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NAVFAC PTS-G30 (September 2022)   
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Preparing Activity: NAVFAC SUPERSEDING PTS-G30 (December 2018)   
  
PERFORMANCE TECHNICAL SPECIFICATION  
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SECTION G30  
  
SITE CIVIL/MECHANICAL UTILITIES  
09/22

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NOTE: This section is intended to be used as a guide and contains requirements that are common to many different types of facilities; however, not all requirements and equipment items will be applicable to all projects. In addition, there may be special requirements for a particular project that are not addressed at all. The RFP preparer may have to incorporate additional information to address these special requirements in this PTS and corresponding Part 3 ESR. If the RFP preparer chooses to delete building elements that are not required for the project, do not change the remaining Uniformat paragraph designations (example - A102001). Uniformat designations are unique to the products they are assigned to. However, the subparagraph numerical extensions (example - 1.2 or a,b,c) of the Uniformat designations may change if subparagraphs are deleted.  
  
This guide specification is formatted utilizing Uniformat II, an industry recognized standard, ASTM E 1557. When the RFP preparer chooses to add a paragraph that does not apply to an existing building element already included in the specification, refer to the Uniformat/WBS located on the NAVFAC Design-Build Website for a listing of Uniformat II designations and definitions.  
  
NOTE: The RFP preparer may view or hide the criteria notes in this PTS section by modifying the WORD preferences for "Hidden text". To view the criteria notes, choose "File" then "Option". Click "Display" then check the "Hidden text" box under "Always show these formatting marks on the screen". In the same section, check the box for "Print hidden text" under "Printing options" to print the criteria notes.  
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**G30 GENERAL**

RFP Part 3 including the Engineering System Requirements (ESR) provide project specific requirements. The RFP Part 4, Performance Technical Sections (PTS) provide generalized technical requirements that apply to multiple facility types and include more requirements than are applicable to any one project. Therefore, only the RFP Part 4 requirements that apply to the project and further define the RFP Part 3 project specific requirements are required.

**G30 1.1 DESIGN GUIDANCE**

Provide the design and installation in accordance with the following references. This Performance Technical Specification (PTS) adds clarification to the fundamental requirements contained in the following Government Standards. The general requirements of this PTS section are located in PTS Section Z10, *General Performance Technical Specification*.

Industry standards, codes, and Government standards referenced in the section text that are not found in the [Unified Master Reference List (UMRL)](https://www.wbdg.org/ffc/dod/unified-master-reference) in the [Federal Facility Criteria (FFC)](https://www.wbdg.org/ffc/federal-facility-criteria) at the [Whole Building Design Guide (WBDG)](https://www.wbdg.org/) website, are listed below for basic designation identification. Comply with the required and advisory portions of the current edition of the referenced standard at the time of Contract award.

**G30 1.1.1 Industry Standards and Codes**

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

**G30 1.1.2 Government Standards**

UNIFIED FACILITIES CRITERIA (UFC)

|  |  |
| --- | --- |
| UFC 1-200-01 | DoD Building Code (A reference in this PTS section to UFC 1-200-01 requires compliance with the Tri-Service Core UFCs that are listed therein, which includes the following significant UFC(s): UFC 1-200-02, High Performance and Sustainable Building Requirements; UFC 3-201-01, Civil Engineering; UFC 3-230-01, Water Storage, Distribution, and Transmission; UFC 3-240-01, Wastewater Collection; UFC 3-240-01, Mechanical Engineering; UFC 3-600-01, Fire Protection Engineering for Facilities) |
| UFC 3-460-01 | Design: Petroleum Fuel Facilities |

**G30 1.2 QUALITY ASSURANCE**

Materials and assemblies installed in the work must be inspected and found to be in compliance with industry standards and these specifications prior to acceptance of the work. Remove items found not to be in compliance, or take corrective measures, to assure compliance with the referenced standard. Perform field tests and provide labor, equipment and incidentals required for testing.

**G30 1.2.1 Materials**

Provide new materials that bear the label of the standardizing agency whenever standards have been established and label service is normally and regularly furnished by the agency. Equipment provided must be listed and suitably labeled for the specified purpose, environment, and application and installed in accordance with manufacturer’s recommendations.

**G30 1.2.2 Additional Work**

Provide such other labor and materials as are required for a complete and usable system in accordance with the requirements of the criteria listed, regardless of whether such materials and associated labor are called for elsewhere in this RFP.

**G30 1.2.3 Qualifications of Well Drillers for Water Supply Wells**

If required by the state waterworks' regulations, the well driller must be certified by the state and remain certified while constructing the well.

**G30 1.2.4 Qualifications of Coating Contractors for Water Storage Tanks**

Contractors and subcontractors that perform surface preparation or coating application must be certified by the Society for Protective Coatings (formerly Steel Structures Painting Council) (SSPC) to the requirements of SSPC QP 5 for the inspection firm prior to Contract award, and remain certified while accomplishing any surface preparation or coating application. The Coating Inspector must also be certified to Level II for exterior and Level III for interior coatings prior to and during the project.

**G30 1.2.5 Qualifications of Oil Interceptor Manufacturers**

Manufacturers must have five years of experience producing packaged oil interceptor units of similar size.

**G30 1.3 PERFORMANCE VERIFICATION AND ACCEPTANCE TESTING**

Compliance with the requirements will be determined by a review of the design and construction submittals and by field inspection. See Part 2 Section 01 33 10.05 20, *Design Submittal Procedures*, and Part 2 Section 01 33 00.05 20, *Construction Submittal Procedures*, for additional requirements.

Verify satisfactory utility system performance via Performance Verification Testing, as detailed in this section of the RFP. Verify satisfactory performance also via testing as detailed in the paragraph, "Field Quality Control", in UFGS Specification Sections utilized.

**G30 1.3.1 Water Supply Well Performance Verification**

Upon completion of the permanent well, conduct performance testing for well capacity, drawdown and pump equipment. Conduct water quality testing in accordance with AWWA A100 and its appendices and state regulations.

**G30 1.3.2 Water Distribution System Verification Testing**

Provide testing on water mains and service lines in accordance with the state waterworks’ regulations and the following:

a. Ductile Iron and other materials: AWWA C600.

b. PVC: AWWA C605.

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NOTE: NFPA 24 requires a minimum test pressure of 1400 kPa 200 psi or 375 kPa 50 psi in excess of the system working pressure. Several of the AWWA standards do not meet the requirements of NFPA 24. Where water mains or water service lines provide fire service or water and fire service, they must be tested in accordance with NFPA 24.  
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Where water mains and water service lines provide fire service, test in accordance with NFPA 24.

Do not begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 5 days after placing of the concrete.

**G30 1.3.3 Fire Distribution System Verification Testing**

Test water mains and water service lines providing fire service or water and fire service in accordance with NFPA 24. The additional water added to the system must not exceed the limits given in NFPA 24.

**G30 1.3.4 Water Booster Pump Station Verification Testing**

Test the water booster pump station in accordance with state regulations. Conduct testing on discharge and site piping in accordance with tests for water distribution mains; see G30, paragraph 1.3.2. Test pumps, controls, and alarms, in operation, under design conditions to ensure proper operation of equipment.

**G30 1.3.5 Sanitary Sewer Distribution System Verification Testing**

Provide testing on sewer mains and laterals in accordance with state regulations.

**G30 1.3.5.1 Deflection Test**

Deflection of pipe in the installed pipeline under external loads must not exceed 4.5 percent of the average inside diameter of pipe, in accordance with ASTM D 2412.

**G30 1.3.5.2 VISUAL TEST**

Perform a visual inspection of the existing sewer before making a connection to the existing sewer line. Verify existing sewer line does not connect to or drain to the storm drainage system. Visually inspect downstream manholes connecting the existing sewer as well as the upstream and downstream manholes where the point of connection will be made to verify that there is no potential for cross connection to the storm sewer system. Perform visual inspection in the presence of the Contracting Officer and Public Works PW6 field support. Obtain approval from the Contracting Officer before making the connection.

Perform a dye check from the project to the first manhole on the next active sewer branch main downstream from the sewer branch main used as the project point of connection. Continue testing until the dye visually confirms the design connection is appropriate. Utilize a nontoxic non-staining sewer tracing dye. During the test monitor the storm drainage system downstream from the project, via either manholes or outfalls for any sign of cross connection.

Perform a smoke test on the project sewer. Testing will verify that project storm drainage inlets or drains have not been connected to the sanitary sewer.

These tests must be observed by the Contracting Officer and the utility operator's inspector.

**G30 1.3.5.3 Leakage Tests**

Test lines for leakage by either infiltration tests or exfiltration tests, or by low-pressure air tests. Prior to testing for leakage, backfill trench up to at least lower half of pipe. To prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. The leakage allowance is indicated in AWWA C 600 for ductile iron pipelines; AWWA C 605 for polyvinyl chloride pipelines; and the state sewerage regulations, whichever is more stringent. When leakage or pressure drop exceeds the allowable amount make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

a. Exfiltration Tests:

ASTM C 969M (ASTM C 969) and perform calculations in accordance with its Appendix.

b. Low-pressure Air Tests:

i. Pipelines: ASTM C 924M (ASTM C 924) and perform calculations in accordance with its Appendix.

ii. PVC plastic pipelines: UBPPA UNI-PUB-6 and perform calculations in accordance with its Appendix.

**G30 1.3.5.4 TV Inspection for Sanitary Sewer**

Complete the post-installation TV inspection to confirm that the completed lines are free of defects. For video recordings include an audio track recorded by the inspection technician during the actual inspection work describing the parameters of the line being inspected. The minimum information to be included is the pipe material, pipe size, starting and stopping manholes and descriptions of any features as they occur. Video recording playback must be at the same speed that it was recorded. Permanently label CDs / DVDs according to their contents; CDs / DVDs will become the property of the Government.

Provide TV inspections of sanitary sewer mains in accordance with the Pipeline Assessment and Certification Program as sponsored by the National Association of Sewer Service Companies (NASSCO). Prior to initiating CCTV inspection, provide copies of PACP Certification of the operators performing the work.

Complete pipe segments and manhole work, including pipe penetrations, manhole benches, main line and manhole visual inspection, pressure testing, deflection and leakage tests on a section of line (manhole to manhole) prior to performing TV.

Complete post-installation TV inspection in the presence of the Contracting Officer or designated representative.

The importance of accurate measurements is emphasized. The meter device must be accurate to one tenth of a foot.

Utilize the full capabilities of the camera equipment to document the completion and the conformance of the work to the Contract Documents. Provide a full 360 degree view of the pipe, joints and service connections. Move the camera through the line in either direction at a moderate rate, stopping to permit proper documentation of the sewer's condition. The maximum speed must be no greater than 30 feet per minute. Use manual winches, power winches, TV cable and powered rewinds or other devices that do not obstruct the camera view or interfere with the proper documentation of the sewer conditions to move the camera through the sewer line.

Once video recording has commenced, the recording must be continuous, without interruption, until the termination manhole is reached.

Provide a color video showing the completed work. Prepare and submit Television Inspection Logs providing location of service connections along with the location of any discrepancies.

