) An air bell constructed of PVC 3 inches in diameter shall be provided for installation at the outlet of the air bubbler

line in the wet well. The air bell shall have a 3/8-inch NPT tapped fitting for connection to the bubbler line.

(d) An air flow indicator gauge shall be provided and connected to the air bubbler piping to provide a visual indication of rate of flow in standard cubic feet per hour.

m. Independent Redundant Float Control (Intrinsically Safe):

(1) General:

(a) The low level float (pump off) is placed below all primary pump off setpoints. The high level float (pump start) is placed above all primary on set-points. If either float condition is achieved, a "Float Control Timer" begins to count. When the timer expires, the float control is latched in, and the floats become active causing an indicating light to become illuminated on the front of the control panel. If the high level float is achieved, a pump will start at a preset speed. If the level persists, the remaining pumps will start in succession at preset speeds, after an adjustable time-period. If the high level float is achieved, both pumps will start, and there will be a High Water Alarm. When the wet well reaches the low level float, all pumps will shut off. The float control includes alternation. The float control system will remain latched until manually reset.

(2) Components:

(a) Intrinsically safe relays, a small PLC, and two (2) non-mercury float switches.

(b) Dry contacts wired to terminal blocks will be provided for the float control active alarm circuit.

(c) Float system includes a stainless steel chain and weight.

2. Maugansville Road and New Regional Pump Station

a. Principal items of equipment shall include two self-priming, horizontal, centrifugal, belt driven sewage pumps, electric motors, valves, internal piping, control panel, liquid level control system, fiberglass enclosure and internal wiring.

b. Factory built pump station design, including materials of construction, pump features, valves and piping, and motor controls shall be in accordance with requirements listed in this section.

c. The pumping equipment shall be manufactured by The Gorman-Rupp Company, Mansfield, OH as supplied by Envirep, Inc., Camp Hill, PA (717-761-7884), or approved equal.

d. Station Enclosure

(1) Description: The station enclosure shall provide sufficient area inside the enclosure for personnel to perform routine operation and maintenance functions in an environment that is sheltered and out of foul weather. The enclosure shall consist of a base to support the pumps and a cover.

e. Station Construction and Design:

(1) The station shall incorporate a fiberglass enclosure and steel base. The station shall be supplied as a complete, weathertight unit with all pump, piping and controls installed and wired by the pump manufacturer.

(2) The enclosure and base is to be rectangular with outside dimensions of 16’ long by 11’-6” wide and having a maximum outside height of 9'-6” at the roof peak. The internal height of the enclosure shall be 8’-6”.

(3) A minimum of (4) four lifting eyes provided on the station base shall be provided to ease handling and installation onto a concrete pad furnished by the CONTRACTOR.

(4) Enclosure walls and roof shall be seamless, one-piece sprayed fiberglass panels laminated to form a structural composite as follows: 1/8" thick fiberglass outside surface, minimum 2" thick urea foam polyurethane core, 7/16" oriented strand board (OSB), and 3/32" thick fiberglass inside surface. OSB shall replace foam at all cut-out openings and penetration points.

(5) Each wall panel shall overlap at the corner and form an internal connection joint using stainless steel hardware. All panel joints shall be thoroughly sealed with silicone caulk. The enclosure shall have a minimum R10 insulation factor and shall be capable of withstanding 150 mph wind loads.

(6) All interior surfaces shall be sprayed white isopthalic gel coat finish offering the same characteristics as the exterior surfaces.

(7) The roof panel shall be an arched, one-piece design incorporating the same materials of construction as the side walls. The roof shall be removable as a unit, allowing for complete access to the pumping equipment with a crane. The pitch of the roof shall be sufficient for good moisture drainage, and withstand a minimum snow load of 40 pounds per square foot.

(8) The station shall be furnished with one (1) 3'0" wide x 6'8" high entrance door(s) shall be constructed of the same laminated fiberglass and foam core materials as the remainder of the station. OSB will replace the insulation in areas where auxiliary equipment will be mounted. Each door shall be hung with (3) three stainless steel ball bearing type hinges incorporating a three point closure system with a lockable door handle. An adjustable door positioner and holder shall be mounted at the top of the door. A gasket consisting of solid rubber and sponge shall seal the door while closed. The door and all hardware shall be mounted to withstand 150 MPH winds. A wall mounted drip molding will be installed above each door.

(9) The station enclosure shall be furnished with one (1) extra wide doors. A double hung door design with 3-point locking hardware, door closer, and hinges on each section shall allow complete access to the 6'-0" x 6'-8" full door opening without the need for a center sill.

(10) The design shall resist deformation of the structure during shipping, lifting, or handling. Base shall incorporate drainage provisions, and an opening sized to permit installation of piping and service connections to the wet well. After installation, the opening shall serve as a grout dam to be utilized by the CONTRACTOR. The base shall incorporate anchor points for securing the complete station to a concrete pad (supplied by the CONTRACTOR) in accordance with the project plans.

(11) Pumps and motor stands shall bolt directly to the station base eliminating the need for a pump skid.

(12) Holes through the base shall be provided for suction and discharge lines, air release lines, and level control cabling or air lines. Holes for the suction and discharge lines shall be provided with a grout dam incorporated in a grout retention cavity which the CONTRACTOR shall fill at installation with suitable grout to seal

each pipe to base joint against the entrance of hazardous gases from the wet well.

(13) The station base shall be coated with a non-slip surface.

(14) The walls of the fiberglass enclosure shall be mounted to the steel base with mechanical fasteners in two foot intervals. The connection between the enclosure walls and the steel base shall be sealed with a neoprene gasket.

(15) The station shall be positioned on the concrete mounting pad supplied by others.

f. Enclosure Functional Equipment:

(1) The interior of the station shall be illuminated by factory installed 120 volt fluorescent light fixtures. All lights will be prewired and run to a load center through PVC conduit and a weatherproof switch shall be installed adjacent to each station entrance. The lighting circuit shall be protected by a thermal-magnetic circuit breaker.

(2) A thermostatically controlled 120 VAC exhaust fan with screen and weatherproof shutters shall be installed in the wall approximately opposite the fresh air intake vent. The fan shall have a minimum capacity of 1600 CFM at free air and be capable of changing the air in the enclosure a minimum of six times per hour. The exhaust fan shall be protected by a thermal-magnetic circuit breaker.

(3) The enclosure will be complete with one (1) set of exhaust louvers. The exhaust louvers will be completely self-contained and shall not require the use of motors, solenoids, or other electrically operated devices. Exhaust louver will consist of four (2) 15" wide and 18-7/8" high shutters that open automatically at 75° F, and close at 60° F. Shutter operation will be the result of the expansion and contraction of wax in an enclosed plunger which shall drive the louver vanes through a mechanical linkage. The exhaust shutter will have the actuator mounted in the flow of the exhaust air and shall maintain the shutter vanes in the open position. Exhaust shutter frame will be constructed of anodized aluminum with zinc plated steel actuator mounting and linkage. The shutter vanes will pivot on plastic bearings. The four (4) intake shutters will be mounted in two aluminum fixed vane louver assemblies to prevent the entrance of rain or snow.

(4) A high capacity electric blower type station heater shall be provided for the protection of the pumping equipment. The heater shall maintain an inside/outside differential temperature of 60 degrees F while operating on the primary voltage supplied to the station. The heater shall be provided with an adjustable thermostat, circuit breaker, and contactor.

(5) One wall mounted duplex GFI utility receptacle providing 120 volt AC power shall be installed and prewired through PVC conduit with the station lighting. The receptacle shall be protected by thermal magnetic circuit breaker.

(6) Consists of a three piece assembly including duck bill check valve, SST strainer top, and PVC spacer to provide a gas and water tight drain receptacle for use in concrete pad within Modular Enclosure. (Note: A 4" PVC drain pipe and PVC coupling shall be required to be provided and installed by CONTRACTOR.)

g. Pumps

(1) Pump Description:

(a) Pumps shall be Gorman-Rupp Model T10A3S-B horizontal, self-priming, centrifugal pumps, specifically designed for pumping raw, unscreened, domestic sanitary sewage.

(b) All openings, internal passages, and internal recirculation ports shall be large enough to permit the passage of the specified spherical solids passing capacity, and any trash or stringy material which may pass through the average house collection system. Screens or any internal devices that create a maintenance nuisance or interfere with priming and performance of the pump shall not be permitted.

(c) The pumps shall have the following characteristics:

| | | Maugansville Pump Station Design | New Regional Pump Station Design |
|---|---|---|---|
| a. | Suction connection, flanged, in | 10 | 12 |
| b. | Discharge connection, flanged, in | 10 | 12 |
| c. | Pump speed, rpm | 950 | 1250 |
| d. | Maximum NPSH required at design point, ft | 6.0 | 7.0 |
| e. | Reprime lift capability, ft | 17 | 17 |
| f. | Spherical solids passing capability, in. diameter | 3 | 3 |

| | | | |
|---|---|---|---|
| g. | Motor horsepower | 40 | 75 |
| h. | Motor speed, rpm | 1750 | 1750 |
| i. | Impeller diameter, in | 14.75 | 14.75 |

(2) Pump Performance:

(a) Each pump must have the necessary characteristics and be properly selected to perform under these operating conditions:

| | | Maugansville Pump Station Design | New Regional Pump Station Design |
|---|---|---|---|
| a. | Capacity, gpm | 1625 | 1760 |
| b. | Total dynamic head, ft | 45 | 76 |
| c. | Maximum static suction lift, ft | 19.82 | 18.35 |
| d. | Discharge static head, ft | 3.0 | -10.3 |

(b) Consideration shall be given to the sanitary sewage service anticipated, in which occasionally debris will lodge between the pump suction check valve and seat, resulting not only in loss of the suction leg, but also in the siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal with proper installation of air release line to atmosphere.

(c) In consideration of such occurrence and of the unattended operation anticipated, each pump shall be so designed as to retain adequate liquid in the pump casing to ensure unattended automatic repriming while operating at its rated speed in a completely open system without suction check valves and with a dry suction leg.

(3) Reprime Performance:

(a) Each pump must be capable of the specified reprime lift while operating at the selected speed and impeller diameter. Reprime lift is defined as the static height of pump suction centerline above liquid that the pump will prime; and delivery within five minutes on liquid remaining in the pump casing after a delivering pump is shut down with the suction check valve removed. Systems requiring ancillary vacuum generating devices shall not be acceptable. Additional standards under which reprime tests shall be run are:

i. Piping shall incorporate a discharge check valve down stream from the pump. Check valve size shall be equal (or greater than) the pump discharge diameter.

ii. A ten-foot length of one-inch pipe shall be installed between pump and discharge check valve. This line shall be open to atmosphere at all times to duplicate the air displacement rate of a typical pump system fitted with an air release valve.

iii. No restrictions shall be present in pump or suction piping that could serve to restrict the rate of siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a minimum horizontal run of 2 feet and one 90-degree elbow.

iv. The pipe size used for the reprime performance test shall be the same size as the pump suction diameter.

v. Impeller shall be set at the clearances recommended by the manufacturer in the pump service manual.

vi. Reprime lift repeatability shall be demonstrated by five sequential reprime cycles.

vii. Liquid to be used for reprime test shall be water.

