

Standard Construction Specifications for

Water and Wastewater Systems

# Gettysburg Municipal Authority

Adams County, PA

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#### INTRODUCTION

These <u>STANDARD CONSTRUCTION SPECIFICATIONS FOR WATER AND WASTEWATER SYTEMS</u> (Specifications) set forth the minimum technical requirements for the design and construction of facilities which are intended to become a part of the Gettysburg Municipal Authority's (Authority) water distribution system and sanitary collection system (System). The Specifications are typically used by engineers and contractors working for developers who intend to construct extensions to Authority's existing System.

These Specifications are in addition to Authority's Rates, Rules and Regulations (Regulations) which contain the general administrative requirements as well as some technical requirements for extensions to the System. The emphasis in these Specifications is on the design and installation of distribution pipeline facilities. In the event of any conflict between the Regulations and these Specifications the Regulations shall prevail. The design of facilities other than water and sewer mains (pumping stations, wells, treatment facilities, storage facilities, etc.) will be reviewed and regulated on a case-by-case basis. These Specifications cannot cover every possible facility design and installation scenario, therefore the Authority reserves the unqualified right to modify or establish additional requirements to insure the integrity, operational viability, and life span of the facilities to be constructed.

All construction plans must be reviewed and approved by the Authority prior to the commencement of any work.

#### Definitions

Developer - An individual, partnership, corporation or other legal entity intending to develop a tract of land for residential or other purposes which tract is proposed to be served by water and sanitary sewer facilities of the Gettysbur Municipal Authority.

Authority - the Gettysburg Municipal Authority, Adams County, PA acting directly through its Board or through any agent, officer or employee duly authorized to act on its behalf.

Drawings or Plans- Collectively, all of the drawings or plans for the subdivision, or land development project approved by the municipality in which the project is located or in the alternative those drawings or plans approved by the Authority with respect to the proposed water facilities. This term shall include any supplementary drawings or plans issued by the Developer and approved by the Authority to provide clarification or additional details for the proposed facilities.

Engineer - the person or firm duly employed by the Authority to provide engineering services in its behalf. Such person or firm may provide construction observation and resident project representative services for the Authority in connection with the development project. The services may be performed by the Engineer directly or through its duly authorized agents, officers, or employees. At the Authority's sole discretion it may act in the role of the Engineer as the term is used throughout these Specifications.

Contractor - the person or firm engaged by the Developer to construct the proposed water facilities as shown on the Drawings or Plans or otherwise as part of the development project. The term includes the Contractor's agents, officers, and employees.

#### SECTION 01 00 00 - GENERAL REQUIREMENTS

#### PART 1 - GENERAL

#### 1.1 DESCRIPTION

A. The Developer shall provide all labor, materials, equipment and services and perform all operations required for complete installation of all items and work in these Specifications and as indicated on the Drawings. Drawings shall be considered construction drawings approved by the Authority or its Engineer. No changes can be made to the approved drawings without the authorization of the Authority or its Engineer.

#### 1.2 REFERENCED STANDARDS AND SPECIFICATIONS

- A. Standards and other publications referenced in these Specifications shall be of the issues in effect at time of construction of the project facilities.
- B. References are made to the Pennsylvania Department of Transportation specifications. Unless otherwise noted, the State specifications referred to are the Department of Transportation Publication 408 Specifications, as Amended. Reference in the State Specifications to 'State', 'Chief Engineer', or 'Department' shall be interpreted as the ENGINEER as herein defined. When particular articles or sections are referred to, all paragraphs other than those relating to measurement and payment shall apply.

## 1.3 WORK CONDITIONS

- A. Construct the work in stages to provide for public convenience.
  - 1. Do not close off public use of facilities until completion of one stage of construction will provide alternative usage.
- B. Conduct construction operations to ensure the least inconvenience to the general public.
- C. Take measures to control traffic when working on or near public roads and streets.
  - 1. Employ traffic control measures in accordance with Pennsylvania Department of Transportation Publication No. 213, "Work Zone Traffic Control".
- D. Restore existing paving outside the limits of the work that is damaged by the Developer's operations, to its original condition at the expense of the Developer.

Continuously keep rights-of-way, storage areas, streets, roads, highways and adjacent properties free from accumulations of waste materials, excess excavation, rubbish and windblown debris resulting from construction operations.