Keep computer printed location records (Television Inspection Logs) and clearly show the location and orientation in relation to an adjacent manhole for each point observed during the TV inspection. Record features of significance such as locations and orientations of service connections, pipe deflections, leaks, rolled or dislodged gaskets, sags or bellies in the line, or wide joints.

Document noted defects and lateral connections as color digital files and color hard copy prints. Photo logs must accompany each photo submitted.

Prior to submission of the TV inspection video, Television Inspection Logs, and digital photographs to the Contracting Officer, review the submittal items to ensure compliance with the quality criteria set forth in this specification. Provide a copy of such video along with the Television Inspection Logs and Digital photographs to the Contracting Officer within five business days of completion of the video-inspection. In the event that the video, Television Inspection Logs or digital photographs are deemed of poor quality or substandard by the Contracting Officer, the videos, Television Logs, or digital photographs will be returned and a re-inspection provided by the Contractor, at no additional cost to the Government.

**G30 1.3.6 Sanitary Sewer Manholes Verification Testing**

Provide a visual inspection of manholes for proper grade and water tightness. Provide testing on sanitary sewer manholes in accordance with state regulations. At minimum, perform hydraulic testing in accordance with ASTM C 969/C 969M.

**G30 1.3.7 Wastewater Pump Station Verification Testing**

Test the wastewater pump station in accordance with state regulations. Conduct testing on discharge piping and force main in accordance with tests for water distribution mains; see G30, paragraph 1.3.2. Test pumps, controls, and alarms, in operation, under design conditions to ensure proper operation of equipment.

**G30 1.3.8 Storm Sewer System Verification Testing**

**G30 1.3.8.1 Deflection Test**

Deflection of pipe in the installed pipeline under external loads must not exceed 4.5 percent of the average inside diameter of pipe, in accordance with ASTM D 2412.

**G30 1.3.8.2 TV Inspection for Storm Sewer Under Pavements**

Complete the post-installation TV inspection to confirm that the completed lines are free of defects. For video recordings include an audio track recorded by the inspection technician during the actual inspection work describing the parameters of the line being inspected. The minimum information to be included is the pipe material, pipe size, starting and stopping manholes and descriptions of any features as they occur. Video recording playback must be at the same speed that it was recorded. Permanently label CDs / DVDs according to their contents; CDs / DVDs become the property of the Government.

Provide TV inspections of storm sewer lines in accordance with the Pipeline Assessment and Certification Program as sponsored by the National Association of Sewer Service Companies (NASSCO). Prior to initiating CCTV inspection, provide copies of PACP Certification of the operators that perform the work.

Complete pipe segments and manhole work, including pipe penetrations, manhole benches, main line and manhole visual inspection, pressure testing, and deflection test on a section of line (manhole to manhole) prior to performing TV.

Complete post-installation TV inspection in the presence of the Contracting Officer or designated representative.

The importance of accurate measurements is emphasized. The meter device must be accurate to one tenth of a foot.

Utilize the full capabilities of the camera equipment to document the completion and the conformance of the work to the Contract Documents. Provide a full 360 degree view of the pipe, joints and service connections. Move the camera through the line in either direction at a moderate rate, stopping to permit proper documentation of the sewer's condition. The maximum speed must be no greater than 30 feet per minute. Use manual wenches, power winches, TV cable and powered rewinds or other devices that do not obstruct the camera view or interfere with the proper documentation of the sewer conditions to move the camera through the sewer line.

Once video recording has commenced, the recording must be continuous, without interruption, until the termination manhole is reached.

Provide a color video showing the completed work. Prepare and submit Television Inspection Logs providing location of service connections along with the location of any discrepancies.

Keep computer printed location records (Television Inspection Logs) and clearly show the location and orientation in relation to an adjacent manhole for each point observed during the TV inspection. Record features of significance such as locations and orientations of service connections, pipe deflections, leaks, rolled or dislodged gaskets, sags or bellies in the line, or wide joints.

Document noted defects and lateral connections as color digital files and color hard copy prints. Photo logs must accompany each photo submitted.

Prior to submission of the TV inspection video, Television Inspection Logs, and digital photographs to the Contracting Officer, review the submittal items to ensure compliance with the quality criteria set forth in this specification. Provide a copy of such video along with the Television Inspection Logs and Digital photographs to the Contracting Officer within five business days of completion of the video -inspection. In the event that the video, Television Inspection Logs or digital photographs are deemed of poor quality or substandard by the Contracting Officer, the videos, Television Logs, or digital photographs will be returned and a re-inspection provided by the Contractor, at no additional cost to the Government.

**G30 1.4 DESIGN SUBMITTALS**

Submit design submittals in accordance with Part 2 Section 01 33 10.05 20, *Design Submittal Procedures*, FC 1-300-09N, *Navy and Marine Corps Design Procedures*, UFC 3-201-01, *Civil Engineering*, and UFC 3-401-01, *Mechanical Engineering*.

Provide sustainability submittals in accordance with Part 2 UFGS Section 01 33 29, *Sustainability Requirements and Reporting*.

**G30 1.5 CONSTRUCTION SUBMITTALS**

Submit construction submittals in accordance with PTS Section Z10, *General Performance Technical Specifications*. In addition to the Z10 requirements, the Designer of Record (DOR) must approve the following construction submittals as a minimum:

Test reports.

Provide sustainability submittals in accordance with Part 2 UFGS Section 01 33 29, *Sustainability Requirements and Reporting*.

**G30 1.6 COORDINATION**

To the extent that site work is indicated on the RFP drawings, verify that the locations and inverts of site utility lines are coordinated with building utility lines. Make adjustments to the locations and inverts indicated on the RFP drawings in accordance with codes and standards.

**G30 1.7 ANTITERRORISM (AT) STANDARDS**

Incorporate the minimum AT standards indicated in UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*.

**G30 1.8 BACKFLOW PREVENTION**

Submit backflow prevention training certificates and backflow preventer devices certification in accordance with Part 2 UFGS Section 01 50 00, *Temporary Construction Facilities and Controls*.

**G30 1.9 WATER STORAGE TANK**

Submit a certificate signed by a registered professional engineer providing a (1) description of the entire tank and foundation structural design loading conditions; (2) description of structural design methods and codes used in establishing allowable stresses and safety factors; (3) statement that the structural design has been checked by experienced engineers specializing in hydraulic structures to ensure that design calculations for member sizes, dimensions and fabrication processes are as prescribed by ACI and AWWA standards; and (4) certification that the completed work was inspected in accordance with AWWA D100 or AWWA D103.

**G30 1.10 NACE CERTIFIED CATHODIC PROTECTION SPECIALIST QUALIFICATIONS**

Submit qualifications of specialist prior to site welding. Submit documentation of current NACE certification.

**G30 1.11 EXCAVATION, BACKFILLING AND COMPACTION OF UTILITIES**

Refer to Section G10, *Site Preparation*.

**G30 1.12 DELIVERY, STORAGE AND HANDLING OF MATERIALS**

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store plastic piping, jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves, and hydrants free of dirt and debris. Handle in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make satisfactory repairs if coatings or linings are damaged. Carry, do not drag pipe to the trench.

**G3010 WATER SUPPLY**

**G3010 1.1 WATER SYSTEM DESIGN**

Determine domestic and fire demands for the facility and verify the design of all components of the domestic and fire protection supply systems. Design and construct the water system in accordance with UFC 3-230-01, *Water Storage, Distribution, and Transmission;* the state waterworks' regulations, and the utility provider's requirements. Design the water supply systems to provide required flows and maintain residual pressures based upon peak demands.

If the new water system is an extension of an existing water system, obtain static pressure, residual pressure and flow characteristics of the existing distribution system by actual field tests. Conduct flow and pressure tests and provide design calculations that show the existing lines are capable of handling the additional flows. Connect the new water system to the nearest existing fitting or water line capable of handling the additional flows.

Design the connections to the water system including the meter assemblies and backflow-preventing devices in accordance with the requirements of the Activity or utility provider and the state waterworks regulations.

Wherever possible, locate valve boxes and other utility access structures out of paved areas.

**G301001 WELL SYSTEMS**

Design and construct the potable water well system in accordance with AWWA A100 and its appendices; the state waterworks' regulations, and the system owner's preferences and requirements.

**G301001 1.1 WATER METER**

Provide a water meter on the well pump discharge piping aboveground in a pump enclosure or in a meter vault underground. Provide type of water meter and remote reading capability in accordance with system owner's preferences and requirements: AWWA C700, displacement type; AWWA C701, turbine type; or AWWA C702, compound type.

**G301001 1.2 TEST HOLE**

Drill test hole(s) at the well site before construction of the permanent well to determine the existing site-specific geologic and hydrologic conditions and groundwater-quality parameters. A test hole may be incorporated into the finished construction provided it meets the requirements for a finished well. Seal test holes not used in finished construction as recommended in accordance with AWWA C654 and the state waterworks' regulations. Upon completion of test hole, provide recommendations for permanent wells and submit data obtained at each well site. Include with the recommendations the appropriate depth, details of construction, length and location of screens, screen openings, gravel size, grout, and an estimation of the quantity of water that can be obtained from each water-bearing stratum and from each completed well. Submit electric log, a drillers log drawn to scale with coarseness and fineness modulus of each strata, time penetration log (time to drill through each formation), and sieve analysis to substantiate recommendations.

**G301001 1.3 WELL CONSTRUCTION**

**G301001 1.3.1 Well Development**

Provide well development in accordance with AWWA A100 and the state waterworks' regulations.

**G301001 1.3.2 Disinfection**

Disinfect well, equipment, and material in accordance with AWWA C654 and the state waterworks' regulations. Provide a sanitary seal for the well to prevent contamination until the pump foundation and pump are installed on the well.

**G301001 1.4 ABANDONMENT OF EXISTING WELLS**

Abandon and seal existing wells in accordance with AWWA A100 and the state waterworks' regulations.

**G301002 POTABLE WATER DISTRIBUTION**

**G301002 1.1 WATER SYSTEM DESIGN**

Provide materials, equipment, labor, testing, and miscellaneous related items for water distribution mains and service lines to the facility and connections to the existing water system in accordance with UFC 3-230-01, *Water Storage, Distribution, and Transmission*; the utility provider's requirements; and the state waterworks' regulations; whichever is more stringent.

Determine available flow at the residual pressure at each point of connection by conducting flow tests in accordance with AWWA M17 and NFPA 291.

Provide water main piping, service lines, fittings, valves, accessories and other materials in compliance with the American Water Works Association (AWWA) standards for a minimum system working pressure of 150 psi (1050 kPa).

**G301002 1.2 WATER DISTRIBUTION MAINS**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*   
NOTE: Do not use plastic piping in areas subject to potential spillage of aromatic hydrocarbons. Aromatic hydrocarbons such as benzene and toluene will dissolve polyvinyl chloride.  
 \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

For underground applications, utilize ductile iron or PVC piping for water mains 12 inches (300 mm) in diameter and less. Utilize ductile iron piping for water mains deeper than 10 feet (3.0 m) or larger than 12 inches (300 mm) in diameter.

For aboveground applications, utilize flanged ductile iron pipe for water mains.