(4) Serviceability: The Pump Manufacturer shall demonstrate to the ENGINEER'S satisfaction that due consideration has been given to reducing maintenance costs by incorporating the following features:

(a) No special tools shall be required for replacement of any components within the pump.

(b) The mechanical seal shall be a one piece cartridge type to allow for easy replacement. Mechanical seals requiring assembly of individual components shall not be acceptable.

(c) The pump must be equipped with a removable suction head, allowing access for service and repair without removing suction or discharge piping.

(d) The pump shall be fitted with a replaceable wear plate that is clamped between a machined shoulder in the pump casing and the suction head flange.

(e) Replacement of the wear plate, impeller, seal, and suction check valve shall be accomplished through the removable suction head without removing suction or discharge piping.

(f) The entire rotating assembly, which includes bearings, shaft, seal, and impeller, shall be removable as a unit without removing the pump volute or piping through the removable suction head or through the shaft end of the pump.

(g) Each pump shall incorporate a suction flap valve that can be removed or installed through the removable suction head opening, without disturbing the suction piping. Sole function of the suction flap valve shall be to eliminate re priming with each cycle. Pumps requiring suction flap valves to prime or reprime will not be acceptable.

(h) Atmospheric isolation: The shaft bearings shall be isolated from the seal cavity with an air gap to provide positive protection of the bearings in the event of a seal leak and to provide for external monitoring of the seal integrity.

(i) Rotating assembly impeller clearance adjustment: Adjustment of the impeller face clearance (distance between impeller and front wear plate) shall be accomplished by moving the entire rotating assembly towards the wear plate by removal of stainless steel shims between the rotating assembly and the volute. Suction head shall be capable of being removed without disturbing clearance settings.

(j) Clearance adjustment that requires movement of the shaft without movement of the entire rotating assembly, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.

(5) Construction:

(a) The pump, excluding the base frame and motor, shall be manufactured of iron that is melted and cast in the United States.

(b) Pump design: Pumps shall be the original design of the pump manufacturer. Products violating intellectual property regulations shall not be allowed, as they may violate domestic or international law and expose the user or ENGINEER to unintended liabilities. Reverse-engineered products fabricated to imitate the design of original products shall not be allowed as they may contain substantial differences in tolerances and material applications that may contribute to product failure.

(c) Hardware: All hardware, nuts and bolts, shall be Unified Thread Standard (UNC) per ASME/ANSI standards.

(d) Pump casing: Made of gray iron no. 30, shall be foot supported, and shall have a horizontal centerline suction and vertical discharge. Suction connection and discharge connection shall be vertically in-line with one another.

i. The casing shall have a top mounted 3-1/2 inch priming fill port with a safety lock bar cover. In consideration for safety, hand nut threads must provide slow release of pressure, and the clamp bar shall be retained by detent lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.

ii. Casing shall have no openings of smaller diameter than the specified sphere size.

iii. Casing shall be designed to retain sufficient liquid to ensure automatic repriming and unattended operation.

iv. A minimum 1-1/2 inch diameter drain hole shall be provided for attachment of the pump drain kit and to ensure complete and rapid draining.

v. Bolts and other threaded fasteners shall have Unified National Standard threads.

vi. Pump shall be provided with a separate capped threaded port for use of an optional casing heater (casing heater not required).

(6) Suction Head: Provide high-grade cast iron suction head that shall direct water into the pump impeller. The suction head shall be provided with a shoulder clamp to allow for removal.

(a) Removable clean out cover plate: Cover plate shall be cast iron Class 30. Retained by hand nuts for complete access to pump interior. Cover plate removal must provide ample clearance for removal of stoppages, and allow removal or service of suction flap valve.

(b) Suction flap valve: Molded neoprene with integral steel reinforcement. Removal or installation of the check valve must be accomplished through the cover plate opening without disturbing the suction piping. Sole function of the suction flap valve shall be to save energy by eliminating need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.

(c) Replaceable front wear plate: A replaceable front wear plate secured to the pump casing. The wear plate shall be ductile iron. The wear plate shall be of sufficient width to maintain the manufacturer's recommended clearance between the entire edge of each impeller vane and the wear plate. The wear plate shall be clamped between a machined shoulder in the pump casing and the suction head flange. The wear plate shall be provided with integral pusher bolt capability for easy removal.

(d) In consideration for safety, a pressure relief valve shall be furnished as an integral part of the suction head. Relief valve shall open at 75 – 200 PSI.

(7) Rotating assembly:

(a) Impeller: Impeller shall be two-vaned, semi-open, non-clog, cast in ductile iron, with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lockscrew.

(b) Shaft: Shaft shall be constructed of Stainless Steel No. 17-4PH and shall employ an Alloy Steel No. 4130 shaft sleeve.

(c) Mechanical seal: A mechanical cartridge seal shall seal the pump shaft against leakage. The stationary sealing member and the mated rotating face shall be tungsten titanium carbide. Each of the mated surfaces shall be lapped to a flatness of three light bands (35 millionths of an inch), as measured by an optical flat under monochromatic light.

The stationary seal seat shall be double floating so that faces will not lose alignment during periods of shock loads that will cause deflection, vibration, and axial movement of the pump shaft. The seal shall be warranted for five (5) years from date of shipment.

(d) Lubrication: Separate oil filled cavities, vented to atmosphere, shall be provided for the lubrication of shaft seal and bearings. Oil cavities shall be cooled by the liquid being pumped. Three lip seals will prevent leakage of oil.

i. The bearing cavity shall have an oil level sight gauge and fill plug with check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.

ii. The seal cavity shall have an oil level sight gauge and fill plug with vent. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the vented fill plug.

iii. Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.

(e) Atmospheric isolation: The shaft bearings shall be isolated from the seal cavity with an air gap to provide positive protection of the bearings in the event of a seal leak and to provide for external monitoring of the seal integrity.

(f) Seal plate: Replaceable seal plate shall be constructed of ductile iron shall be bolted to the bearing housing.

(g) Back wear plate: Replaceable back wear plate shall be constructed of ductile iron shall be secured to the seal plate by four welded studs and nuts.

(h) Shaft bearings: Shall be anti-friction ball or tapered roller bearings, of ample size and proper design to withstand all radial and thrust loads which can reasonably be expected during normal operation. Pump designs in which the same oil lubricates both the shaft bearings and the shaft seal shall

not be acceptable.

(i) Rotating assembly shall have threaded holes to accept pusher bolts to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same cap screws as used for retaining rotating assembly.

(8) Suction and discharge spools: Each pump shall be equipped with one-piece, cast iron spools, flanged on each end. Each spool shall have one 1 1/4-inch NPT and one 1/4-inch NPT tapped hole with pipe plugs for mounting of gauges or other instrumentation.

h. Pump Accessories

(1) Spare Parts: Furnished the following spare parts:

(a) Two (2) Spare Parts Kit(s) each including one (1) mechanical cartridge seal, one (1) set of rotating assembly adjustment shims, one (1) cover plate “o”-ring, one (1) rotating assembly “o”-ring

(b) One (1) complete rotating assembly

(c) One (1) impeller

(d) One (1) front wear plate

(e) One (1) impeller shaft

(f) One (1) impeller socket head capscrew

(g) One (1) impeller washer

(h) Four (4) suction flap valve assemblies

(i) One (1) belt tensioning gauge(s) – spring loaded

(j) Two (2) quart(s) of seal lubricant

(k) One (1) air pump for bubbler level control system

(l) Two (2) air pump repair kits for bubbler level control system

(m) Two (2) air pump connector rod kits for bubbler level control system

(n) Two (2) air pump inline check valves

(o) Two (2) air release valve diaphragms

(p) Two (2) air release valve springs

(q) One (1) ARV spring compression tool

(r) One (1) gallon touch-up paint, white

(s) One (1) quart touch-up paint, safety orange

(2) Gauge Kit With Vibration Isolation Frame:

(a) Each pump shall be equipped with a glycerin-filled compound gauge to monitor suction pressures, and a glycerin-filled pressure gauge to monitor discharge pressures. Gauges shall be a minimum of 4-inches in diameter, and shall be graduated in feet water column. Rated accuracy shall be 1 percent of full-scale reading. Compound gauges shall be graduated -34 feet to +34 feet water column minimum. Pressure gauges shall be graduated 0 to 140 feet water column minimum.

(b) Gauges shall be mounted on a vibration isolation frame assembly with resilient panel, frame, and adjustable brackets which shall be firmly secured to pumps or piping. Gauge installations shall be complete with all hoses and fittings, and shall include a shutoff valve installed in each gauge inlet at the point of connection to suction and discharge pipes.

(c) Gauge kit shall be supplied with stainless steel fittings.

(3) Pump Drain Kit:

(a) A pump drain kit shall be provided, including the following:

i. One set of drain fittings for each pump. Each set of drain fittings includes a pipe nipple, bushing, bronze ball valve and aluminum quick connect male Kamlock fitting.

ii. One drain hose for common use among all pumps. Drain hose shall consist of a 10’ length of plastic hose with an aluminum quick connect female Kamlock fitting on one end.

(b) All fittings shall be supplied as stainless steel, unless specified otherwise above.

i. Valves And Piping

(1) Check Valves, 10 in.:

(a) Each pump shall be equipped with a full flow type check valve, each capable of passing a 3” spherical solid, with flanged ends and be fitted with an external lever and spring. The valve seat shall be constructed of stainless steel and shall be replaceable. The valve body shall be cast iron. The valve shall be equipped with a removable cover plate to permit entry for complete removal and replacement of internal components without removing the valve from the line. Valve clapper shall have a molded neoprene seating surface incorporating low pressure sealing rings. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings, sealing bushing shall have double o-rings. O-rings shall be easily replaceable without requiring access to interior of valve body. Valve shall be rated at 175-PSI water working pressure, 350-PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3” spherical solid shall not be acceptable.

(b) Each check valve shall be provided with a ¼-inch treaded tap with plug on the downstream side of the valve for installation of a pressure gauge.

(2) Check Valves, 12 in.:

(a) Each pump shall be equipped with a full flow type check valve, each capable of passing a 3” spherical solid, with flanged ends and be fitted with an external lever and spring. The valve seat shall be constructed of stainless steel and shall be replaceable. The valve body shall be cast iron. The valve shall be equipped with a removable cover plate to permit entry for complete removal and replacement of internal components without removing the valve from the

line. Valve clapper shall have a molded neoprene seating surface incorporating low pressure sealing rings. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings, sealing bushing shall have double o-rings. O-rings shall be easily replaceable without requiring access to interior of valve body. Valve shall be rated at 175-PSI water working pressure, 350-PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable.

(b) Each check valve shall be provided with a ¼-inch treaded tap with plug on the downstream side of the valve for installation of a pressure gauge.

(3) Plug Valve, 10 in.:

(a) A 3 - way plug valve must allow either or both pumps to be isolated from the force main. The plug valve shall be non-lubricated, tapered type. Valve body shall be semi-steel with flanged end connections drilled to 125-pound standard. The drip-tight shutoff plug shall be mounted in stainless steel bearings and shall have a resilient facing bonded to the sealing surface. Valve shall be operated with a chainfall actuator.