E. Protection of Existing Utilities and Structures:

- 1. Notify Pennsylvania One Call by dialing 811 at least 3 working days in advance of intent to excavate, do demolition work or use explosives and give the location of the job site. Mark area to be excavated with white paint. Renew notification every 10 days. The Contractor is solely responsible for the protection of existing utilities.
- 2. Advise each person in physical control of powered equipment or explosives used in excavation or demolition work of the type and location of utility lines at the job site, the Utility Company assistance to expect, and procedures to follow to prevent damage.
- 3. Immediately report to the Utility Company and to the Authority and its Engineer any break, leak or other damage to the lines or protective coatings made or discovered during the work and immediately alert the occupants of affected premises of any emergency created or discovered.
- 4. Allow free access to the site to Utility Company personnel at all times for purposes of maintenance, repair and inspection.
- 5. Notify County Control, all school districts affected, Adams County EMA and the affected Township if any interference with the normal flow of traffic will be caused by this work.
- 6. Developer must obtain a Road Occupancy Permit from the affected Township if the work affects a Township road.

# 1.4 PENNDOT HIGHWAY OCCUPANCY PERMIT AND BONDS

- A. The Developer's attention is directed to Chapter 459, Occupancy of Highways by Utilities under Title 67 Transportation of the Pennsylvania Code. The Authority will be designated as the permittee. The Developer will pay the cost of the highway occupancy permit and the costs of inspection as required by PENNDOT. The Developer shall pay all other costs in connection with the highway occupancy permit or permits, including but not limited to all costs for special insurances and bonds and state inspectors.
- B. Bonds for construction to be performed in PennDOT right-of-ways will be held in force for the required maintenance period of two (2) years. This two (2) year period shall begin from the date of PennDOT's final inspection of the restoration

## 1.5 PERMITS

- A. The Developer will secure and pay the cost for the Department of Environmental Protection Public Water Supply permit, if applicable.
- B. The Developer shall secure and pay for all other permits required to comply with Federal, State, and local ordinances and regulations.
- C. The Developer shall obtain and pay for a Borough or Township Road Occupancy Permit when working on local Roads.
- PART 2 PRODUCT (NOT USED)
- PART 3 EXECUTION

## 3.1 PROCEDURE

A. Confer and verify with other contractors and Utility Companies as to locations and extent of their work, to the end that interferences and deletions between trades are prevented.

#### 3.2 DEVELOPER'S USE OF PREMISES

- A. Confine construction equipment, the storage of materials and equipment, and operations of workmen to within the permanent and temporary rights-of-way.
- B. Pipeline materials may be stored appropriately along the route of the work provided such stored materials do not unduly restrict public use or infringe on private property.
- C. Assume full responsibility for materials stored on site.
- D. Transport materials remaining at the completion of the project to an acceptable storage area.

#### 3.3 SEWER AND WATER MAIN SEPARATION

- A. Horizontal Separation:
  - 1. Sewers (sanitary and storm), including manholes, should be separated at least 10 feet, horizontally, from any existing or proposed water mains. Should local conditions prevent a lateral separation of 10 feet, a sewer may be closer than 10 feet to a water main if:
    - a. it is laid in a separate trench; or if
    - b. it is laid in the same trench with the water main located at one side of a bench of undisturbed earth; and if
    - c. the elevation of the top (crown) of the sewer is at least 18 inches below the bottom of the bottom (invert) of the water main.
- B. Vertical Separation:
  - 1. Whenever sewers cross under water mains, the top of the sewer shall be at least 18 inches below the bottom of the water main.
  - 2. When the elevation of the sewer cannot be varied to provide the required 18" vertical separation, relocate the water main, for a distance of 10 feet extending on each side of the sewer, with one full length of water main centered over the sewer so that both joints will be as far from the sewer as possible. Water main should be constructed of AWWA slip-on or mechanical joint ductile iron pipe.
  - 3. Sewers shall be constructed of AWWA mechanical joint cast iron pipe for any portion within 10 feet of the water main with the sewer joints equidistant from the water main and as far as possible from the water main joints. Both sewer and water main services shall be pressure tested to assure watertightness prior to backfilling. Where a water main crosses under a sewer, provide adequate structural support for the sewer to prevent damage to the water main.
- C. A minimum separation is required both horizontally and vertically between water mains and all other utilities (i.e. power lines, gas lines, etc.). Horizontal separation shall be five (5) feet. Vertical separation shall be 12 inches. Where it is not possible to achieve this 12 inches of separation minimum, the Developer must receive approval from the Authority.