**G301002 1.2.1 Materials**

a. Ductile Iron Pressure Pipe   
  
1) Pipe: AWWA C151, Pressure Class 350.   
  
2) Fittings: AWWA C110 or AWWA C153.   
  
3) Interior Lining: AWWA C104.   
  
4) Exterior Protection (if required): AWWA C105, polyethylene encasement.

b. PVC Pressure Pipe   
  
1) Pipe: AWWA C900, Pressure Class 150.   
  
2) Fittings: Ductile Iron (AWWA C110 or AWWA C153).

c. Flanged Ductile Iron Pipe   
  
1) Pipe: AWWA C115 and its appendices.   
  
2) Fittings: AWWA C110 or AWWA C153.   
  
3) Lining: AWWA C104.

**G301002 1.2.2 Installation**

a. Ductile Iron: AWWA C600.

b. PVC: AWWA C605.

Provide nondetectable warning tape and a continuous length of tracer wire for the full length of each run of nonmetallic piping below grade. Warning tape to be color coded with warning and identification of utility type imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (utility type) LINE BELOW" or similar wording. Color to be blue for potable water systems and purple for nonpotable, reclaimed water, and irrigation lines. Terminate tracer wire above grade at valve boxes and at exterior of building.

**G301002 1.2.3 Connections to Existing Water Lines**

Make connections to existing water lines after approval from the system owner is obtained and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped.

**G301002 1.3 WATER SERVICE LINES**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*   
NOTE: Do not use plastic piping in areas subject to potential spillage of aromatic hydrocarbons. Aromatic hydrocarbons such as benzene and toluene will dissolve polyvinyl chloride.  
 \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

Utilize copper tubing or PVC piping for water service lines less than 4 inches (100 mm) in diameter.& Utilize ductile iron pipe or PVC pressure pipe for water service lines 4 inches (100 mm) and 6 inches (150 mm) in diameter; see G301002, paragraph 1.2, "Water Distribution Mains" for additional requirements for ductile iron and PVC piping.

**G301002 1.3.1 Materials**

a. Copper Tubing   
  
1) Pipe: ASTM B 88/B 88M, Type K.   
  
2) Fittings for Solder-Type Joint: ANSI B16.8 or ASME B16.22.   
  
3) Fittings for Compression-Type Joint: ASME B16.26, flared tube type.

b. PVC Pressure Pipe   
  
1) Pipe: ASTM D1785, Schedule 40 or ASTM D 2241, with SDR rating for 160 psi (1.1 MPa) pressure rating.   
  
2) Fittings: ASTM D 2466.   
  
3) Joints: Elastomeric gaskets for pressure rating; solvent cement joints, ASTM D 2564.

**G301002 1.3.2 Service Connections**

Connect service lines 2-inch (50 mm) diameter or less to the main by a corporation stop and install a gate valve on service line below the frostline.

a. Ductile-iron water mains: AWWA C600.

b. PVC water mains: UBPPA UNI-PUB-8 and the recommendations of AWWA M23, Chapter 9, "Service Connections."

**G301002 1.3.3 Installation**

Install pipe, fittings and accessories in accordance with manufacturer's instructions.

a. Metallic Piping: in accordance with requirements of AWWA C600.

b. PVC: ASTM D 2774 and ASTM D 2855.

**G301002 1.4 CORROSION PROTECTION**

**G301002 1.4.1 Insulating Joints**

Provide insulating joints to prevent contact between dissimilar metals at the joint between adjacent sections of piping in accordance with the pipe manufacturer's recommendations. Ensure that there is no metal-to-metal contact between dissimilar metals after the joint has been assembled.

To prevent the possibility of bi-metallic corrosion, wrap service lines of dissimilar metal to the water mains and the attendant corporation stops with polyethylene or dielectric tape for a minimum clear distance of 3 feet (900 mm) from the main.

**G301002 1.5 VALVES**

Install valves with the same diameter and have the same joint ends as the mains to which they are installed. Provide each type of valve from one manufacturer.

**G301002 1.5.1 Gate Valves**

**G301002 1.5.1.1 Location**

Install valves at new points of connection. At a minimum, locate valves to ensure that no more than two fire hydrants will be out of service in the event of a single break in a water main. Locate valves outside of pavement and heavy traffic areas whenever possible.

**G301002 1.5.1.2 Gate Valves 3-inch (75 mm) and Larger in Diameter**

a. Valves (20-inch and smaller in diameter): AWWA C509 or AWWA C515, nonrising stem and of one manufacturer.

b. Valves (greater than 20-inch in diameter): AWWA C500.

c. Valves for Indicator Post: AWWA C509 or AWWA C500, as indicated above, with indicator post flange in accordance with requirements of UL 262.

d. Interior Coating: AWWA C550.

**G301002 1.5.1.3 Gate Valves Smaller than 3-inch (75 mm) in Diameter**

MSS SP-80, Class 150, solid wedge. Provide valves with flanged or threaded end connections, with unions on both sides of the valve and a handwheel operator.

**G301002 1.5.1.4 Valve Box**

Provide a cast iron, adjustable, valve box for each gate valve on buried piping. Provide valve boxes of a size suitable for the valve on which it is to be used with a minimum diameter of 5-1/4 inches (130 mm). Provide a round head and cast the word "WATER" on the lid.

**G301002 1.5.2 Check Valves**

Provide check valves sized 2-inches (50 mm) to 24-inches (600 mm) as swing-check type (AWWA C508) and with a protective epoxy interior coating conforming to AWWA C550. For underground applications, provide check valve in a valve vault.

**G301002 1.5.3 Air Release, Air/Vacuum, and Combination Air Valves**

AWWA C512 and AWWA M51.

**G301002 1.5.4 Corporation Stops**

If service lines 2—inch diameter or less are tapping water mains, provide corporation stops. Provide ground key type, bronze corporation stops, ASTM B61 or ASTM B62.

**G301002 1.5.5 Installation of Valves**

Make and assemble joints to valves as specified for making and assembling the same type of joints between pipe and fittings.

**G301002 1.6 WATER METERS**

Provide water meter and remote reading as required by the utility provider and in accordance with AWWA standards.

**G301002 1.7 BACKFLOW PREVENTION**

Provide backflow prevention and cross connection control in accordance with AWWA M-14 and governing local/state plumbing codes and waterworks' regulations.

**G301002 1.8 FIRE HYDRANTS**

Provide fire hydrants from one manufacturer and in accordance with UFC 3-600-01, *Fire Protection Engineering*. Coordinate with the project's fire protection designer of record. Provide protection for fire hydrants located in areas subject to vehicle damage. Provide fire hydrants with National Standard threads on hose and pumper connections. Provide a 6 inch (150 mm) inlet, two 2.5 inch (62 mm) hose connections and one pumper connection sized to accommodate local fire department equipment requirements. Paint hydrants with at least one coat of primer and two coats of enamel paint. Barrel and bonnet colors must be in accordance with UFC 3-600-01. Stencil hydrant number and main size on the hydrant barrel using black stencil paint.

a. Dry Barrel Fire Hydrants: AWWA C502 with frangible sections.

b. Wet Barrel Fire Hydrants: AWWA C503 or UL 246, "Wet Barrel" design, with breakable features.

c. Installation: Install hydrants with the pumper connection facing the adjacent paved surface. If there are two, paved adjacent surfaces, contact the Contracting Officer for further direction.

**G301002 1.9 THRUST RESTRAINT**

Provide thrust restraint for all piping, valves, fittings, and other appurtenances of the water distribution system.

Provide thrust restraint using restrained joints in accordance with pipe manufacturer's recommendations, AWWA C600 and if for fire service main, NFPA 24.

**G301002 1.10 DISINFECTION**

Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with the state waterworks' regulations and AWWA C651.

**G301003 POTABLE WATER STORAGE**

**G301003 1.1 POTABLE WATER STORAGE TANKS**

Provide potable water storage facilities in accordance with UFC 3-230-01, *Water Storage, Distribution, and Transmission;* and the state waterworks' regulations.

An elevated, steel water storage tank must be in accordance with AWWA D100. A ground, steel water storage tank must be in accordance with AWWA D100 for welded tanks and AWWA D103 for bolted tanks.

**G301003 1.2 TANK ACCESSORIES**

Provide piping and valves in accordance with G301002. Install an altitude valve in a valve vault with appropriate shut off valves and check valve.

**G301003 1.3 TANK COATINGS**

Utilize primer, intermediate coat and topcoat materials from one manufacturer. Secondary materials, produced or specifically recommended by the coating system manufacturer, may be used. Contrasting colors between coats are required.

**G301003 1.3.1 Interior Coating System**

Provide a commercially available interior coating system that is certified in accordance with AWWA D102, ICS-No. 2 or ICS-No. 5, and with NSF 61 and is in accordance with the state waterworks' regulations.

The color of the final coat must be approved in writing by the Contracting Officer before application begins.

Apply coatings at the following specified thickness:

|  |  |  |
| --- | --- | --- |
| **Coat** | **Minimum DFT (mils)** | **Maximum DFT (mils)** |
| Primer | 3 | 5 |
| Intermediate | 3 | 5 |
| Top | 3 | 5 |
| Total Systems | 9 | 15 |

**G301003 1.3.2 Exterior Coating System**

Provide a commercially available, zinc/epoxy/polyurethane exterior coating system that is certified in accordance with AWWA D102, OCS-No. 6 and is in accordance with the state waterworks' regulations.

The color of the final coat must be approved in writing by the Contracting Officer before application begins.

Apply coatings at the following specified thickness:

|  |  |  |
| --- | --- | --- |
| **Coat** | **Minimum DFT (mils)** | **Maximum DFT (mils)** |
| Primer | 3 | 5 |
| Intermediate | 3 | 5 |
| Top | 2 | 3 |
| Total Systems | 8 | 13 |

**G301004 FIRE PROTECTION WATER DISTRIBUTION**

**G301004 1.1 GENERAL REQUIREMENTS**

Refer to portions of Section G301002 and Section D40, *Fire Protection*. Provide water main piping, service lines, fittings, valves, accessories and other materials in compliance with the American Water Works Association (AWWA) standards for a minimum system working pressure of 200 psi (1380 kPa).

**G301004 1.2 DETECTOR CHECKS**

UL 312; detector check includes bypass meter, piping, gate valves, check valve and connections to detector check valve. Set valve to allow minimal water flow through bypass meter when major water flow is required.

**G301004 1.3 FIRE DEPARTMENT CONNECTIONS**

UL 405.

**G301004 1.4 INDICATOR POSTS**

UL 789.

**G301005 FIRE PROTECTION WATER STORAGE**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*   
NOTE: Include FAA requirements if storage facility is located in the vicinity of an airfield.  
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Design and construct Fire Protection Water Storage systems in accordance with UFC 3-600-01 and NFPA 22.

**G301006 NON-POTABLE WATER DISTRIBUTION**

Refer to G301002; note that system disinfection is not required.

**G301007 PUMPING STATIONS**

If a pump station is allowed, provide a packaged booster pump station including pumps, piping, valves, sensors, controls, and accessories to maintain the water system pressure in accordance with UFC 3-230-01, *Water Storage, Distribution, and Transmission;* and the state waterworks' regulations.