(b) Three way plug valve shall include an upper journal grease fitting and a lower journal grease fitting for lubrication of the shaft.

(4) Plug Valve, 12 in.:

(a) A 3 - way plug valve must allow either or both pumps to be isolated from the force main. The plug valve shall be non-lubricated, tapered type. Valve body shall be semi-steel with flanged end connections drilled to 125-pound standard. The drip-tight shutoff plug shall be mounted in stainless steel bearings and shall have a resilient facing bonded to the sealing surface. Valve shall be operated with a chainfall actuator.

(b) Three way plug valve shall include an upper journal grease fitting and a lower journal grease fitting for lubrication of the shaft.

(5) Air Release Valves (Diaphragm Type):

(a) Each pump shall be equipped with one pressure actuated automatic air release valve, designed to permit the escape of air to the atmosphere during initial priming or unattended repriming cycles. Upon completion of the priming or repriming cycle, the valve shall close to prevent recirculation. Valves shall provide visible indication of valve closure, and shall operate solely on discharge pressure. Level/float actuated air release valves shall not be acceptable.

(b) All valve parts exposed to sewage shall be constructed of cast iron, stainless steel, or similar corrosion resistant materials. Diaphragms shall be fabric-reinforced neoprene or similar inert material.

(c) A cleanout port, 3 inches or larger in diameter, shall be provided for ease of inspection, cleanout, and service.

(d) Valves shall be field adjustable for varying discharge heads.

(e) Air release valves shall be connected to pump station piping using stainless steel pipe fittings.

(f) Each air release valve shall be provided with an isolation ball valve.

(g) Air release valve piping must discharge directly into wet well. ARV piping shall not discharge to a sump.

(h) Each air release valve shall have a separate air release discharge pipe back to the wet well for each air release valve. Discharge pipe shall be minimum 1-½-inch diameter.

(6) Header Piping:

(a) Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and Class 53 thickness. Flanges shall be cast iron Class 125 and comply with ANSI B16.1. All piping pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.

(b) Boltholes shall be in angular alignment within ½-degree between flanges. Flanges shall be faced and a gasket finish applied that shall have concentric grooves a minimum of 0.01 inch deep by approximately 0.03 inch wide, with a minimum of three grooves on any given surface spaced a maximum of ¼ inch apart.

(7) Supports and Thrust Blocks:

(a) CONTRACTOR must ensure all pipes connected to the pumping system are supported to prevent piping loads from being transmitted to pumps or system piping.

(b) Pump station discharge force main piping shall be anchored with thrust blocks by the CONTRACTOR where shown on the contract drawings.

(8) Gauge Connection Assembly:

(a) The header piping shall be equipped with a gauge connection assembly located between the discharge check valve and force main isolation plug valve allowing the operator to easily attach a discharge gauge on any pump for troubleshooting.

(b) The gauge assembly shall consist of a 1/4" brass pipe nipple, 1/4" brass full port ball valve and a quick connect fitting.

(c) The gauge connection assembly shall be installed in the discharge header piping such that the static and dynamic pressure in the force main can be read at all times unless the force main isolation plug valve is closed for that particular pump.

j. Drive Unit

(1) Motors:

(a) Provide motors as specified herein. Any additional motor requirements specified in another Specification Section, but not specified herein, shall not apply to the motors for this equipment.

(b) The pump motors shall be horizontal, totally enclosed fan cooled, induction type, with normal starting torque and low starting current characteristics.

(c) The motors shall not be overloaded at the design condition or at any head in the operating range as specified.

(d) Motors shall be suitable for use with variable frequency drives.

(e) Motors shall be tested in accordance with provisions of ANSI/IEEE Std. 112.

(f) Each motor shall be in current NEMA design B cast iron frame with copper windings.

(g) Motors shall be NEMA Premium Efficient, per NEMA MG-1, Table 12-12.

(2) Drive Transmission:

(a) Power shall be transmitted from motors to pumps by means of v-belt drive assemblies. The drive assemblies must be selected to establish proper pump speed to meet the specified operating conditions.

(b) Each drive assembly shall have a minimum of two v-belts. In no case will a single belt drive be acceptable. Each v- belt drive assembly shall be selected on the basis that adequate power will be transmitted from driver to pump. Drive systems with a safety factor of less than 1.5 shall not be considered sufficient for the service intended. Computation of safety factors shall be based on performance data published by the drive manufacturer.

(c) V-belts shall be the banded type.

(3) Belt Guards:

(a) Pump drive transmissions shall be enclosed on all sides in a guard constructed of any one or combination of materials consisting of expanded, perforated, or solid sheet metal, except that maximum perforated or expanded openings shall not exceed ½ inch.

(b) Guards shall be manufactured to permit complete removal from the pump unit without interference with any unit component, and shall be securely fastened to the unit base.

(c) All metal shall be free of burrs and sharp edges. Structural joints shall be continuously welded. Panels may be riveted to frames with not more than five-inch spacing. Tack welds shall not exceed four-inch spacing.

(d) The guard shall be finished with one coat of gray W.R. non-lift primer and one coat of orange acrylic alkyd W.R. enamel in accordance with section 3, Color Definitions of ANSI 253.1; Safety Color Code for Marking Physical Hazards.

k. Finish

(1) Surface Preparation and Painting:

(a) Pumps, piping, and exposed steel framework shall be cleaned prior to coating, using an approved solvent wipe or phosphatizing cleaner. The part must thoroughly dry before pain application. Open joints shall be caulked with an approved polyurethane sealant.

(b) Exposed surfaces to be coated with one coat of Tnemec Series 69 Polymide Epoxy primer and one finish coat of Series 73 Aliphatic Acrylic Polyurethane for a total dry film thickness of 4-6 mils. Finish coat shall be semi-gloss white for optimum illumination and enhancement.

(c) The finish coat shall be corrosion, moisture, oil, and solvent resistant when completely dry.

(d) The factory finish shall allow for over-coating and touch up for 6 months after coating. Thereafter, sanding may be required to accept a topcoat or touch-up coating.

l. Pump Control System

(1) General:

(a) This specification covers a pump control system for the duplex pumping system including motor circuit breakers, variable frequency drives, thermal overload relays, door mounted operator controls, and liquid level controls.

(b) The liquid level control will include an air bubbler level control system, electronic pressure switch, pump sequence control, alarms and pump safety shutdowns.

(2) UL Listing:

(a) The pump controls shall be manufactured by the pump manufacturer who shall be a UL panel builder and each assembly shall bear a serialized UL label listed for "Enclosed Industrial Control Panels."

(b) The enclosure and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures. Listing for open style industrial control panels or an assembly of listed or recognized components shall not be acceptable.

(3) Panel Enclosure:

(a) Enclosure shall be constructed in conformance with applicable section of national electrical manufacturers' association (NEMA) standards for Type 1 electrical enclosures. Enclosure shall be fabricated of stainless steel having a minimum thickness of not less than 0.075 inch (14 gauge).

(b) Door shall be hinged and sealed with a neoprene gasket and shall be held closed with clamps that are quick and easy to operate. The door shall accommodate the mounting of switches and indicators.

(c) Enclosure shall be furnished with a removable back panel, fabricated of steel having a thickness of not less than 0.106 inch (12 gauge), which shall be secured to the enclosure with collar studs. Such panel shall be of adequate size to accommodate all basic components.

(d) All control components shall be securely fastened to a removable back panel with screws and lock washers. Switches, indicators and instruments shall be mounted through the control panel door. Self-tapping screws shall not be used to mount any components.

(e) Each control assembly shall be furnished with main terminals and ground lug for field connection of the

electrical supply. The connections shall be designed to accept copper conductors of sufficient size to serve the loads. The main terminals shall be mounted to allow incoming wire bending space in accordance with article 373 of the National Electric Code (NEC). A separate terminal strip shall be provided for 115 volt, single-phase control power and shall be segregated from the main terminals. Ten percent of the control terminals shall be furnished as spares.

(4) Motor Branch Components:

(a) Three-phase Circuit Breakers:

i. Pump #1 VFD
ii. Pump #2 VFD
iii. Pump #1 RVSS Bypass
iv. Pump #2 RVSS Bypass
v. Station Heater
vi. Wet Well Grinder

(b) All motor branch components shall be of the highest industrial quality. Operating coils of all AC control devices shall be rated for 120 volts, and shall be suitable for use in a voltage range of 108 to 132 volts, 60 hertz. The short circuit rating of all power circuit devices shall be a tested combination or evaluated per the National Electric Code Article 409. The lowest rated power circuit component shall be the overall control panel short circuit rating and shall not be less than the fault current available. The minimum control panel rating shall not be less than 10 kA, rms symmetrical. Control assemblies operating at 120 volts nominal or less may be provided with transformers which limit that fault current and may be rated less than the minimum required short circuit rating.

(c) Circuit Breakers and Operating Mechanisms:

i. A padlocking operating mechanism shall be installed on each motor circuit breaker. Operator handles for the mechanisms shall be located on the exterior of the control compartment door, with interlocks which permit the door to be opened only when circuit breakers are in the “off” position.

(5) Variable Frequency Drives:

(a) The inverter shall be suitable for operation of NEMA Design B, 4 pole motors. The inverter will have a diode bridge rectifier on the input to minimize the generation of electrical noise back into the line and provide near unity power factor. Output devices shall be transistors.

(b) Environment Conditions: The inverter shall be capable of operation under any combination of the following conditions without mechanical or electrical damage. Ambient Temperature: 0 to + 40 degrees C Relative Humidity: Less than 95% non-condensing Altitude: Less than 1,000M (3300 ft) above sea level Vibration: 0.006 inches displacement, 1G peak Shock: 15G peak for 11mS (+/- 1.0mS)

(c) Control Specification:

| | |
|---|---|
| Control System: | Sinusoidal pulse width modulated voltage waveform |
| Frequency Accuracy: | +/- 0.4% of max. frequency |
| Volts/Hertz Ratio: | V/Hz user programmable |
| Operation Frequency: | 0 to 400 Hz |
| Overload Capacity: | 110% Overload capability for up to 1 minute 150% Overload capability for up to 3 seconds |

(d) Digital Readout and Monitor:

i. Interface to the drive is provided via a module with integral LCD display. Unit is a 7 line by 21 character backlit LCD display with graphics capability. It is used to display drive operating conditions, fault / alarm indications and programming information with full text support in multiple languages, including but not limited to English, German, French, Italian, Spanish, Portuguese and Dutch. The unit will display standby status (power on, not running), output frequency (drive run), set-up parameters and fault. With keypad, user can monitor current, voltage, frequency, acceleration and deceleration time, minimum frequency and maximum frequency. Readout also provides inverter status and protective circuits status.