The packaged booster pump station must have an Underwriter’s Laboratories (UL) label indicating compliance of the equipment under the packaged pumping systems UL listing category. This label must be inclusive of the entire station with enclosure so as to demonstrate compliance with the National Electrical Code requirements for working clearances and wiring procedures.

Interior coatings of pumps, piping, valves and other accessories must be a National Standard Foundation (NSF) Standard 61 certified material for potable water.

**G301008 PACKAGED WATER TREATMENT PLANTS**

Provide packaged water treatment plants in accordance with UFC 3-230-03, *Water Treatment;* for pipeline materials and the state waterworks' regulations for treatment plant requirements.

**G3020 SANITARY SEWER**

**G3020 1.1 GENERAL REQUIREMENTS**

Design and construct the gravity sanitary sewage collection system in accordance with UFC 3-240-01, *Wastewater Collection;* and the state sewer collection and treatment regulations. Connect the new sanitary sewage collection system to the nearest existing sanitary manholes or sanitary line adjacent to the project site. Provide design calculations that show the existing system is capable of handling the additional flows.

In areas where chemicals and other substances may be stored (including mechanical and electrical rooms), eliminate floor drains or make provisions to prevent spills from entering the sanitary sewer system. If there is process flow from equipment, discharge can be hard piped, with air gap, to the sanitary sewer.

Wherever possible, locate manholes and other utility access structures out of paved areas.

**G302001 SANITARY SEWER PIPING**

**G302001 1.1 GENERAL REQUIREMENTS**

Provide materials, equipment, labor, testing, and miscellaneous related items to provide sanitary sewage lines for collection and services from the buildings.

**G302001 1.2 GRAVITY SEWER PIPING**

For gravity sanitary sewer mains and laterals, utilize Ductile Iron, PVC or Polypropylene sewer pipe and fittings. Use Ductile Iron under roadways or at depths greater than 10 feet (3.0 m). PVC and Polypropylene may only be used under roadways or at depths greater than 10 feet (3.0 m) when written approval is received by the Government's Civil Reviewer or indicated in another part of the RFP.

**G302001 1.2.1 Materials**

a. PVC Gravity Sewer Pipe   
  
1) Piping and Fittings: ASTM D3034 or ASTM F679, SDR 35.   
  
2) Joints: ASTM D3212 and ASTM F477.

b. Ductile Iron Gravity Sewer Pipe   
  
1) Piping: ASTM A746. Provide required Thickness Class based on design information and methods in ASTM A746.   
  
2) Fittings: AWWA C110 or AWWA C153.   
  
3) Joints: AWWA C111.   
  
4) Interior Coating: AWWA C104.   
  
5) Exterior Protection (if required): AWWA C105, polyethylene encasement.

c. Dual Wall and Triple Wall Polypropylene Sewer Pipe 12 inches to 60 inches

1) Piping and Fittings: ASTM F2736 and ASTMF2764/F2764M.

2) Joints: ASTM D3212 and ASTM F477.

**G302001 1.2.2 Connections to Existing Lines**

Obtain approval from the Contracting Officer before making a connection to an existing line. Conduct work so that there is minimum interruption of service on existing line and provide a new manhole at the connection point.

**G302001 1.2.3 Installation**

Install pipe, fittings and accessories in accordance with manufacturer's instructions.

a. PVC and Dual and Triple Wall Polypropylene: ASTM D2321. Do not use ASTM D2321 Class IV or V materials for bedding, haunching or initial backfill materials.

b. Ductile Iron: AWWA C600.

Provide nondetectable warning tape and a continuous length of tracer wire for the full length of each run of nonmetallic piping below grade. Warning tape to be color coded with warning and identification of utility type imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (utility type) LINE BELOW" or similar wording. Color to be green for sewer systems. Terminate tracer wire above grade at valve boxes and at exterior of building.

**G302001 1.3 PIPING FOR CLEANOUTS**

**G302001 1.3.1 Materials**

a. Cast-Iron Soil Pipe for Cleanouts   
  
1) Pipe: ASTM A 74, service.   
  
2) Joints: ASTM C 564 compression-type rubber gaskets.   
  
3) Exterior Protection (if required): AWWA C105, polyethylene encasement.

**G302001 1.3.2 Installation**

Install cast iron pipe and fittings in accordance with the recommendations of the pipe manufacturer.

**G302002 SANITARY SEWER MANHOLES & CLEANOUTS**

**G302002 1.1 GENERAL REQUIREMENTS**

Provide all materials, equipment, labor, testing, and miscellaneous related items for the sanitary manholes in accordance with the following:

a. Set manhole rim elevations flush with finished surface of paved areas or 1 inch (25 mm) above finished grade in unpaved areas.

b. ASTM C 923M (ASTM C 923), resilient connectors for making joints between manhole and pipes entering manhole.

c. Provide drop manholes when a gravity sewer pipe enters a manhole at an elevation of 24 inches (610 mm) or more above the manhole invert.

d. New utility underground structures, manholes, utility vaults or similar structures within aircraft pavements, within 500 feet (153 m) of runway pavements or within 50 feet (15 M) of any other full strength aircraft pavements, must be designed in accordance with FAA Advisory Circular AC 150/5320-6D, Airport Pavement Design and Evaluation, Appendix 3, Design of Structures for Heavy Aircraft with a maximum wheel load of 75,000 pounds (34,019 KG) for paved surfaces and 50,000 pounds (22,680 KG) for unpaved surfaces.

**G302002 1.2 PRECAST CONCRETE MANHOLES**

ASTM C 478/C 478M; base and first riser must be monolithic.

Precast manhole sections must have:

a. ASTM C 990/C 990M butyl gaskets;

b. ASTM C 443/C 443M rubber O-ring joints; or

c. ASTM C 443, Type B gaskets.

**G302002 1.3 CAST-IN-PLACE CONCRETE MANHOLES**

Reinforced concrete; designed according to ASTM C 890 for A-16 (AASHTO HS20-44), heavy-traffic, structural loading. Provide concrete work in accordance with ACI 301/301M and ACI 350-01; provide a minimum compressive strength of 4000 psi (28 MPa).

**G302002 1.4 MANHOLE FRAMES AND COVERS**

Frame and cover must be cast gray iron, ASTM A48/A48M, Class 35B, cast ductile iron, ASTM A536, Grade 65-45-12, or reinforced concrete, ASTM C478 ASTM C478M. Provide frame and cover adequate to accommodate the imposed live loads. Stamp or cast the words "Sanitary Sewer" into covers so that it is plainly visible.

For airfield structures, fabricate frames and covers of standard commercial grade steel welded by qualified welders in accordance with AWS D1.1/D1.1M. Provide covers of rolled steel floor plate having an approved anti-slip surface. Steel frames and covers must be hot dipped galvanized after fabrication. At the Contractor's option, ductile iron covers and frames may be used for airfield drainage structures if designed for a minimum proof load of 100,000 pounds (45,000 kg) in lieu of the steel frames and covers. Provide covers of the same material as the frames (i.e. ductile iron frame with ductile iron cover, galvanized steel frame with galvanized steel cover). Perform proof loading in accordance with ASTM A 48/A 48M. Physically stamp proof loads into the cover. Provide the Contracting Officer copies of previous proof load test results performed on the same frames and covers as proposed for this Contract. Modify the top of the structure to accept the ductile iron structure in lieu of the steel structure indicated. The finished structure must be level and non-rocking, with the top flush with the surrounding pavement.

**G302002 1.5 MANHOLE STEPS**

a. Zinc-coated steel: 29 CFR 1910.27.

b. Plastic or rubber coating pressure molded to steel: ASTM D 4101, copolymer polypropylene; or ASTM C 443/C 443M, except shore A durometer hardness must be 70 plus or minus 5.

Aluminum steps or rungs are not allowed.

Steps are not required in manholes less than 4 feet (1.2 m) deep.

**G302002 1.6 MANHOLE CONSTRUCTION**

Where a new manhole is constructed on an existing line, remove existing pipe to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For cast-in-place concrete, no parging will be allowed on interior manhole walls.

**G302002 1.7 CONNECTIONS TO EXISTING MANHOLES**

Center pipe connections to existing manholes on the manhole. Holes for the new pipe must be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cut the manhole in a manner that causes the least damage to the walls.

**G302002 1.8 CLEANOUTS**

Construct cleanouts of cast iron soil pipe and fittings; see G302001, paragraph 1.3.

**G302003 LIFT STATIONS AND PUMPING STATIONS**

**G302003 1.1 GENERAL REQUIREMENTS**

If a pump station is allowed, provide materials, equipment, labor, testing and miscellaneous related items for a packaged lift or pump station system for the facility in compliance with the UFC 3-240-01, *Wastewater Collection*; the state sewerage regulations; and the utility provider's requirements.

**G302003 1.2 SUBMERSIBLE PUMPS**

Provide pumps capable of handling raw wastewater and passing spheres of at least 3 inches (75 mm) in diameter. The pump's suction and discharge openings must be at least 4 inches (100 mm) in diameter.

Provide submersible sewage pumps, with guide rail system. Include ASTM A48/A48M, Class 25, nonclog, cast-iron impeller; and hermetically sealed motor with moisture-sensing probe, mechanical seals, and waterproof power cable. Construct the guide rail system of stainless steel. Provide a stainless steel lifting chain for raising and lowering the pump in the basin.

**G302003 1.3 GRINDER PUMPS**

Provide grinder-type sewage pumps, with guide rail system. Include stainless steel or bronze impeller and hermetically sealed motor with moisture-sensing probe, mechanical seals, and waterproof power cable. Construct the guide rail system of stainless steel. Provide a stainless steel lifting chain for raising and lowering the pump in the basin.

**G302003 1.4 SUCTION LIFT PUMPS**

Provide pumps capable of handling raw wastewater and passing spheres of at least 3 inches (75 mm) in diameter. The pump's suction and discharge openings must be at least 4 inches (100 mm) in diameter.

Provide dry-chamber-mounting, vacuum-primed, nonclog sewage pumps located in dry compartment above wet pit. Include ASTM A48/A48M, Class 25, nonclog, cast iron impeller; mechanical or stuffing box seals; pedestal mounted motor; and suction piping extending to bottom of wet pit.

Provide suction-lift pumps capable of automatic rapid self priming and re-priming at the "lead pump on" elevation. Suction piping must not exceed 25 feet (7.6 meters) in total length. Priming lift at the "lead pump on" elevation must include a safety factor of at least 4 feet (1.2 meters) from the maximum allowable priming lift for the specific equipment at design operating conditions. The combined total of dynamic suction-lift at the "pump off" elevation and the required net positive suction head at design operating conditions must not exceed 22 feet (6.7 meters).

**G302003 1.5 PUMP MOTOR**

Provide pump motor sized to accommodate pump operation along the entire impeller curve.

**G302003 1.6 STATION PIPING WITHIN WET WELL AND VALVE VAULT**

**G302003 1.6.1 Piping Less than 4-Inch (100 mm) in Diameter**

a. PVC Pressure Pipe   
  
1) Pipe: ASTM D 1785, Schedule 80.   
  
2) Fittings: Schedule 80 socket fittings, ASTM D 2467; Schedule 80 threaded fittings, ASTM D 2464.