(e) Protection

i. The variable speed drive system shall include a diode or fully gated bridge rectifier, capacitor filter, and transistorized inverter section. Base driver signals to control firing of the power transistors will be designed with optically coupled isolators for maximum protection of the control circuits from high voltage and noise. The output will be a sinusoidal, pulse width modulated, voltage waveform for reduced harmonic heating in the motor.

ii. The system protection will provide the following:

1) Intermittent overload - 50 to 150%
2) Current limit - 50 to 115%
3) Overcurrent - 220-300% of rated output current
4) Inverse time overload - 50 to 100%
5) Short circuit - Phase to phase or phase to ground
6) Overvoltage - 10% above input line or DC bus voltage
7) Undervoltage - 10% below line voltage
8) Power loss ride-through - 500mS

iii. When the inverter trips out on a fault, the fault relay shall activate and the display shall indicate the reason for the trip as follows:

1) Overcurrent
2) Short circuit
3) Overload
4) Overvoltage
5) Undervoltage
6) Overheat
7) Ground fault
8) Motor stalled
9) Power supply fault

iv. Auto restart shall occur when the inverter faults. Auto restart shall be adjustable up to 9 attempts with 0.5 to 30 second intervals. Auto restart will not be attempted for ground fault, output shorted, transistor shorted or internal microprocessor fault

but will trip out immediately, activate the fault relay and make the appropriate indication on the display.

v. In the event of a fault trip, the microprocessor shall save the status of the inverter at the time of the fault and make that information available on the digital display. Information regarding the last 4 faults is maintained in event of a power loss.

(f) Operational Functions:

i. Acceleration and deceleration time independently adjustable from 0.1 to 3600.0 seconds (selectable ranges).

ii. Volts/Hertz patterns user selectable.

iii. Maximum and minimum frequency limit adjustments.

(6) Line Reactors:

(a) Each drive assembly will be furnished with a 3% input line reactor. The line reactor shall provide circuit inductance to slow the rate of rapid current changes and to act as a buffer between the drive and the electrical distribution system. The line reactor is designed to minimize nuisance tripping, line notching, cross talk, harmonic current demand and voltage distortion.

(b) The line reactor shall be constructed of copper wire or foil wound on steel cores. Reactors will be sized for the total connected load and shall be rated for 150% of nominal 60 Hz current for 5 minutes. Reactors shall be UL recognized and suitable for use in UL 508 applications.

(c) The line reactor shall be mounted inside each drive unit and connected between the circuit breaker and drive input.

(7) Bypass Contactors:

(a) Each pump motor shall be furnished with a reduced voltage solid-state (RVSS) bypass system. Each system shall include a separate circuit breaker, a RVSS motor starter, and an isolation contactor for the VFD.

(b) The control system shall include a Bypass-Off-VFD (BOV) switch and a bypass run light. The BOV switch shall include three positions: Bypass, Off and VFD. The BOV switch shall be mounted in the door of the pump control panel.

(c) A bypass elapsed time (ET) meter and pilot light shall be provided for each pump motor and shall be mounted in the door of the control panel.

(d) A RVSS motor starter, circuit breaker and bypass contactor shall be provided for each pump motor and shall be mounted in the pump control panel. The isolation contactor for each VFD shall be mechanically interlocked with the RVSS bypass motor starter to prevent simultaneous operation.

(e) In the event of a drive fault, the BOV switch shall be manually set to the Bypass position to operate the pump motors using the full voltage starters. When set to the Bypass position by the operator, the pump control panel shall be configured to operate the pumps at full speed and full voltage either manually or automatically through the level control.

(8) Indicators:

(a) Physical indicating light operators shall be made of an industrial grade thermoplastic and chemical-resistant for harsh environments. Lights shall have a protection rating of IP 65/66 (type 3/3R/4/4X/12/13). Lights shall include an easily replaceable, integrated LED power module for long lamp life. Indicating lights shall be push-to-test.

(b) Indicating lights will be furnished for the following functions:

i. General alarm (Integrinex) - Red
ii. Pump No. 1 run - Green
iii. Pump No. 2 run - Green
iv. Pump Fault, No. 1 - Red
v. Pump Fault, No. 2 - Red
vi. Drive Fault, No. 1 - Red
vii. Drive Fault, No. 2 – Red
viii. Pump No. 1 Bypass Run – Green
ix. Pump No. 2 Bypass Run – Green

x. High Water Alarm - Red

(9) Control Circuit Components:

(a) Single Phase Circuit Breakers

i. Outlet
ii. Fan
iii. Station Light
iv. Security Light

(b) A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.

(c) Pump mode selector switches shall permit manual start or stop of each pump individually, or permit automatic operation under control of the liquid level control system. Manual operation shall override all shutdown systems, except the drive fault. Selector switches to be heavy duty, oil-tight design with contacts rated NEMA A300 minimum.

(d) Six digit elapsed time meter (non-reset type) shall be connected to each motor starter to indicate total running time of each pump in "hours" and "tenths of hours".

(e) The PLC shall be an Allen-Bradley CompacLogix Model L2. The PLC shall be equipped with a CPU and Ethernet communication ports.

(f) The PLC shall operate on 120vac power and be equipped with the communication devices, digital and analog I/O necessary to accomplish the specified operation. A minimum of 10% spare of the I/O used shall be supplied.

(g) The program logic shall be stored in battery backed random access memory, as well as on a programmable, read only memory module. The memory module shall auto load and run when installed in the programmable control processor and is included to facilitate field repair or replacement of the programmable control hardware without the use of programming terminals or personal computers.

(h) The PLC shall communicate with the drive using Ethernet. The PLC shall issue drive start/stop and speed commands. Drive status shall also be communicated using Ethernet.

The drive shall be configured to operate manually without the use of the PLC.

(i) An Allen-Bradley Panelview 1000C color electronic operator interface shall be provided for data entry and display. The operator interface shall be mounted on the front of the control panel with other operator controls and shall be compatible with the PLC DFI communication protocol. The operator interface shall be a backlit, touch-screen terminal.

(j) Electromechanical relays and timers, when used shall be equipped with 120vac coils and contacts rated NEMA A-300 minimum. Timers shall be pneumatic or synchronous motor driven.

(k) A duplex ground fault receptacle providing 115 VAC, 60 Hz, single-phase current, will be mounted on the control enclosure. Receptacle circuit shall be protected by a 15-ampere thermal-magnetic circuit breaker.

(10) Control Logic:

(a) Control logic shall be accomplished using programmable controllers. Electromechanical relays may be used when necessary. However, the primary control logic shall be performed by the PLC.

(b) The O&M manual shall be provided with complete ladder logic program documentation including English names, rung comments, and coil/contact cross-references.

(c) The control shall be pre-programmed or wired to provide the following routines:

i. Pump alternation at lead stop
ii. Excessive pump run time alternation
iii. Jump to next pump on lead failure
iv. Duplex pump operation
v. Start/stop pumps at normal level settings
vi. Pump start delays when called to run simultaneously
vii. General alarm pilot light activation: Quick flashing alarm/slow flashing acknowledge/ steady on reset/off when clear
viii. Station trouble alarm (115vac and normally open dry contact)

ix. High and low level alarms
x. Pump start/stop level control
xi. Drive speed/level control
xii. Pump high temperature shutdown
xiii. Drive fault alarm

(d) The operator interface shall be equipped with the following displays and functions:

i. Main Menu
ii. Wet Well Level
iii. Wet Well Level Simulation
iv. Low Water Alarm Status
v. High Water Alarm Status
vi. Pump High Temperature Status #1, #2
vii. Drive Fault Status #1, #2
viii. Pump Sequence Selection
ix. Alarm Silence
x. Alarm Reset
xi. General Alarm Lamp Test
xii. Lead Level Start/Stop Setpoints
xiii. Lag Level Start/Stop Setpoints
xiv. Low Water Alarm Setpoints
xv. High Water Alarm Setpoints
xvi. Speed/Level Setpoints (1 pump running)
xvii. Speed/Level Setpoints (2 pumps running)
xviii. Power-up Delay Setpoint
xix. Alarm Delay Setpoint
xx. Pump Start Delay Setpoint
xxi. Alternation Time Interval Setpoint
xxii. Level Transmitter Calibration
xxiii. Alarm History (minimum 20 events)

(11) High Pump Temperature Shutdown:

(a) The control panel shall be equipped with circuitry to override the level control system and shut down the pump motor(s) when required to protect the pump from damage caused by excessive temperature.

(b) A thermostat shall be mounted on each pump to detect its temperature. If the pump temperature should rise to a level that could cause pump damage, the thermostat shall cause the pump motor to shut down. A visual mechanical indicator shall indicate that the pump motor has been stopped because of a high temperature condition.

(c) The pump shall remain locked out until the pump has cooled and the circuit has been manually reset. Automatic reset of such a circuit shall not be acceptable.

(12) Elapsed Time Meters:

(a) Six-digit elapsed time meters (non-reset type) shall be connected to each motor starter to indicate the total running time of each pump in "hours" and "tenths of hours".

(13) Elapsed Time Meter for Two Pump Operation:

(a) A Six-digit elapsed time meter (non-reset type) shall be connected to both motor starters to indicate the total running time of both pumps operating simultaneously. Activation of ETM for two pump operation shall not disable individual ETM's.

(14) Pump Start Delay:

(a) The lag pump will be equipped with a time delay to prevent simultaneous motor starts.

(15) Alarm Contacts:

(a) Provide separate alarm contacts for the following alarm conditions:

i. High water
ii. Phase failure
iii. Pump fault, #1
iv. Pump fault, #2
v. VFD Fault, #1
vi. VFD Fault, #2
vii. Station low temperature
viii. Pump run, #1 – normally open
ix. Pump run, #2 – normally open
x. Pump run, #1 – normally closed
xi. Pump run, #2 – normally closed
xii. Simultaneous pump run – normally open (Activation of simultaneous run contact shall deactivate individual pump run contacts.)
xiii. Backup level control active

(16) Three Phase Voltage Monitor:

(a) The control panel shall be equipped to monitor the incoming power and shut down the pump when required to protect the motor(s) from damage caused by phase-reversal, phase loss and voltage. The motor(s) shall automatically restart when power conditions return to normal.

(17) Secondary Surge Arrestor:

(a) All Control Panels shall have Surge Protective Devices installed immediately after the main overcurrent device or immediately after the supply conductors to the panel have been terminated. The Surge Protective Device(s) shall follow IEEE C62.41 recommendation for cascading to protect all voltage levels to and including 24 volts AC/DC and shall be as follows:

(b) Be UL 1449 3rd Edition Recognized for UL Type 2 applications except at 48 volts AC/DC and below may be UL 1449 3rd Edition for Type 3 applications.

(c) Provide suppression for both normal mode (L-N [Wye]) and common mode (L+N-G [Wye] or L-G [Delta]).

(d) Have a Surge Current Capacity (Imax) of at least 40kA.

(e) Have a Nominal Surge Current Rating (In) of 20kA.

(f) Have SCCRs of 200kA, except that 347Y/600V, 240/480V High leg Delta and 347V single-phase SPDs shall have a minimum SCCR of 125kA.

(g) Use MOV technology with thermal disconnect.

(h) Be RoHS compliant.

(i) SPD status monitoring shall be provided by local visual indication and, if needed, by remote contact signaling using an optional Form C contact relay.

(j) Hardwired Listed Type 1 or Type 2 Surge Protective Devices Shall:

(a) All Type 1 or Type 2 surge protective devices shall be manufactured by a single ISO-9001 registered company normally engaged in the design, development and manufacture of such devices for electrical distribution system/ equipment protection. Surge protective devices shall be UL Listed with a Short-Circuit Current Rating of 200kA, Nominal Discharge Current (In) of 20kA, and Surge Current Capacity (Imax) of120kA, 200kA, 300kA or 400kA. These SPDs shall be installed in accordance with the NEC® and/or local code requirements. The said manufacturer shall offer a minimum five (5)

year warranty for its Type 1 and Type 2 surge protective devices.

(b) The hardwired surge protective device shall have specifications as shown below:

(c) The Maximum Continuous Operating Voltage (MCOV) shall not exceed 25% on Wye and 40% on Delta systems of the nominal voltage (system voltage) in the configuration being used

(d) Prewired NEMA 1 or NEMA 4X factory sealed enclosure suitable for the intended installation location

(e) Shall have a two color LED status indicator per phase

(f) Have an operating temperature range of at least -40˚C to +50˚C

(g) Only use thermally protected MOV technology, such as Bussmann SurgePOD™.

(h) Surge Protective Device Agency Information: SPDs shall be "Listed" by Underwriters Laboratories, Inc. to UL 1449 3rd Edition as a Type 1 or Type 2 device and shall exhibit the UL Listing mark for the UL category VZCA for USA and/or VZCA2 for Canada; and must have CSA certification.

(i) Manufacturers must provide verification of performance data for UL and CSA standards.

(j) All SPDs must be RoHS compliant.

(k) Surge protective devices shall be installed and located in accordance with the all applicable agency, NEC® and local code requirements. The SPDs must be suitable for the particular installation, be it on the upstream side (Type 1) or downstream side (Type 1 or Type 2) of service entrance Overcurrent Protective Device (OCPD).

(l) All SPDs shall match voltage and system specific requirements as provided by the manufacturer.

(m) All SPDs shall provide surge protection for both normal mode (L-N [Wye], L-L [Delta]) and common mode (L+N-G [Wye] or L-G [Delta]).

(n) Surge protective device shall be clearly marked with specifications as required by UL 1449 3rd Edition along with UL holographic label on the SPD.

(o) Each surge protective device should be serial numbered along with barcode for easy identification and traceability.

(18) Receptacle:

(a) A duplex ground fault interrupter utility receptacle providing 115 VAC, 60 hertz, single-phase current shall be provided. Receptacle circuit shall be protected by a 15-ampere thermal-magnetic circuit breaker.

(19) Auxiliary Power Transformer:

(a) A 5 KVA step-down transformer shall be provided to supply 115 volt, AC, single phase for the control and auxiliary circuits. The primary side of the transformer shall be protected by a thermal-magnetic air circuit breaker, specifically sized to meet the power requirements of the transformer. A mechanical operating mechanism shall be installed on the circuit breaker to provide a means of disconnecting power to the transformer.

(b) A padlockable operator handle for the operating mechanism shall be located on the exterior of the control panel with interlocks which prevent opening the door until primary circuit breaker is in the "OFF" position.

m. Wiring

(20) General:

(a) The pump control as furnished by the manufacturer shall be completely wired except for the power feeder lines to the branch circuit breakers and final connections to remote alarm devices and between control assemblies.

(b) All wiring, workmanship, and schematic wiring diagrams shall be in compliance with applicable standards and specifications set forth by the National Electric Code (NEC).

(c) All user serviceable wiring shall be type MTW or THW, 600 volts, and shall be color-coded as follows:

| | | |
|---|---|---|
| i. | Line and load circuits, AC or DC power | Black |
| ii. | AC control circuit less than line voltage | Red |
| iii. | DC control circuit | Blue |
| iv. | Interlock control circuit, from external source | Yellow |
| v. | Equipment grounding conductor | Green |

| | | |
|---|---|---|
| vi. | Current carrying ground | White |
| vii. | Hot with circuit breaker open | Orange |

(2) Wire Identification and Sizing:

(a) Control circuit wiring inside the panel, with the exception of internal wiring of individual components, shall be 16-gauge minimum, type MTW or THW, 600 volts. Motor branch wiring shall be 10-gauge minimum.

(b) Motor branch conductors and other power conductors shall not be loaded above 60-degree C temperature rating, on circuits of 100 amperes or less, nor above 75-degree C on circuits over 100 amperes. Wires shall be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be of the ring tongue type with nylon insulated shanks. All wires on the subplate shall be bundled and tied or installed in duct. All wires extending from components mounted on door shall be terminated on a terminal block mounted on the back panel. All wiring outside the panel shall be installed in conduit.

(3) Wire Bundles:

(a) Control conductors connecting components mounted on the enclosure door shall be bundled and tied in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall be allowed so that the door can swing to its full open position without undue mechanical stress or abrasion on the conductors or insulation. Bundles shall be clamped and held in place with mechanical fastening devices on each side of the hinge.

(4) Conduit:

(a) All conduit and fittings shall be UL listed.

(b) Liquid tight flexible metal conduit shall be constructed of a smooth, flexible, galvanized steel core with a smooth abrasion resistant, liquid tight, polyvinyl chloride cover.

(c) Conduit shall be supported in accordance with Articles 346, 347, and 350 of the National Electric Code.

(d) Conduit shall be sized according to the National Electric Code.

(5) Grounding:

(a) The pump control manufacturer shall ground all electrical equipment to the enclosure back panel. The mounting surface of all ground connections shall have any paint removed before making final connections.

(b) The CONTRACTOR shall provide an earth driven ground connection to the control panel at the main ground lug in accordance with the National Electric Code (NEC).

n. Level Control System

(1) Liquid Level Control:

(a) The manufacturer of the liquid level control system must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

(b) The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.

(c) The level control system shall be an air bubbler type level control system.

(d) The level control system shall utilize the PLC sequencer to select first one pump, then the second pump for a pumping cycle. The control system shall alternate between the pumps to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle or if one pump runs as the lead pump for an excessive time. The time interval shall be adjustable via the operator interface.

(e) Level and speed controls shall include logical comparator setpoints. Settings shall be provided to control the levels at which the pumps start and stop as well as level endpoints for minimum and maximum speed. Two sets of speed setpoints shall be provided. The first set will be enabled when a single pump is running. The second set shall be enabled when two pumps are running. Each of the settings shall be adjustable and accessible to the operator without opening the control panel. Controls shall be provided to

permit the operator to read and adjust the selected levels and speeds on the operator interface. Setpoint adjustments that require hard wiring, the use of electronic test equipment or artificial level simulation are not acceptable.

(f) Upon operator selection of automatic operation, the PLC shall start and stop the motors for each pump in response to changes in the liquid level in the wet well.

(g) Upon rising wet well level, the lead pump set will start at the "Lead Pump ON" level and shall ramp up and down from maximum speed to minimum speed proportional to wet well level using the lead pump proportional 4 to 20 ma band. Should the wet well level continue to rise to the "Lag Pump ON" level, the lag pump will start and shall ramp up and down from maximum speed to minimum speed with the lead pump using a separate lag pump proportional 4 to 20 ma band.

(h) Each pump shall shut down at its own independent "OFF" level.

(i) In the manual mode, the operator shall be able to manually set the pump(s) speed on the VFD human interface module. The pump(s) shall operate at that speed until the operator either manually changes speed or shuts off the pump(s). Manual controls shall override all automatic controls, with the exception of the drive fault.

(j) Level control range shall be 0 to 12.0 feet of water. Speed control range shall be 20.0 to 60.0 hertz. Overall repeat accuracy shall be (plus/minus) 0.1 feet of water or hertz.

(2) Air Bubbler System:

(a) The level control system shall be the air bubbler type, containing air bubbler piping, which extends into the wet well. A pressure sensor contained within the electronic pressure switch shall sense the air pressure in this piping to provide wet well level signals for the remainder of the level control system.

(b) Two vibrating reeds, industrial rated, air pumps shall be furnished to deliver free air at a rate of approximately 5 cubic feet per hour and a pressure not to exceed 7 psi. Liquid level control systems utilizing air compressors

delivering greater quantities of air at higher pressures, requiring pressure-reducing valves, air storage reservoirs, and other maintenance nuisance items will not be acceptable. A selector switch shall be furnished to provide manual alternation of the air pumps. The switch shall be connected in such a manner that either pump may be selected to operate continuously. The selector switch shall be oil-tight design with contacts rated NEMA A300 minimum.

(c) An air bell constructed of PVC 3 inches in diameter shall be provided for installation at the outlet of the air bubbler line in the wet well. The air bell shall have a 3/8" NPT tapped fitting for connection to the bubbler line.

(d) An air flow indicator gauge shall be provided and connected to the air bubbler piping to provide a visual indication of rate of flow in standard cubic feet per hour.

o. Independent Redundant Float Control (Intrinsically Safe):

(1) General:

(a) The low level float (pump off) is placed below all primary pump off setpoints. The high level float (pump start) is placed above all primary on set-points. If either float condition is achieved, a "Float Control Timer" begins to count. When the timer expires, the float control is latched in, and the floats become active causing an indicating light to become illuminated on the front of the control panel. If the high level float is achieved, a pump will start at a preset speed. If the level persists, the remaining pumps will start in succession at preset speeds, after an adjustable time-period. If the high level float is achieved, both pumps will start, and there will be a High Water Alarm. When the wet well reaches the low level float, all pumps will shut off. The float control includes alternation. The float control system will remain latched until manually reset.

(2) Components:

(a) Intrinsically safe relays, a small PLC, and two (2) non-mercury float switches.

(b) Dry contacts wired to terminal blocks will be provided for the float control active alarm circuit.

(c) Float system includes a stainless steel chain and weight.

## C. Execution

1. Examination

   a. CONTRACTOR shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Pumping equipment manufacturer shall provide written instructions for proper handling. Immediately after off-loading, CONTRACTOR shall inspect pumping 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.

2. Installation

   a. Install, level, and align pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.

   b. Suction pipe connections must be vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump system piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well.

   c. Each air release valve shall have a separate air release discharge pipe back to the wet well for each air release valve. Discharge pipe shall be minimum 1-½-inch diameter, and constantly downward slope towards the wet well.

   d. 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.

   e. 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.

f. After all anchor bolts, piping connections are installed, seal all openings between wet well and pump enclosure.

3. Protection

a. The pumping equipment should be placed into service soon after delivery of the equipment. If installation is delayed, the pumping equipment and motor control center shall be stored indoors, free of excessive dust, in a low humidity, heated environment.

b. During installation and after the pumping equipment is placed into operation the motor control center shall operate in an environment free of excessive dust, in a low humidity, heated environment.

4. Field Quality Control

a. Prior to acceptance by the COUNTY, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

b. Prior to start-up, clean wet well by removing construction debris and foreign material.

5. Manufacturer's Pre-Startup Inspection

a. Coordinate system pre-startup with manufacturer's factory-trained service technician. The factory-trained service technician will inspect the installation and answer any installation questions by the CONTRACTOR, ENGINEER, or OWNER.

b. Manufacturer's representative shall provide pre-startup checklist to be completed by the CONTRACTOR prior to pre-startup inspection.

c. Verify that operations and maintenance manual is on site and installation instructions contained in the manual have been followed.

d. Verify that all pumping equipment, piping, level control system, alarms and ancillary equipment has been properly installed and all wiring is complete.

e. Verify that all spare parts for the pumping equipment are on site.

f. Pre-startup inspection shall be a separate trip and shall not be less than two weeks prior to the startup of the equipment.