**G302003 1.6.2 Piping 4 inch (100 mm) Diameter and Larger**

a. Flanged Ductile Iron Pipe   
  
1) Pipe: AWWA C115 and its appendices.   
  
2) Fittings: AWWA C110 or AWWA C153.   
  
3) Lining: AWWA C104.

**G302003 1.7 FORCE MAINS**

**G302003 1.7.1 Force Mains for Submersible and Suction Lift Pumps**

Force mains must be at least 4 inches (100 mm) in diameter and be constructed of either ductile iron or PVC pressure pipe.

a. Ductile Iron Pressure Pipe   
  
1) Pipe: AWWA C151, Pressure Class 350.  
  
2) Fittings: AWWA C110 or AWWA C153.  
  
3) Interior Lining: AWWA C104.  
  
4) Exterior Protection (if required): AWWA C105, polyethylene encasement.

b. PVC Pressure Pipe   
  
1) Pipe: AWWA C900, Pressure Class 150. AWWA C905.  
  
2) Fittings: Ductile Iron (AWWA C110 or AWWA C153).

**G302003 1.7.2 Force Mains for Grinder Pumps**

Utilize PVC pressure pipe for force mains less than 4 inches (100 mm) in diameter :

a. PVC Pressure Pipe   
  
1) Pipe: ASTM D 1785, Schedule 40 or ASTM D 2241, with SDR rating for 160 psi (1.1 MPa) pressure rating.   
  
2) Fittings: ASTM D 2466.   
  
3) Joints: Elastomeric gaskets for pressure rating; solvent cement joints, ASTM D 2564.

**G302003 1.8 PIPING ACCESSORIES**

**G302003 1.8.1 Insulating Joints**

Provide between pipes of dissimilar metals a rubber gasket or other approved insulating joint or dielectric coupling to effectively prevent metal-to-metal contact between adjacent sections of piping.

**G302003 1.8.2 Accessories**

Provide flanges, connecting pieces, transition glands, transition sleeves, and other adapters as required.

**G302003 1.8.3 Flexible Flanged Coupling**

Provide flexible flanged coupling for sewage as indicated. Use flexible flanged coupling designed for a working pressure of 350 psi (2400 kPa).

**G302003 1.9 VALVES**

Provide shutoff and check valves on the discharge line of each pump. Locate the check valve between the shutoff valve and the pump. Locate valves in accordance with state sewerage regulations. Check valves must be suitable for the material being handled and placed on the horizontal portion of the discharge piping except for ball check valves, which may be placed in the vertical run. Provide valves capable of withstanding normal pressure and water hammer. Use valves from one manufacturer.

**G302003 1.9.1 Shut Off Valves**

**G302003 1.9.1.1 Shut Off Valves Less than 4 Inch (100 mm) in Diameter**

PVC ball valves.

**G302003 1.9.1.2 Shut Off Valves 4 Inch (100 mm) and Larger in Diameter**

AWWA C509 or AWWA C515, nonrising stem, and flanged. Provide valves with handwheels that open by counterclockwise rotation of the valve stem. Provide epoxy coating in accordance with AWWA C550.

**G302003 1.9.2 Check Valves**

**G302003 1.9.2.1 Check Valves Less than 4-Inch (100 mm) in Diameter**

Neoprene ball check valve with integral hydraulic sealing flange, designed for a hydraulic working pressure of 175 psi (1200 kPa).

**G302003 1.9.2.2 Check Valves 4-Inch (100 mm) and Larger in Diameter**

AWWA C508, flanged. Provide a nonclog, swing check valve rated for not less than 175 psig (1200 kPa) working pressure capable of passing 3-inch (75 mm) diameter solids.

**G302003 1.9.3 Air Relief Valves**

Provide air relief valves at high points in the force main to prevent air locking in accordance with AWWA M51. Provide vacuum relief valves to relieve negative pressures on force mains.

**G302003 1.10 IDENTIFICATION TAGS AND PLATES**

Provide valves with tags or plates numbered and stamped for their usage. Use plates and tags of brass or nonferrous material and mounted or attached to the valve.

**G302003 1.11 THRUST RESTRAINT**

Provide thrust restraint for force mains, valves and other features of the wastewater distribution system.

Provide thrust restraint using restrained joints in accordance with pipe manufacturer's recommendations, AWWA C600 and if for fire service main, NFPA 24.

**G302003 1.12 STATION CONTROL SYSTEM**

**G302003 1.12.1 Operating Controls**

**G302003 1.12.2 Alarm Controls**

Provide alarms for pumping and lift stations; at minimum provide alarms for high level, power failure, pump failure, unauthorized entry or any cause of station malfunction. Provide alarms as required by the pump manufacturer to obtain warranty.

**G302003 1.12.3 Telemetry**

If required, provide a telemetry system in accordance with state sewer collection and treatment regulations and system owner's requirements to relay alarms to a facility that is manned 24 hours a day.

**G302003 1.13 UNDERGROUND ENCLOSURES**

**G302003 1.14 STATION ACCESSORIES**

**G302003 1.14.1 Ventilation**

Provide covered wet wells with provisions for air displacement venting to the outside. Provide galvanized ASTM A 53/A 53M pipe with insect screening.

Provide adequate ventilation for pump stations.

**G302003 1.14.2 Metering**

Provide devices for measuring wastewater flow at pumping stations. Provide indicating, totalizing and recording flow measurement at pumping stations with a 1200 gpm (76 l/s) or greater design peak hourly flow. For smaller stations, provide elapsed time meters in conjunction with pumping rate tests.

**G302003 1.14.3 Pipe and Valve Supports**

Use schedule 40 galvanized steel piping conforming to ASTM A 53/A 53M for pipe and valve supports. Provide either ANSI B16.3 or ANSI B16.11 galvanized threaded fittings.

**G302003 1.14.4 Miscellaneous Metals**

Use stainless steel bolts, nuts, washers, anchors, and supports for installation of equipment.

**G302004 PACKAGED SANITARY SEWER TREATMENT PLANTS**

Provide packaged wastewater treatment facilities in accordance with UFC 3-240-02, *Domestic Wastewater Treatment;* for pipeline materials and the state sewer collection and treatment regulations for treatment plant requirements.

**G302005 SEPTIC TANKS**

Provide septic tanks in accordance with the state and treatment regulations and the International Private Sewage Disposal Code 2000.

**G302006 DRAIN FIELDS**

Provide drain fields in accordance with the state and treatment regulations and the International Private Sewage Disposal Code 2000.

**G302090 OTHER SANITARY SEWER**

**G302090 1.1 OIL INTERCEPTOR**

Refer to G303090.

**G3030 STORM SEWER**

Provide materials, equipment, labor, testing, and miscellaneous related items to provide storm drainage collection system to drain the site. Design and construct the storm sewer collection system in accordance with UFC 3-201-01, *Civil Engineering*; the utility provider's requirements; and the state stormwater management laws and regulations. Design project site to prevent stormwater runoff in excess of the capacity of the existing utility system.

**G303001 STORM SEWER PIPING**

**G303001 1.1 PIPING**

Storm sewer piping 12 inches (300 mm) and larger in diameter must be reinforced concrete, ductile iron or corrugated steel; PVC, corrugated aluminum, polyethylene and polypropylene pipe may only be used when written approval is received by the Government's Civil Reviewer or indicated in another part of the RFP.

Utilize perforated PVC or HDPE for subsurface drainage piping.

**G303001 1.1.1 Materials**

a. PVC Pipe   
  
1) Piping and Fittings: ASTM D3034, SDR 35.   
  
2) Joints: ASTM D3212 and ASTM F477.

b. Ductile Iron Pipe   
  
1) Piping: ASTM A746. Provide required Thickness Class based on design information and methods in ASTM A746.   
  
2) Fittings: AWWA C110 or AWWA C153.   
  
3) Joints: AWWA C111.   
  
4) Interior Coating: AWWA C104.   
  
5) Exterior Protection (if required): AWWA C105, polyethylene encasement.

c. Reinforced Concrete Pipe   
  
1) Circular Pipe: ASTM C76/C76M. Provide required Class based on design information and methods in ASTM C76/C76M. Class III minimum.   
  
2) Elliptical Pipe: ASTM C507/C507M. Provide required Class based on design information and methods in ASTM C76/C76M.   
  
3) Joints:

a) ASTM C990/C990M butyl gaskets;

b) ASTM C 443/C 443M rubber O-ring joints; or

c) AASHTO M 198, Type B preformed plastic gaskets.

d. Corrugated Aluminum Pipe   
  
1) Piping: ASTM B745/B745M.   
  
2) Joints: Coupling bands conforming to ASTM B745/B745M.   
  
3) Coating: Fully bituminous coated in accordance with ASTM A849. For applications where piping is part of a piped storm sewer system (not a culvert), provide pipe fully bituminous coated, invert (half) paved with concrete lining in accordance with ASTM A849.

e. Corrugated Steel Pipe   
  
1) Piping: ASTM A760/A760M.   
  
2) Joints: Coupling bands conforming to ASTM A760/A760M.   
  
3) Coating: Fully bituminous coated in accordance with ASTM A849. For applications where piping is part of a piped storm sewer system (not a culvert), provide pipe fully bituminous coated, invert (half) paved with concrete lining in accordance with ASTM A849.

f. Polyethylene (PE) Pipe   
  
1) Piping 12 inches to 60 inches and Fittings: ASTM 2648/F2648M and AASHTO M 294 Type S, corrugated.   
  
2) Joints: ASTM F477 and ASTM D3212

g. Dual and Triple Wall Polypropylene (PP) Pipe  
  
1) Piping 12 inches to 60 inches and Fittings: ASTM F2736, ASTM F2764/F2764M, ASTM F2881 and AASHTO M 330 Type S or D  
  
2) Joints: ASTM F477 and ASTM D3212

h. Perforated PVC Pipe: ASTM D 2729.

i. Perforated PE Pipe   
  
1) Piping and Fittings: AASHTO M 294, Type SP, corrugated.   
  
2) Joints: AASHTO M 294, Soiltight.

**G303001 1.1.2 Installation**

Install piping in accordance with manufacturer's recommendations and the following standards:

1. PVC, PE and Dual and Triple Wall PP: ASTM D 2321. Do not use ASTM D 2321 Class IV or V materials for bedding, haunching or initial backfill materials.

2. Ductile Iron: AWWA C600.

3. Reinforced Concrete: ACPA 01-102 and 01-103.

4. Corrugated Aluminum: ASTM B 788/B 788M.

5. Corrugated Steel: ASTM A 798/A 798M.

6. Perforated PVC and Perforated PE: ASTM D 2321. Do not use ASTM D 2321 Class IV or V materials for bedding, haunching or initial backfill materials.

Provide nondetectable warning tape and a continuous length of tracer wire for the full length of each run of nonmetallic piping below grade. Warning tape to be color coded with warning and identification of utility type imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (utility type) LINE BELOW" or similar wording. Color to be green for sewer systems. Terminate tracer wire above grade at valve boxes and at exterior of building.

**G303001 1.2 PIPING FOR CLEANOUTS**

**G303001 1.2.1 Materials**

a. Cast-Iron Soil Pipe for Cleanouts  
  
1) Pipe: ASTM A 74, service.  
  