6. Manufacturer's Startup and Field Performance Testing

a. 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 COUNTY.

b. Equipment startup shall be tested under both utility power and emergency power.

c. CONTRACTOR shall supply clear water of adequate volume to operate the system including the force main through several pumping cycles.

d. CONTRACTOR shall have an electrician present at startup to resolve any wiring issues.

e. Observe and record operation of pumps, suction and discharge gage readings, voltage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment. Test manual and automatic control systems. Test all alarms. Report any undue noise, vibration or other operational problems.

f. Startup shall be a separate trip.

7. Manufacturer's Operation and Maintenance Training

a. The manufacturer shall furnish the services of a qualified, factory-trained operations and maintenance serviceman to instruct and train COUNTY'S personnel in the proper care, operation and maintenance of the equipment. The training shall include, but not be limited to, the following:

(1) Theory of operation
(2) Actual operation
(3) Mechanical maintenance
(4) Hydraulic troubleshooting
(5) Electrical maintenance
(6) Instrumentation and level controls
(7) Optimization of the system
(8) Alarm circuits
(9) Safe operating and working practices and operation of safety devices.

b. One (1) training session is required. Training shall be completed after startup services have been performed. Training shall be a separate trip and shall not be less than two weeks after the startup of the equipment. Time, location, and duration of all training sessions shall be coordinated with COUNTY or COUNTY'S REPRESENTATIVE.

c. Hands-on training and demonstrations shall use the installed equipment.

d. Supplier shall provide all materials for training and shall provide training manuals to all personnel being trained.

8. Manufacturer's Equipment Re-Certification

a. The CONTRACTOR shall require, and cover the cost in his bid, for the manufacturer's factory-trained service technician to return to the site six (6) month's after initial startup of the equipment to perform a final re-certification of the equipment.

b. The re-certification shall consist of demonstrating and certifying that the equipment is meeting the performance requirements of the specifications. Equipment service technician shall perform field-testing of the equipment in the presence of the COUNTY. Results of all field-testing shall be submitted to the ENGINEER and the COUNTY.

9. Cleaning And Housekeeping

a. Prior to acceptance, inspect interior and exterior of pump station for dirt, splashed material or damaged paint. Clean or repair accordingly. Use touch-up paint provided under spare parts to repair any painted surfaces damaged during installation or startup. Remove from the job site all tools, surplus materials, scrap and debris.

**300-002**
**Comminutor**

## A. Description

1. This section of the specification describes the sewage grinders and motor controllers. The equipment, including spare parts, will be furnished and installed as shown on the plans, as recommended by the supplier, and in compliance with all OSHA, local, State, and federal codes and regulations.

2. Each grinder will be capable of processing pump station's design flow with a maximum headloss of 45 inches of water column on clean wastewater.

3. The comminutor shall be manufactured by Franklin Miller or approved equal, and shall include grinder assembly, submersible drive assembly, wet well and/or channel frame and controller. Materials noted in this Specification shall be installed as shown on the Contract Drawings and as noted in Table 300-002-1.

**Table 300-002-1**
**Location of Specified Materials**

| Specified Material | Location |
|---|---|
| Franklin Miller TaskMaster TM8516 5 hp Submersible Drive Comminutor with pre-fabricated FRP Manhole Assembly | Farm Lane Pump Station |
| Franklin Miller TaskMaster TM14024 5 hp Submersible Drive Comminutor | Maugansville Road Pump Station |
| Franklin Miller TaskMaster TM14024 5 hp Submersible Drive Comminutor | New Regional Pump Station |

4. Quality Assurance

   a. Manufacturer shall have installations of same design equipment in service for at least twenty (20) years to be considered. Supplier shall provide a list of names and dates of installations for verification by the ENGINEER or COUNTY.

## B. Materials

1. Sewage Grinder

   a. The twin-shaft grinder shall be designed to reduce solids normally found in sewage.

   b. The grinder shall employ counter rotating cutter stacks with intermeshing cutters driven by a common drive, appropriate to handle specified flow

rate with an intrinsically open dual shaft design that allows liquid flow to pass through freely without the need for auxiliary screen diverters.

c. The shafts shall counter-rotate with the driven cutter peripheral linear speed operating at approximately two-thirds (2/3) that of the drive cutter peripheral linear speed.

d. The twin-shaft grinder shall employ a “full-cut” design wherein cutters fill 90% of the cutting chamber. Units with passive style diverter screens or diverter disks shall not be accepted.

e. All cutters shall be constructed of 4140 Heat-treated Alloy Steel, through hardened to a minimum of Rc45-49 and precision ground for uniformity.

2. Grinder Housing

a. The main housing components shall be constructed of Ductile Iron.

b. The main housing components shall be independent of and shall not be subject to wear from seal or labyrinth seal system and shall not constitute a seal wear element.

c. The unit shall employ high flow side rails on both sides of the cutters incorporating a series of parallel slots on the sides of the unit housing to optimize the unit flow capability and reduce headloss.

3. Cutters

a. The cutters shall be a monolithic type comprising a plurality of 5/16" (8 mm) thick, 7-tooth cam shaped cutter elements, or approved equal. The cartridges shall be designed to eliminate individual cutter and spacer disks for improved strength and transmission of power from the shaft. Units using individual cutters and spacers shall not be accepted due to the severe nature of the anticipated application conditions.

b. No cutter stack re-tightening shall be required with this system for regular maintenance.

c. The cutter profile shall be a 5/16" (8 mm) thick, 7-tooth cam type to minimize frictional drag. To maintain particle size, the height of the tooth shall not exceed ½ inch (13 mm) above the root diameter. Cutter-to-cutter root diameter overlap shall not be less than 1/16 inch (1.6 mm) or greater than ¼ inch (6.0 mm) to maintain the best possible cutting efficiency while incurring the least amount of frictional losses.

d. The inside configuration of cutters shall be hexagonal to fit the shafts with a total clearance that shall not to exceed 0.015 inch (0.381 mm) across the flats to ensure positive drive and minimize wear. Cutters employing drive keys shall not be accepted.

e. The spaces defined by the adjacent side surfaces of the cutting edges and outer surface of the connecting spacer areas shall be cylindrically ground for uniformity.

f. Each cutter shall further have a total accumulated tolerance of plus or minus .0005 inch (0.127 mm) to eliminate shimming, cutter stack tolerance accumulation and misalignment.

g. The cutters shall exert a minimum force of 440 lbs./hp (2650 N/kW) continuously and 1530 lbs./hp (9140 N/kW) at momentary load peaks at the tooth tip.

h. Each disk shall incorporate a multi-tooth cutting disk and spacer as one integrated element for high strength. The disks shall have a minimum of 10” diameter with 14 cutting edges per disk, with a hexagonal bore.

4. Shafts

a. The shafts shall be made of 2 inch (51 mm) AISI 4140 heat-treated hexagonal steel with a nominal tensile strength rating of 180,000 PSI (1241.1 MPa).

b. Two-shaft design shall consist of two parallel shafts stacked with intermeshing cutters.

c. Each shaft size shall be a minimum of 2 inch (51 mm) hexagon (across the flats).

5. Side Frames

a. Side frames shall have a high flow design with a series of parallel comb tines designed to enhance liquid flow capacity.

6. Bearings and Seals

a. The bearings and seals shall be housed in replaceable cartridges that support and align the bearings and seals. The cartridge housings shall be constructed of hardened AISI 17-4 PH Stainless Steel for superior resistance to corrosive and abrasive contaminants.

b. The cutter shaft's radial and axial loads shall be borne by a sealed oversize deep-groove (Conrad type) ball bearing at each end. The bearings shall have a minimum rating of 11,000 lbs (49kN) (dynamic $C_E$).

c. Units without bearings on both ends shall not be accepted.

d. The bearings shall be protected by a combination of a replaceable and tortuous path device and end face mechanical seals.

e. Face materials shall be tungsten carbide vs. tungsten carbide and shall not require an external flush.

f. The seals shall employ elastomeric members operating as opposing disk springs when compressed and, at the same time, maintain a positive seal face pressure to ensure positive sealing. No metal springs shall be employed.

g. The contact-less labyrinth rings shall be supplied to further protect from coarse and fine granular contaminants.

h. Components subject to wear shall be designed as replaceable elements and shall not be a part of the ductile iron unit main housing.

i. O-rings shall be made of Buna-N elastomers.

7. Painting Specifications

a. All steel or iron structural components shall be prepared and painted in accordance with the following procedures:

i. The surfaces shall be properly prepared as defined by (SSPC) Steel Structures Paint Council.

ii. The metal surfaces shall be blast cleaned to near-white in preparation for painting to substantially remove mill scale, rust, paint or foreign matter including oil, grease, dirt or oxides.

iii. The cleaned surfaces shall be primed the same day as cleaned.

iv. The parts shall be painted with 2 coats of Polyamide Epoxy. One (1) coat primer, and one (1) Top coat.

v. The dry film thickness shall be 3 to 5 mil per coat.

vi. All stainless steel parts, if used, shall not be painted.

8. Reducer

a. The speed reducer shall be a grease-filled cycloidal type reducer with "Heavy-Shock" load classification. The reduction ratio shall be 29:1.

b. Helical gear drives shall not be acceptable.

c. The high-speed shaft of the grinder shall be coupled with the reducer via a coupling.

d. The two-piece, three-lobed coupling shall have jaws that intermesh by at least ¾ inch (19 mm) for dependable torque transmission.

e. The gear reducer shall be fully sealed and capable of operating submerged continuously.

f. A coupling adapter shall be used for accurate alignment and smooth operation. The coupling adapter shall be sealed to prevent water contamination. The adapter shall be firmly connected to the input of the reducer and shall rigidly support the motor weight.

g. The reducer shall have a rigid input shaft supported by heavy bearings capable of handling thrust and radial loads and shock conditions.

9. Submersible Drive

a. Motor

i. Submersible-Explosion Proof design, 5 HP (3.7 kW), 230/460 Volt, 3-phase, 60 Hz.

ii. Motor service factor shall be 1.15 with NEMA premium efficiency standards.

iii. The unit shall incorporate a submersible explosion-proof motor rated for Division 1, Class 1, Group D and Class 1, Group C and D.

iv. The motor shall be IP68 submersible, continuous in air and while submerged. IP67 motors shall not be accepted.

v. The motor shall be supplied with 60 ft. (18.29 m) of cable.

vi. The motor shall contain moisture-resistant class F 155EC/311EF insulation.

vii. The motor shall be Squirrel cage induction, NEMA design B for continuous operation.

viii. The motor shall be capable of continuous operation while submerged to 200 feet.

ix. The motor shaft shall be constructed of AISI 416 Stainless Steel.

10. Channel Frame

a. The CF-4000 channel frame shall support the unit and provide for convenient installation and removal without entering the confined space area.

b. The CF-4000 channel frame and guide rail system shall be constructed of AISI 304 stainless steel.

c. The CF-4000 frame shall be designed to direct flow from the influent pipe to the grinder.

d. An overflow bar screen, constructed of FRP, shall be provided and mounted to the frame and front side walls.

e. The grinder shall be supported by two parallel pipes which shall extend vertically from the wastewater channel frame to near the top of the wet well or manhole.

f. The pipes shall secure the grinder in operating position as well as act as a guide for grinder removal or installation.

g. After frame installation, the grinder is lowered into operating position by engaging the guide pipes and lowering with a hoist.

h. It shall not be necessary to bolt or otherwise affix the unit to the structure.

11. Controller

a. The controller shall completely sequence the operation of the equipment covered by the scope of supply.

b. The enclosure shall be rated NEMA 4X constructed of FRP and suitable for wall mounting. Hinges and latches shall be corrosion resistant. Enclosure shall house the control devices, relays, terminal blocks, and reversing motor components. A provision shall be made within the enclosure for the connection of a grounding cable.

12. Power Infeed

    a. Terminal blocks only shall be provided for the primary feeder cables entering the controller enclosure.

    b. A separate disconnect means with lockout provisions must be provided adjacent to the controller by others.

13. Motor Starter

    a. A reversing starter shall be provided for the motor indicated in the job specifications. The size of the starter shall be based on IEC requirements for the motor horsepower, rated 18A minimum. Motor starter shall be a full voltage reversing type with 120 VAC operating coils. Forward and reverse contactors shall have both mechanical and electric interlocks.

    b. A motor protection relay shall be furnished as part of the starting equipment. The motor protector shall be adjustable so that the range selected includes the motor nameplate listed FLA (full load amps) rating and the service factor.

    c. Repeated unsuccessful attempts to start the motor or a short circuit shall cause the motor protector to trip.

    d. Tripping of the motor protector shall stop the motor and flash the trip light. Resetting the relay shall allow the alarm circuitry to be reset.

    e. Output terminals shall be provided for connection of the motor leads exiting the enclosure.

14. Control Circuit

    a. The control circuit voltage shall nominally be 120V. In addition, an adequately sized DC power supply shall be provided where DC is required.

    b. The control transformer shall be sized to carry the control-circuit load plus a minimum of 20% spare capacity for future load growth.

    c. The transformer primary and secondary side leads shall be fuse protected.

15. Operator Control

    a. A three-position “HAND-OFF/RESET- AUTO” selector switch shall be provided for the Grinder. Its function is as follows:

b. Hand: When in this position, the equipment shall run under the control of the PLC until the switch is placed in Off/Reset.

c. Off/Reset: When in this position, the motor shall be prevented from starting (in both the forward and reverse directions); the remote-start signal shall be disabled; and the established Alarm Condition lockout circuitry reset.

d. Auto: In this position, when a remote Run signal is received, the motor shall cycle under the control of the PLC. The cycle shall be terminated if the run signal is interrupted, or the selector switch is placed in the Off/Reset position or if the equipment experiences an Alarm Condition.

e. Indicators: The following full voltage LED indicators shall be provided:

i. A white "POWER ON" pilot light shall be illuminated when power is available on the secondary side of the control transformer.

ii. A green "RUNNING" indicating light shall be illuminated when the selector switch is in the Hand or Auto position with the equipment motor running in the forward or reverse direction; and during motor reversal pauses.

iii. A red "TRIP" indicating light shall:

1. Be illuminated steadily when the selector switch is in the Hand or Auto position and the equipment has experienced an Alarm Condition stoppage. It shall remain illuminated until the selector switch is placed in the Off/Reset position, resetting the Alarm Condition Lockout circuit.

2. Flash when the motor protection relay trips.

3. "Double flash" when the motor winding temperature causes the embedded thermostats to open.

iv. A red "SEAL FAIL" indicating light shall be illuminated when excessive moisture is detected in the submersible motor.

16. Remote I/Os

a. The following inputs and outputs shall be supplied.

b. Run Status: A Form C dry-contact output shall close when the equipment motor is running (and during motor reversal pauses). It shall open when

the equipment is stopped, trips on an Alarm Condition, or power to the controller is disconnected.

c. Trip Status: A Form C dry-contact output shall close when the equipment experiences an Alarm Condition stoppage. It shall open when the Alarm Condition lockout circuit has been reset.

d. The contact shall also close and remain closed (no pulsing) when the motor overload relay trips. It shall open when the relay is reset.

e. Motor Thermostats: Provisions shall be made for connection of motor thermostats to indicate Motor over temperature failures. Thermostats shall be connected to individual inputs on the PLC.

f. Remote E-stop: Provisions shall be made for connection of a maintained contact pushbutton (by others). Depressing the pushbutton shall disable the system. The terminals shall be jumpered (to be removed if installed).

g. Remote Start: Provision shall be made to accept a remote contact closure input (by others) that shall start the cycle when the selector switch is in the Auto position.

17. PLC

a. A programmable logic controller shall be provided within the controller.

b. PLC shall be manufactured by IDEC or Siemens.

c. A minimum of 72k programming memory shall be provided with a minimum of 80% of space available for future expansion.

d. PLC shall have an integrated Ethernet port capable of Modbus/TCP communications.

e. Terminal blocks shall be removable to allow for replacement of the PLC without requiring wire removal.

f. The PLC shall have a USB programming port and an SD slot to allow for uploading and downloading of a program without requirement of a PC.

18. Instrumentation

a. Current Sensor: One phase shall be monitored for a high current condition (for the Grinder) with a current sensor and current relay. If the phase current reaches an adjustable set point, the appropriate motor starter shall be de-energized and after a five second delay [user adjustable], an “Auto-

Clear" sequence as described below shall be initiated. When starting the motor the control should delay looking for a signal from the current sensor for 1.5 seconds [user adjustable] to avoid tripping on motor inrush currents.

b. Panel mounted pilot lights shall be full voltage LED 120VAC and visible in sunlight. To meet Sunlight Visible requirement, indicators shall have a minimum luminous intensity of 542 mcd and a minimum luminance of 1482 cd/$m^2$.

c. Moisture Detection: A moisture relay shall be provided within the enclosure. When the probe in the motor detects excessive moisture, the grinder motor is de-energized, the Seal Fail light is illuminated, and an Alarm Condition lockout circuit is established. Terminals shall be provided for sensor leads.

19. Spare Parts shall be provided for specified grinders, including:

a. For TM8516 model, provide one (1) cutter cartridge, three (3) fuses, three (3) lamps, and one (1) gasket set.

b. For each TM14024 model, provide one (1) cutter cartridge, three (3) Titan discs, three (3) fuses, three (3) lamps, and one (1) gasket set.

20. Operation

a. The Grinder shall be controlled via a reversing motor starter that will normally operate in the forward direction with momentary reversing operation.

b. Normal Cycle: Placing the selector switch in the Hand or (when a remote run signal is received, if in the Auto position), shall energize the Reverse motor starter and the equipment rotates in that direction for two seconds (adjustable) before the reverse starter coil is de-energized.

c. After a delay of five seconds (adjustable) to allow the equipment to coast to a stop, the equipment shall run continuously in the Forward direction of rotation.

d. It shall continue to run in this direction until the motor starter is de-energized by interrupting the remote-run signal, or by turning the selector switch to the 'Off' position, or if the equipment experiences a jam condition.

e. Auto Clear Cycle: If the phase current reaches an adjustable set point (factory-set), the motor starter shall be de-energized.

f. After a delay of five (adjustable) seconds to allow the equipment to coast to a stop, the sequence described above for a normal starting cycle shall be initiated in an attempt to clear the Jam condition.

g. This automatic auto-clear cycle shall repeat a total of four times.

h. If at any time the equipment runs for more than 30 seconds continuously in the forward direction during the four attempts, the reversal counter shall be reset.

i. Alarm Condition: If after four tries, however, the Jam condition still exists, the forward starter coil shall be de-energized, and after a two second delay, the reverse starter coil shall be energized for one second then de-energize. An Alarm Condition lockout circuit shall then be established and remain in the alarm state (even if power is lost) until it is reset.

j. The lockout circuit shall disable the automatic cycle, cause the Trip pilot light to be illuminated, the Trip Status contact to close, the Running pilot light to be extinguished, and the Run Status contact to open. Once the obstruction has been cleared, the Alarm Condition lockout circuit can be reset by moving the selector switch to Off/Reset position.

## C. Execution

1. Each machine shall be factory tested to ensure satisfactory operation.

2. All components shall be installed in accordance with the supplier's installation instructions, and in compliance with all OSHA, local, state, and federal codes and regulations.

3. Operation and Maintenance Manuals

   a. Supplier shall provide (2) Operation and Maintenance Manuals. The manuals shall include equipment descriptions, operating instructions, drawings, troubleshooting techniques, a recommended maintenance schedule, and the recommended lubricants.

   b. Operation and Maintenance Manuals shall be provided in hardcover 3-ring binders with the serial number and equipment model information displayed on the front cover.

**300-003**
**Electrical System Study**

## A. Description

1. Related Documents

   a. For work under this contract, this specification shall comply with the standard specifications except as modified herein.

2. Summary

   a. This Section covers the furnishing of an electrical short circuit study, over current protective device coordination study, arc flash analysis, and harmonic distortion analysis including coordination with Utility Company for the electrical system required under this construction contract.

   b. The short circuit analysis, protective device coordination study, arc flash study, and harmonic distortion analysis must be approved by the ENGINEER prior to submitting shop drawings of electrical equipment. Shop drawings of electrical equipment will not be reviewed until the short circuit analysis, protective device coordination study, and arc flash study are approved by ENGINEER. No exceptions will be allowed.

3. Submittals

   a. The short circuit analysis, protective device coordination study and arc flash study shall be approved by the ENGINEER prior to submitting the release of equipment for manufacture. The shop drawings of the equipment will not be reviewed until the short circuit analysis, protective device coordination study, and arc flash study are approved by ENGINEER. No exceptions will be allowed.

   b. All short circuit analysis, protective device coordination study, arc flash hazard study, and harmonic distortion analysis shall be performed with the aid of digital computer program as specified herein.

   c. The CONTRACTOR shall affix approved arc flash labels on electrical equipment at least 30 days prior to energizing the electrical equipment.

   d. CONTRACTOR shall submit complete settings for all relays included in study. For any microprocessor relays used, CONTRACTOR shall provide electronic configuration files incorporating all relay settings. Electronic files shall include all parameter settings for enabled and disabled functions as shown in coordination study, and shall be submitted with the studies specified herein for ENGINEER approval.

e. Submittal shall include specific recommendations to the protection scheme to correct any instances where the calculated incident energy was deemed to be in excess of 40 cal/cm2. Provide additional studies implementing the specific recommendations.

f. Submittal shall include specific recommendations to the electrical distribution system to correct any instances where the total harmonic distortion is in excess of IEEE 519 limits. Provide additional studies implementing the specific recommendations.

g. Study shall be signed/sealed by a Professional Electrical Engineer registered in the State of Maryland, responsible for performing the studies.

h. The study report shall include the following sections:

i. Descriptions, purpose, basis, and scope of the study.

ii. Supporting documentation including correspondence from utility company utility fault current and utility settings; and correspondence from VFD manufacturer depicting the detailed harmonic profile for the utilized VFD.

iii. Detailed one-line diagram with identification/parameters of electrical equipment, protective devices/settings, impedance elements, all distribution components, etc.

iv. Study shall simulate multiple system operating conditions to determine the worst-case scenario.

v. Short circuit analysis for the studied distribution system including fault duty report, momentary duty report, and interrupting duty report.

vi. Evaluation of equipment withstand ratings protective device interrupting ratings, versus calculated short circuit currents.

vii. Protective device time-current coordination study to ascertain an optimal protection and selectivity of protective devices.

viii. Arc flash evaluation with detailed summary spreadsheet tabulating incident energy and arc flash hazard/risk category at each location.

i. Provide sample arc flash labels for each type of equipment for reviews and approval by the ENGINEER.