2) Joints: ASTM C 564 compression rubber gaskets.  
  
3) Exterior Protection (if required): AWWA C105, polyethylene encasement.

**G303001 1.2.2 Installation**

Install cast iron pipe and fittings in accordance with the recommendations of the pipe manufacturer.

**G303002 STORM SEWER STRUCTURES**

**G303002 1.1 GENERAL REQUIREMENTS**

Provide materials, equipment, labor, testing, and miscellaneous related items for the drainage structures in accordance with the following:

a. Set structure rim elevations flush with finished surface of paved areas or 1 inch (25 mm) above finished grade in unpaved areas.

b. Provide resilient connectors for making joints between manhole and pipes entering manhole in conformance with ASTM C 923M (ASTM C 923).

c. New utility underground structures, manholes, catch basins, utility vaults or similar structures within aircraft pavements, within 500 feet (153 M) of runway pavements or within 50 feet (15 M) of any other full strength aircraft pavements, must be designed in accordance with FAA Advisory Circular AC 150/5320-6D, Airport Pavement Design and Evaluation, Appendix 3, Design of Structures for Heavy Aircraft with a maximum wheel load of 75,000 pounds (34,019 KG) for paved surfaces and 50,000 pounds (22,680 KG) for unpaved surfaces.

**G303002 1.2 PRECAST CONCRETE INLETS**

Provide work and materials in accordance with requirements of the State Highway Specifications (SHS) and standards where the project is located.

**G303002 1.3 CAST-IN-PLACE CONCRETE DRAINAGE STRUCTURES**

Provide work and materials in accordance with drainage structures indicated in the State Highway Specifications (SHS) and standards where the project is located.

For airfield drainage structures, provide work and materials in accordance with FAA AC 150/5370-10C.

**G303002 1.4 DRAINAGE STRUCTURE FRAMES AND COVERS**

Frame and cover for gratings must be cast gray iron, ASTM A48/A48M, Class 35B; cast ductile iron, ASTM A536, Grade 65-45-12; or cast aluminum, ASTM B26/B26M, Alloy 356.OT6. Provide frame and cover adequate to accommodate the imposed live loads. Stamp or cast the words "Storm Sewer" into covers so that it is plainly visible.

For airfield drainage structures, fabricate frames and covers of standard commercial grade steel welded by qualified welders in accordance with AWS D1.1/D1.1M. Provide covers of rolled steel floor plate having an approved anti-slip surface. Steel frames and covers must be hot dipped galvanized after fabrication. At the Contractor's option, ductile iron covers and frames may be used for airfield drainage structures if designed for a minimum proof load of 100,000 pounds (45,000 KG) for paved surfaces and 50,000 pounds (22,680 KG) for unpaved surfaces in lieu of the steel frames and covers. Covers must be of the same material as the frames (i.e. ductile iron frame with ductile iron cover, galvanized steel frame with galvanized steel cover). Perform proof loading in accordance with A 48/A 48M. Physically stamp proof loads into the cover. Provide the Contracting Officer copies of previous proof load test results performed on the same frames and covers as proposed for this Contract. Modify the top of the structure to accept the ductile iron structure in lieu of the steel structure indicated. The finished structure must be level and non-rocking, with the top flush with the surrounding pavement.

**G303002 1.5 DRAINAGE STRUCTURE STEPS**

a. Zinc-coated steel: 29 CFR 1910.27.

b. Plastic or rubber coating pressure molded to steel: ASTM D 4101, copolymer polypropylene; or ASTM C 443/C 443M, except shore A durometer hardness must be 70 plus or minus 5.

Aluminum steps or rungs are not allowed.

Steps are not required in structures less than 4 feet (1.2 m) deep.

**G303002 1.6 DRAINAGE STRUCTURE CONSTRUCTION**

Where a new structure is constructed on an existing line, remove existing pipe to construct the structure. Cut existing pipe so that pipe ends are approximately flush with the interior face of structure wall, but not protruding into the structure.

**G303002 1.7 CONNECTIONS TO EXISTING STRUCTURES**

Center pipe connections to existing structures on the structure. Holes for the new pipe must be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cut the structure in a manner that causes the least damage to the walls.

**G303002 1.8 CLEANOUTS**

Construct cleanouts of cast iron soil pipe and fittings; see G303001, paragraph 1.2.

**G303003 LIFT STATIONS**

A stormwater pump station(s) is not allowed.

**G303004 CULVERTS**

Provide reinforced concrete or corrugated steel piping for culverts 12 inches (300 mm) and larger in diameter; PVC, corrugated aluminum, polyethylene and polypropylene pipe may only be used when written approval is received by the Government's Civil Reviewer or indicated in another part of the RFP. See G303001, paragraphs 1.1.1 and 1.1.2 for material and installation requirements.

Provide flared end sections of the same material as the pipe material.

Provide erosion control in accordance with the State Erosion and Sedimentation Control Standards or EPA guidance where State Standards are unavailable.

**G303005 HEADWALLS**

Provide cast-in-place concrete headwalls in accordance with the State Highway Specification (SHS) and standards where the project is located.

For airfield drainage structures, provide work and materials in accordance with FAA AC 150/5370-10C

**G303006 EROSION & SEDIMENT CONTROL MEASURES**

Refer to Section G103011.

**G303007 STORMWATER MANAGEMENT**

**G303007 1.1 STORMWATER COLLECTION AND STORAGE**

Provide permanent stormwater management (i.e., detention and retention ponds, LID and other drainage features) to control stormwater runoff in accordance with UFC 3-201-01, *Civil Engineering*, UFC 3-210-10, *Low Impact Development*, FC 1-300-09N *Navy and Marine Corps Design Procedures*, State and local stormwater management Laws and Regulations and project sustainability goals. Integrate permanent stormwater management features into the site design in accordance with UFC 3-201-01, *Civil Engineering*.

Parking areas, roads, walks, courtyards, training areas and similar site features may not be used to detain or retain stormwater. Manage stormwater within detention or retention ponds and the LID features indicated in Part 3 of this RFP. Prevent upstream and downstream property damage.

**G303090 OTHER STORM SEWER**

**G303090 1.1 OIL INTERCEPTOR**

Provide an oil interceptor to remove free oil from oil-in-water mixtures originating from proposed facility operations. Provide grit protection upstream of the oil interceptor.

Provide an oil interceptor utilizing coalescing media and conforming to the guidelines of the American Petroleum Institute (API).

Provide materials or a coating system which protects the interceptor from the oil-in-water mixture, atmosphere, and in-situ soil conditions.

Use an interceptor with a completely removable cover.

**G3040 HEATING DISTRIBUTION**

**G304001 OVERHEAD HOT WATER SYSTEMS**

**G304001 1.1 PIPING & FITTINGS**

Hot water piping must be ASTM A 53, Type E (electric-resistance welded), Grade A or B), or Type S (seamless, Grade A or B); black steel, Weight Class XS (Extra Strong). ASTM A 106, Grade A or B, black steel, Schedule 80 may be used.

**G304001 1.2 INSULATION**

Mineral fiber, calcium silicate, or cellular glass pipe insulation with aluminum jacket which matches existing or surrounding insulation. Paint jacket to suit Base Architectural Plan. The minimum insulation thickness must be in accordance with the following table:

Table 1 Insulation Thickness for Hot Water Systems

|  |  |  |  |
| --- | --- | --- | --- |
| **Nominal Pipe Diameter inches (mm)** | **Mineral Fiber inches (mm)** | **Calcium Silicate inches (mm)** | **Cellular Glass inches (mm)** |
| 1.00 (25) | 1.5 (38) | 1.5 (38) | 1.5 (38) |
| 1.5 (38) | 1.5 (38) | 1.5 (38) | 1.5 (38) |
| 2.0 (51) | 1.5 (38) | 1.5 (38) | 1.5 (38) |
| 2.5 (64) | 1.5 (38) | 1.5 (38) | 1.5 (38) |
| 3.0 (76) | 1.5 (38) | 1.5 (38) | 1.5 (38) |
| 4.0 (100) | 2.0 (51) | 2.5 (64) | 1.5 (38) |
| 5.0 (125) | 2.0 (51) | 2.5 (64) | 1.5 (38) |
| 6.0 (150) | 2.5 (64) | 2.5 (64) | 1.5 (38) |
| 8.0 (200) | 2.5 (64) | 2.5 (64) | 1.5 (38) |
| 10.0 (250) | 2.5 (64) | 2.5 (64) | 1.5 (38) |
| 12.0 (300) | 2.5 (64) | 2.5 (64) | 1.5 (38) |
| 14.0 (350) | 2.5 (64) | 2.5 (64) | 1.5 (38) |
| 16.0 (400) | 2.5 (64) | 2.5 (64) | 1.5 (38) |
| 18.0 (450) | 2.5 (64) | 2.5 (64) | 1.5 (38) |

**G304001 1.3 EXPANSION**

Compensate for piping expansion by utilizing expansion loops and joints. Provide guided slip or flexible ball expansion joints.

**G304001 1.4 SUPPORTS**

MSS SP-58 and MSS SP-69, adjustable supports with insulation protection saddles. Provide stainless steel axles for rollers. Provide support poles with guy wires and hardware.

**G304002 OVERHEAD STEAM SYSTEMS**

**G304002 1.1 PIPING & FITTINGS**

**G304002 1.1.1 Steam Piping**

ASTM A 53, Type E (electric-resistance welded, Grade A or B) or Type S (seamless, Grade A or B), black steel. Provide Weight Class STD (Standard) for welding end connections. Provide Weight Class XS (Extra Strong) for threaded end connections. ASTM A 106, Grade A or B, black steel, Schedule 40 may be used for pipe sizes through 9 inches (250 mm), and minimum pipe wall thickness of 0.35 inches (9.5 mm) for pipe sizes 12 inches (300 mm) and larger for welding end connections. Provide Schedule 80 for threaded end connections.

**G304002 1.1.2 Condensate Piping**

ASTM A 53, Type E (electric-resistance welded), Grade A or B), or Type S (seamless, Grade A or B); black steel, Weight Class XS (Extra Strong). ASTM A 106, Grade A or B, black steel, Schedule 80 may be used.

**G304002 1.2 INSULATION**

Fibrous glass, calcium silicate, or cellular glass pipe insulation with aluminum jacket which matches existing or surrounding insulation. Paint jacket to suit Base Architectural Plan. The minimum insulation thickness must be in accordance with the following tables:

Table 1 Insulation Thickness for Steam Systems

|  |  |  |  |
| --- | --- | --- | --- |
| **Nominal Pipe Diameter inches (mm)** | **Fibrous Glass inches (mm)** | **Calcium Silicate inches (mm)** | **Cellular Glass inches (mm)** |
| 1.00 (25) | 3.5 (90) | 4.0 (100) | \* |
| 1.5 (38) | 3.5 (90) | 4.0 (100) | \* |
| 2.0 (51) | 3.5 (90) | 4.0 (100) | \* |
| 2.5 (64) | 3.5 (90) | 4.0 (100) | \* |
| 3.0 (76) | 4.0 (100) | 4.5 (115) | \* |
| 4.0 (100) | 4.0 (100) | 4.5 (115) | \* |
| 5.0 (125) | 4.5 (115) | 5.0 (125) | \* |
| 6.0 (150) | 4.5 (115) | 5.0 (125) | \* |
| 8.0 (200) | 5.0 (125) | 6.0 (150) | \* |
| 10.0 (250) | 5.0 (125) | 6.0 (150) | \* |
| 12.0 (300) | 5.0 (125) | 6.0 (150) | \* |
| 14.0 (350) | 5.0 (125) | 6.0 (150) | \* |
| 16.0 (400) | 5.0 (125) | 6.0 (150) | \* |
| 18.0 (450) | 5.0 (125) | 6.0 (150) | \* |

\* Cellular glass pipe insulation having an insulating efficiency not less than that of the specified thickness of calcium silicate may be provided.