4. References

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

i. American National Standards Institute (ANSI): C37.010, Application Guide for AC High Voltage Current Circuit Breakers on a Symmetrical Basis.

ii. Institute of Electrical and Electronic Engineers (IEEE):

(1) 141-1993, or latest version Recommended Practice for Electric Power Distribution in Industrial Plants.

(2) 242-2001, or latest version Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

(3) 399, Recommended Practice for Industrial and Commercial Power System Analysis.

(4) 1582-2004/2004a, IEEE Guide for Performing Arc Flash Hazard Calculations.

(5) 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.

iii. InterNational Electrical Testing Association (NETA): ATS, Latest Edition: Acceptance Testing Specifications for Electrical Power and Distribution Equipment and Systems.

iv. National Fire Protection Association (NFPA):

(1) 70, National Electric Code.
(2) 70E, Standard for Electrical Safety in the Workplace.

5. Quality Assurance

a. Comply with applicable standards.

**B. Materials**

1. Simulation Software

a. Electrical system studies shall be performed using the latest version of:

i. SKM; Power Tools

ii. ESA; Easy Power
iii. E-tap

## C. Execution

1. Electrical Equipment

a. The Contract Drawings and Specifications indicate the general requirements for the low voltage equipment. Determine additional specific characteristics of equipment furnished in accordance with the results of the short circuit and protective device coordination, and arc flash analysis study.

b. The scope of the study applies to all new equipment and associated components furnished under this project, as shown on the Contract Drawings. In addition, this study shall include existing medium voltage and low voltage switchgear and all of the existing equipment shown on the Contract Drawings.

2. Study Requirements

a. Provide comprehensive report complying with following:

i. CONTRACTOR shall obtain all the correct data required for the short circuit and protective coordination and arc flash analysis study. Past study will be provided to the CONTRACTOR, upon request, for informational purpose only.

ii. Obtain required study data including available fault currents and upstream protective device information from the utility company. Include copy of utility correspondence letters in submittal.

iii. Study shall be prepared by an experienced professional engineer registered in the State of Maryland with a minimum of 5 years' experience in the preparation of short circuit, protective device, arc flash analysis, and harmonic studies of medium and high voltage industrial systems.

iv. Submit the study report to the ENGINEER for approval prior to submitting electrical equipment shop drawings and prior to release of equipment for manufacture.

v. Reset and calibrate any existing relays on the upstream and downstream side of the equipment, if required, by the coordination study at no additional cost to the COUNTY.

vi. Provide protective devices, protective device settings, relays, fuses, breakers, etc. in accordance with the coordination study.

b. Include following features in report.

i. Perform additional studies and accordingly provide specific recommendations to improve protection device coordination and to reduce arc flash hazard category of all new electrical equipment to Category 4 and below.

ii. Multifunction Relays: Based on the protective device settings as determined from the power system study, CONTRACTOR shall provide complete relay device configuration settings files for each multifunction relay installed or modified under this project together with the study report. CONTRACTOR shall provide the relay settings files on a CD as well as include the hard copy printouts for each multifunction relay. Configuration settings files shall be provided using the latest authoring software version for the installed or modified relays.

3. Short Circuit Study

a. Perform short circuit of entire electrical distribution system to calculate available three-phase and ground fault currents at each location within the electrical system. Provide calculations for symmetrical half-cycle three-phase fault currents, momentary three-phase fault currents, and asymmetrical 3-cycle/5-cycle/8-cycle three-phase fault currents.

b. Study shall include simulation of both the normal condition and the worst-case operating condition that yields the greatest calculated fault currents.

c. Provide fault duty report, momentary duty report, and interrupting duty report. Provide equipment evaluation report confirming that manufacturer's equipment withstand and interrupting ratings are adequate for the worst-case calculated fault currents.

d. Short circuit study shall consist of all electrical equipment identified in Article Electrical Equipment of this Specification.

4. Coordination Study

a. Provide phase overcurrent and ground overcurrent study with the following items as a minimum:

i. Coordination plots graphically indicating the coordination proposed for the several systems. Provide plots centered on full scale log-log forms.

ii. Coordination plots with:

(1) Complete titles.

(2) Representative one-line diagrams and legends.

(3) Associated power company's relay or system characteristics, motor controller fuses and relays.

(4) Significant motor starting characteristics.

(5) Transformer characteristics including inrush points.

(6) Complete operating bands for low voltage circuit breaker trip devices, fuses, if applicable, and the associated system load protective devices.

iii. Coordination plots which define the types of protective devices selected, together with the proposed coil taps, time dial settings and pickup settings required.

iv. In the short time region, indicate:

(1) The medium voltage relay instantaneous elements.

(2) The magnetizing inrush.

(3) ANSI withstand transformer parameters.

(4) The low voltage circuit breaker, short time and instantaneous trip devices.

(5) Fuse manufacturing tolerance bands, including the low voltage network protector fuses, when applicable.

(6) Significant symmetrical and asymmetrical fault currents.

b. Coordinate each item of equipment as follows:

i. Select each primary protective device required for a delta-to-wye-connected transformer so that the characteristics or operating band is within the transformer parameters which includes a parameter

equivalent to 58 percent of the ANSI withstand point to afford protection for secondary line-to-ground faults.

ii. Provide the transformer damage curve for each transformer when the selected protective device is not within the associated parameters.

iii. Separate low voltage power circuit breakers from each other and the associated primary protective device by a suitable current margin for coordination and protection in the event of secondary line-to-line faults.

iv. Separate medium voltage relays by a minimum 0.1-second time margin when the maximum three-phase fault flows, to assure proper selectivity.

v. Suitably terminate the protective device characteristics or operating band to reflect the actual symmetrical and asymmetrical fault currents sensed by the device.

vi. Source combinations of large motors.

c. Obtain pertinent information for the upstream and downstream protective devices including:

i. Characteristics and settings.

ii. Feeder sizes, types, and lengths including motors connected to the substations and motor control centers.

iii. Motors and disconnect switches connected to the electrical equipment.

d. Coordination study shall consist of all electrical equipment identified in Article Electrical Equipment of this Specification.

5. Arc Flash Analysis

a. Provide arc flash analysis results in a tabular format depicting the following for each bus: bus name, protective device name, bus voltage, calculated 3-phase bolted fault current, calculated arc-fault current, trip delay, breaker opening time, equipment type, grounding type, arc flash boundary, working distance, incident energy, and NFPA 70E hazard/risk category. For each bus in the table, provide description indicating location within the distribution system.

b. Arc flash analysis results shall include all motor contributions. Arc flash calculations shall include evaluation of all equipment that can be operated or maintained while energized including, but not limited to, disconnect switches, VFD, control panels, etc.

c. Arc flash analysis shall consist of all electrical equipment identified in Article "Electrical Equipment" of this Specification.

6. Arc Flash Labels

a. Provide arc flash labels on all studied equipment including, but not limited to, disconnect switches, control panels, etc. for arc flash and shock hazard in accordance with the NFPA 70E for safe work practices and for personal protection. Layout and format of arc flash labels shall exactly match the layout of existing arc flash labels installed at the facility.

b. The arc flash labels for equipment shall be 4 inches by 6 inches and shall include the following at minimum:

DANGER
ARC FLASH AND SHOCK HAZARD
Appropriate PPE required for arc flash and shock hazards

NFPA Hazard/Risk Category

Flash Hazard Boundary _____ inches

Incident Energy _____cal/$cm^2$ at _____ inch working distance

PPE Required

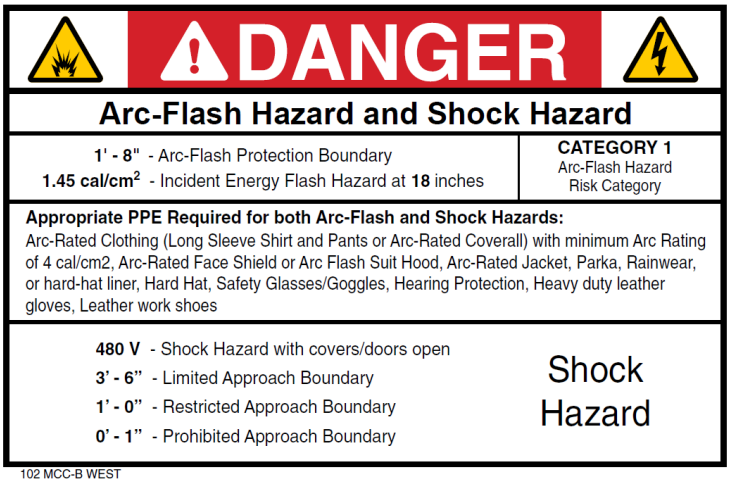
Shock Hazard Voltage _____volts

Limited Approach Boundary _____inches

Restricted Approach Boundary _____inches

Prohibited Approach Boundary _____inches

c. Label layout provided shall be in accordance with the sample template below




d. Arc flash labels shall be provided for all electrical equipment identified in Article Electrical Equipment of this Specification.

e. Arc flash labels template shall be:

   i. Brady; Label Part No. Y464249, Lot No. 5701477.
   ii. Or equal.

f. During submittal review, submit sample label of each equipment type for ENGINEER'S approval. Arc flash labels shall be in accordance with NFPA 70, NFPA 70E, and all applicable standards of ANSI Z535. Arc flash labels shall be prepared and affixed onto corresponding electrical equipment upon completion of approved arc flash analysis. Labels shall consist of a die-cut material that is resistant to facing, moisture, heat, rain, or freezing temperatures. Labels shall be provided with over-laminate or as directed by the ENGINEER.

g. Install arc flash labels on electrical equipment in accordance with NEC Article 110.16 and NFPA 70E. Labels shall be installed by the CONTRACTOR under direct supervision of the professional engineer who is performing the power systems study. On MCC labels shall be affixed on each accessible front and rear cubicle doors or buckets.

7. Harmonic Distortion Analysis

a. Provide a voltage and current total harmonic distortion analysis for the distribution system at the unit substation point of common coupling (PCC) as well as all non-PCC locations to ensure adequate power quality conditions within the facility.

b. Obtain harmonic analysis and characteristics for each VFD, reactor and/or filters from the VFD manufacturer.

c. Perform a system analysis to demonstrate not more than 5% total harmonic distortion (THD) voltage and current distortion level in accordance with the IEEE 519 at all identified distribution buses.

d. Where THD-voltage is greater than 5% or THD-current is greater than the IEEE 519 recommended level, provide specific recommendations to reduce distortion by the addition of filters, reactors, or other means.

e. The harmonics analysis shall be performed by assuming the system transformers are 50% loaded and 100% loaded. Simulate additional conditions where one main transformer is out of service. Provide a summary of data at the studied scenarios.