Table 2 Insulation Thickness for Condensate Systems

|  |  |  |
| --- | --- | --- |
| **Nominal Pipe Diameter inches (mm)** | **Mineral Fiber inches (mm)** | **Fibrous Glass inches (mm)** |
| 1.00 (25) | 2.5 (64) | \* |
| 1.5 (38) | 2.5 (64) | \* |
| 2.0 (51) | 2.5 (64) | \* |
| 2.5 (64) | 2.5 (64) | \* |
| 3.0 (76) | 3.0 (76) | \* |
| 4.0 (100) | 3.0 (76) | \* |
| 5.0 (125) | 3.5 (90) | \* |
| 6.0 (150) | 3.5 (90) | \* |
| 8.0 (200) | 3.5 (90) | \* |
| 10.0 (250) | 3.5 (90) | \* |
| 12.0 (300) | 3.5 (90) | \* |
| 14.0 (350) | 3.5 (90) | \* |
| 16.0 (400) | 3.5 (90) | \* |
| 18.0 (450) | 3.5 (90) | \* |

\* Fibrous glass pipe insulation having an insulating efficiency not less than that of the specified thickness of mineral fiber may be provided.

**G304002 1.3 EXPANSION**

Compensate for piping expansion by utilizing expansion loops and joints. Provide guided slip or flexible ball expansion joints.

**G304002 1.4 SUPPORTS**

MSS SP-58 and MSS SP-69, adjustable supports with insulation protection saddles. Provide stainless steel axles for rollers. Provide support poles with guy wires and hardware.

**G304003 UNDERGROUND HOT WATER SYSTEMS**

**G304003 1.1 PIPING & FITTINGS**

Direct buried, factory pre-fabricated, pre-insulated, piping systems must consist of a service pipe with polyurethane insulation and a high-density polyethylene (HDPE) jacket. Provide factory fabricated fittings and components. Field insulation of fittings is not allowed.

**G304003 1.2 INSULATION**

The minimum insulation thickness must be in accordance with the following tables:

Table 1 Insulation Thickness for Drainable/Dryable Systems

|  |  |  |  |
| --- | --- | --- | --- |
| **Nominal Pipe Diameter inches (mm)** | **Paroc inches (mm)** | **Epitherm inches (mm)** | **Kaylo-10 Thermo-12 Super Caltemp inches (mm)** |
| 1.00 (25) | 2.0 (51) | 2.5 (64) | 4.0 (100) |
| 1.5 (38) | 2.0 (51) | 2.5 (64) | 4.0 (100) |
| 2.0 (51) | 2.5 (64) | 3.5 (90) | 4.5 (115) |
| 2.5 (64) | 2.5 (64) | 3.5 (90) | 4.5 (115) |
| 3.0 (76) | 3.0 (76) | 4.0 (100) | 5.0 (125) |
| 4.0 (100) | 3.0 (76) | 4.0 (100) | 5.0 (125) |
| 5.0 (125) | 3.0 (76) | 4.0 (100) | 5.0 (125) |
| 6.0 (150) | 3.5 (90) | 4.5 (115) | 5.5 (140) |
| 8.0 (200) | 3.5 (90) | 4.5 (115) | 5.5 (140) |
| 10.0 (250) | 4.0 (100) | 5.0 (125) | 6.0 (150) |
| 12.0 (300) | 4.0 (100) | 5.0 (125) | 6.0 (150) |
| 14.0 (350) | 4.0 (100) | 5.0 (125) | 6.0 (150) |
| 16.0 (400) | 4.0 (100) | 5.0 (125) | 6.0 (150) |
| 18.0 (450) | 4.0 (100) | 5.0 (125) | 6.0 (150) |

Table 2 Insulation Thickness for Water Spread Limiting Systems

|  |  |  |
| --- | --- | --- |
| **Nominal Pipe Diameter inches (mm)** | **Calcium Silicate inches (mm)** | **Polyurethane inches (mm)** |
| 1.00 (25) | N/A | N/A |
| 1.5 (38) | N/A | N/A |
| 2.0 (51) | N/A | N/A |
| 2.5 (64) | N/A | N/A |
| 3.0 (76) | 1.00 (25) | 1.23 (31) |
| 4.0 (100) | 1.00 (25) | 1.23 (31) |
| 5.0 (125) | N/A | N/A |
| 6.0 (150) | 1.5 (38) | 1.34 (34) |
| 8.0 (200) | 2.0 (51) | 1.21 (30) |
| 10.0 (250) | 2.5 (64) | 1.31 (33) |
| 12.0 (300) | 2.0 (51) | 1.29 (33) |
| 14.0 (350) | N/A | N/A |
| 16.0 (400) | N/A | N/A |
| 18.0 (450) | N/A | N/A |

**G304003 1.3 UHDS DESIGN**

Design and provide direct buried, factory-prefabricated, pre-insulated main hot water piping, including piping in manholes. Asbestos cement or plastic conduit is not acceptable. The Underground Heat Distribution System (UHDS) representative must be certified in writing by the UHDS manufacturer to be technically qualified and experienced in the installation of the system. Provide a Certificate of Satisfactory Operation certifying that at least 3 systems installed by the UHDS manufacturer within the previous 10 years have and are operating satisfactorily for not less than 5 years. The certificate must include verification information.

**G304003 1.4 VALVING**

Provide isolation valves on supply and return lines at take-offs for service to each building. Locate valves in valve boxes. Valves must be ASME class 150.

**G304003 1.5 EXPANSION**

Compensate for piping expansion by utilizing expansion loops.

**G304004 UNDERGROUND STEAM DISTRIBUTION SYSTEMS**

**G304004 1.1 PIPING & FITTINGS**

Direct buried, factory pre-fabricated, pre-insulated, steam and condensate piping systems must consist of a steel service pipe with polyurethane insulation and a high-density polyethylene (HDPE) jacket. Provide factory fabricated fittings and components. Field insulation of fittings is not allowed.

**G304004 1.2 INSULATION**

The minimum insulation thickness must be in accordance with the following tables:

Table 1 Insulation Thickness for Drainable/Dryable Systems

|  |  |  |  |
| --- | --- | --- | --- |
| **Nominal Pipe Diameter inches (mm)** | **Paroc inches (mm)** | **Epitherm inches (mm)** | **Kaylo-10 Thermo-12 Super Caltemp inches (mm)** |
| 1.00 (25) | 2.0 (51) | 2.5 (64) | 4.0 (100) |
| 1.5 (38) | 2.0 (51) | 2.5 (64) | 4.0 (100) |
| 2.0 (51) | 2.5 (64) | 3.5 (90) | 4.5 (115) |
| 2.5 (64) | 2.5 (64) | 3.5 (90) | 4.5 (115) |
| 3.0 (76) | 3.0 (76) | 4.0 (100) | 5.0 (125) |
| 4.0 (100) | 3.0 (76) | 4.0 (100) | 5.0 (125) |
| 5.0 (125) | 3.0 (76) | 4.0 (100) | 5.0 (125) |
| 6.0 (150) | 3.5 (90) | 4.5 (115) | 5.5 (140) |
| 8.0 (200) | 3.5 (90) | 4.5 (115) | 5.5 (140) |
| 10.0 (250) | 4.0 (100) | 5.0 (125) | 6.0 (150) |
| 12.0 (300) | 4.0 (100) | 5.0 (125) | 6.0 (150) |
| 14.0 (350) | 4.0 (100) | 5.0 (125) | 6.0 (150) |
| 16.0 (400) | 4.0 (100) | 5.0 (125) | 6.0 (150) |
| 18.0 (450) | 4.0 (100) | 5.0 (125) | 6.0 (150) |

Table 2 Insulation Thickness for Water Spread Limiting Systems

|  |  |  |
| --- | --- | --- |
| **Nominal Pipe Diameter inches (mm)** | **Calcium Silicate inches (mm)** | **Polyurethane inches (mm)** |
| 1.00 (25) | N/A | N/A |
| 1.5 (38) | N/A | N/A |
| 2.0 (51) | N/A | N/A |
| 2.5 (64) | N/A | N/A |
| 3.0 (76) | 1.00 (25) | 1.23 (31) |
| 4.0 (100) | 1.00 (25) | 1.23 (31) |
| 5.0 (125) | N/A | N/A |
| 6.0 (150) | 1.5 (38) | 1.34 (34) |
| 8.0 (200) | 2.0 (51) | 1.21 (30) |
| 10.0 (250) | 2.5 (64) | 1.31 (33) |
| 12.0 (300) | 2.0 (51) | 1.29 (33) |
| 14.0 (350) | N/A | N/A |
| 16.0 (400) | N/A | N/A |
| 18.0 (450) | N/A | N/A |

Table 3 Insulation Thickness for Condensate Return Systems

|  |  |  |  |
| --- | --- | --- | --- |
| **Nominal Pipe Diameter inches (mm)** | **Paroc inches (mm)** | **Epitherm inches (mm)** | **Kaylo-10 Thermo-12 Super Caltemp inches (mm)** |
| 1.00 (25) | 2.0 (51) | 2.5 (64) | 4.0 (100) |
| 1.5 (38) | 2.0 (51) | 2.5 (64) | 4.0 (100) |
| 2.0 (51) | 2.5 (64) | 3.5 (90) | 4.5 (115) |
| 2.5 (64) | 2.5 (64) | 3.5 (90) | 4.5 (115) |
| 3.0 (76) | 3.0 (76) | 4.0 (100) | 5.0 (125) |
| 4.0 (100) | 3.0 (76) | 4.0 (100) | 5.0 (125) |
| 5.0 (125) | 3.0 (76) | 4.0 (100) | 5.0 (125) |
| 6.0 (150) | 3.5 (90) | 4.5 (115) | 5.5 (140) |
| 8.0 (200) | 3.5 (90) | 4.5 (115) | 5.5 (140) |
| 10.0 (250) | 4.0 (100) | 5.0 (125) | 6.0 (150) |
| 12.0 (300) | 4.0 (100) | 5.0 (125) | 6.0 (150) |
| 14.0 (350) | 4.0 (100) | 5.0 (125) | 6.0 (150) |
| 16.0 (400) | 4.0 (100) | 5.0 (125) | 6.0 (150) |
| 18.0 (450) | 4.0 (100) | 5.0 (125) | 6.0 (150) |

**G304004 1.3 UHDS DESIGN**

Design and provide direct buried, factory-prefabricated, pre-insulated main steam and condensate piping in separate conduits and including piping in manholes. Asbestos cement or plastic conduit is not acceptable. The UHDS representative must be certified in writing by the UHDS manufacturer to be technically qualified and experienced in the installation of the system. Provide a Certificate of Satisfactory Operation certifying that at least 3 systems installed by the UHDS manufacturer within the previous 10 years have and are operating satisfactorily for not less than 5 years. The certificate must include verification information.

**G304004 1.4 VALVING**

Provide isolation valves on supply and return lines at take-offs for service to each building. Locate valves in manholes. Valves must be ASME class 150.

**G304004 1.5 EXPANSION**

Compensate for piping expansion by utilizing expansion loops. Locate anchors outside manholes.

**G304005 REINFORCED CONCRETE MANHOLES & VALVE BOXES**

**G304005 1.1 MANHOLE CONSTRUCTION**

Manholes must be constructed of reinforced, 3000 psi (206.8 bar) concrete and extend a minimum of 6 inches (300 mm) above grade. Depth must be as required to maintain proper pipe slopes. Construct manhole floor and sides in one monolithic pour. Provide galvanized steel or sectioned aluminum, open grate or solid cover as indicated in ESR Section G30. Provide ventilation openings for solid cover. Provide steel ladder with non-slip surfaces and anchored to the wall. Manhole floor and walls must be watertight. Provide sleeves or core drill openings for pipes with modular mechanical seals. Provide sump pit for pump.

**G304005 1.2 VALVE BOX CONSTRUCTION**

Cast-iron or ductile-iron box of a suitable size. Provide cast-iron or ductile-iron cover for the box with word(s) describing the utility cast on the cover.

**G304005 1.3 MANHOLE SUMP PUMPS**

Vertical sump pump. Operating temperature design must be 195 degrees F (93 degrees C) minimum. Provide with 2-pole float control.

**G304090 OTHER HEATING DISTRIBUTION**

**G304090 1.1 WARNING & IDENTIFICATION TAPE**

Polyethylene plastic tape manufactured specifically for warning and identifying buried utility lines. Warning tape to be color coded with warning and identification of utility type imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (utility type) LINE BELOW" or similar wording. Color to be white for steam systems.

**G304090 1.2 CORROSION PROTECTION**

Provide a cathodic protection system for the underground piping system. System must be designed by a National Association of Corrosion Engineers (NACE) certified Cathodic Protection Engineer. The corrosion engineer must obtain soil data and existing system conditions. Corrosion engineer must supervise, inspect and test the installation and performance of the cathodic protection system. Test stations must be post mounted and placed at the manhole or nearby building. Test stations must be located at each end of each cathodically protected section.

**G3050 COOLING DISTRIBUTION**

**G305001 OVERHEAD COOLING SYSTEMS**

**G305001 1.1 PIPING & FITTINGS**

**G305001 1.1.1 Chilled and Condenser Water Piping**

Chilled and condenser water piping must be electric resistance welded or seamless Schedule 40 black steel pipe conforming to ASTM A 53. Piping 4 inch (100 mm) and smaller may be ASTM B 88 Type K or L copper.

**G305001 1.1.2 Steel Pipe Fittings**

For piping 2 inch (50 mm) and smaller, provide ANSI/ASME B16.3 malleable iron screwed fittings or ASME B16.11 socket welding (Class 3000) or threaded type (Class 2000). Provide ASME/ANSI B16.9 butt-welding fittings or ASME/ANSI B16.5 flanged type for piping 2-1/2 inch (63 mm) and larger. Grooved joint pipe coupling systems of appropriate pressure rating are acceptable in lieu of welded or screwed fittings.

**G305001 1.1.3 Copper Fittings**

Provide ANSI B16.18 cast bronze solder joint type or ASME/ANSI B16.22 wrought copper solder joint type.

**G305001 1.2 INSULATION**

Mineral fiber, Urethane, cellular glass, Faced Phenolic Foam, or Flexible Cellular pipe insulation with aluminum jacket in accordance with ESR Section G30. The minimum insulation thickness must be in accordance with the following table:

Table 1 Insulation Thickness for Cold Water Systems

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Nominal Pipe Diameter inches (mm)** | **Mineral Fiber inches (mm)** | **Urethane inches (mm)** | **Cellular Glass inches (mm)** | **Faced Phenolic Foam inches (mm)** | **Flexible Cellular inches (mm)** |
| 1.00 (25) | 1.00 (25) | 0.75 (19) | 1.5 (38) | 1.00 (25) | 0.75 (19) |
| 1.5 (38) | 1.00 (25) | 0.75 (19) | 1.5 (38) | 1.00 (25) | 0.75 (19) |
| 2.0 (51) | 1.00 (25) | 0.75 (19) | 1.5 (38) | 1.00 (25) | 0.75 (19) |
| 2.5 (64) | 1.00 (25) | 0.75 (19) | 1.5 (38) | 1.00 (25) | 0.75 (19) |
| 3.0 (76) | 1.00 (25) | 0.75 (19) | 1.5 (38) | 1.00 (25) | 0.75 (19) |
| 4.0 (100) | 1.5 (38) | 0.75 (19) | 1.5 (38) | 1.00 (25) | 0.75 (19) |
| 5.0 (125) | 1.5 (38) | 0.75 (19) | 1.5 (38) | 1.00 (25) | 0.75 (19) |
| 6.0 (150) | 1.5 (38) | 1.00 (25) | 1.5 (38) | 1.5 (38) | 1.00 (25) |
| 8.0 (200) | 1.5 (38) | 1.00 (25) | 1.5 (38) | 1.5 (38) | 1.00 (25) |
| 10.0 (250) | 1.5 (38) | 1.00 (25) | 1.5 (38) | 1.5 (38) | 1.00 (25) |
| 12.0 (300) | 1.5 (38) | 1.00 (25) | 1.5 (38) | 1.5 (38) | 1.00 (25) |
| 14.0 (350) | 1.5 (38) | 1.00 (25) | 1.5 (38) | 1.5 (38) | 1.00 (25) |
| 16.0 (400) | 1.5 (38) | 1.00 (25) | 1.5 (38) | 1.5 (38) | 1.00 (25) |
| 18.0 (450) | 1.5 (38) | 1.00 (25) | 1.5 (38) | 1.5 (38) | 1.00 (25) |

**G305001 1.3 SUPPORTS**

Provide MSS SP-58 and MSS SP-69, adjustable supports with insulation protection saddles. Provide stainless steel axles for rollers. Provide support poles with guy wires and hardware.

**G305001 1.4 EXPANSION**

Compensate for piping expansion by utilizing expansion loops and joints. Provide guided slip or flexible ball expansion joints.

**G305002 UNDERGROUND COOLING SYSTEMS**

**G305002 1.1 PIPING & FITTINGS**

Direct buried, factory-prefabricated, pre-insulated, chilled water piping systems. Fittings and accessories must be designed and factory-fabricated to prevent moisture from entering into the system. Backfill and install to meet the requirements of the piping system manufacturer.

**G305002 1.2 VALVES**

Provide isolation valves on supply and return lines at take-offs for service to each building. Locate valves in valve boxes.

**G305090 OTHER COOLING DISTRIBUTION**

**G305090 1.1 EXPANSION**

Compensate for piping expansion by utilizing expansion loops. Locate anchors outside manholes.

**G305090 1.2 WARNING & IDENTIFICATION TAPE**

Polyethylene plastic tape manufactured specifically for warning and identifying buried utility lines. Warning tape to be color coded with warning and identification of utility type imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (utility type) LINE BELOW" or similar wording.

**G305090 1.3 CORROSION PROTECTION**

Provide a cathodic protection system for the underground chilled water and condenser water piping system. System must be designed by a National Association of Corrosion Engineers (NACE) certified Cathodic Protection Engineer. The corrosion engineer must obtain soil data and existing system conditions. Corrosion engineer must supervise, inspect and test the installation and performance of the cathodic protection system. Test stations must be post mounted and placed at the manhole or nearby building. Test stations must be located at each end of each cathodically protected section.

**G3060 FUEL DISTRIBUTION**

**G306001 LIQUID FUEL DISTRIBUTION PIPING**

Underground pipe lines shall be fuel grade double-walled pipe with monitoring sumps where pipe transitions to above ground. Sumps shall be sealed and shall have constant electronic monitoring.

**G306001 1.1 MATERIALS**

Fuel piping must be ASTM A 53, Type E (electric-resistance welded, Grade A or B) or Type S (seamless, Grade A or B), black steel or API SPEC 5L, seamless, submerged-arc weld or gas metal-arc weld, Grade B, black steel. Provide Weight Class STD (Standard) for welding end connections. Provide Weight Class XS (Extra Strong) for threaded end connections.

For underground fuel distribution lines, provide nondetectable warning tape for the full length of each run of piping. Warning tape to be color coded with warning and identification of utility type imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (utility type) LINE BELOW" or similar wording. Color to be yellow for fuel lines.

**G306003 LIQUID FUEL STORAGE TANKS**

**G306003 1.1 STORAGE TANKS**

Double wall in accordance with UL 2085. Provide secondary containment and leak monitoring with a capacity to meet the system requirements. Provide with overfill and spill containment, overfill protection and vents.

**G306003 1.2 FUEL PUMPS**

Fuel pumps must comply with NEMA MG 1, NFPA 70, and be designed for use with hydrocarbon fuels and working pressure of 275 psig (1896 kilopascals) at 100 degrees F (38 degrees C).

**G306003 1.3 FUEL METERS**

Continuous duty, positive displacement type, with electronic thermal compensation capability, suitable for outdoor installation, and designed for use with hydrocarbon fuels and working pressure of 275 psig (1896 kilopascals) at 100 degrees F (38 degrees C).

**G306004 LIQUID FUEL DISPENSING TANKS**

Double wall in accordance with UL 2085 with secondary containment and leak monitoring with a capacity to meet the system requirements. Provide with overfill and spill containment, overfill protection, vents, tank mounted dispenser with filter, vacuum breaker, safety breakaway, hose and nozzle.

**G306006 GAS DISTRIBUTION PIPING (NATURAL & PROPANE)**

**G306006 1.1 STEEL PIPE**

Gas piping must be ASTM A 53, Type E (electric-resistance welded, Grade A or B) or Type S (seamless, Grade A or B), black steel. Provide Weight Class STD (Standard) for welding end connections. Provide Weight Class XS (Extra Strong) for threaded end connections.

**G306006 1.2 POLYETHYLENE (PE)**

PE pipe and heat fusion fittings must conform to ASTM D 2513, Grade PE2406 or PE3408.

**G306007 GAS STORAGE TANKS**

**G306007 1.1 PROPANE STORAGE TANKS**

ASME labeled tank in accordance with NFPA 58 with a capacity to meet the system requirements.

**G306009 OTHER GAS DISTRIBUTION**

**G306009 1.1 WARNING & IDENTIFICATION TAPE**

Detectable aluminum foil, plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identifying buried piping. Warning tape to be color coded with warning and identification of utility type imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (utility type) LINE BELOW" or similar wording. Color to be yellow for gas lines.

-- End of Section --