#### 3.4 SOIL EROSION AND SEDIMENTATION CONTROL PLAN

A. The Developer is required to provide soil erosion and sedimentation control measures as indicated in the Soil Erosion and Sedimentation Control Plan from the Adams County Conservation District which will be completed as necessitated by the nature or extent of the work. The Developer is responsible for

obtaining approval of the Erosion and Sediment Control Plan including any associated costs. Approval must be obtained prior to starting work.

## 3.5 FIELD INSPECTION

A. Field inspection will be required and provided by the Authority or its Engineer. Inspection will also include witnessing of testing. The Authority's Inspector shall have the authority to halt construction if, in his opinion, construction is not being done according to specifications. The approved design may not be altered without written approval of the Authority and/or its Engineer. A final inspection of all facilities is required before acceptance of flow or dedication of the facilities to the Authority. Any inspection costs incurred by the Authority will be the responsibility of the Developer.

#### 3.6 SAFETY

A. The Developer and Contractor are responsible for compliance with all laws, codes, and regulations relating to safety provisions at the construction site. The Authority and its representatives will not be responsible for the safety of construction personnel, persons visiting the site, or the general public nor will it be responsible for the enforcement of any laws, codes, or regulations relating to safety. Enforcement of safety regulations will be the responsibility of the appropriate agency.

## END OF SECTION

# SECTION 03 30 53

# CONCRETE FOR UTILITY CONSTRUCTION

#### PART 1 GENERAL

#### 1.1 DESCRIPTION

- A. The Work of this section includes, but is not limited to:
  - 1. Cast-in-place Cement Concrete Construction
  - 2. Reaction and Support Blocking
  - 3. Cradles and Encasement

B. Related Work specified elsewhere:

- 1. Section 31 23 17 Trenching, Backfilling & Compacting
- 2. Section 33 30 10 Manholes

## 1.2 <u>REFERENCES</u>

- A. Pennsylvania Department of Transportation (PennDOT): Publication 408 Specifications.
- B. All materials used in the PennDOT Road right-of-way must be from a certified PennDOT supplier.
- C. American Society for Testing and Materials (ASTM):
  - 1. ASTM A615 Deformed and Plain Billet Steel Bars for Concrete Reinforcement
  - 2. ASTM C31 Methods of Making and Curing Concrete Test Specimens in the Field
  - 3. ASTM C39 Test Method for Compressive Strength of Cylindrical Concrete Specimens
  - 4. ASTM C42 Methods of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
  - 5. ASTM C94 Ready Mixed Concrete
  - 6. ASTM C143 Test Method for Slump of Portland Cement Concrete
  - 7. ASTM C172 Method of Sampling Fresh Concrete
  - 8. ASTM C173 Test Method for Air Content of Freshly Mixed Concrete Volumetric Method
  - 9. ASTM C231 Test Method for Air Content of Freshly Mixed Concrete Pressure Method

## 1.3 SUBMITTALS

- A. Submit certification from the concrete producer attesting that the cement concrete conforms to the State Specifications for the class of concrete being used.
- B. Submit certified results of compressive strength tests performed by an independent testing laboratory.
- C. Submit detailed shop drawings of reinforcing steel.

#### PART 2 - PRODUCTS

## 2.1 <u>CEMENT CONCRETE</u>

- A. Ready-mixed, conforming to Section 704, cement concrete, Pub. 408 Specifications.
- B. Requirements for State approved batch plants, design computations and plant inspection shall not apply; the acceptability of concrete will be based on conformance with the Cement Concrete Criteria specified below and the results of the specified tests.
- C. Cement Concrete Criteria:
  - 1. Class A:
    - a 28-day compressive strength: 3300 psi
    - b Slump: 1 to 3 inches
    - c Air content: 5% +/- 1%
  - 2. Class C:
    - a 28-day compressive strength: 2000 psi
    - b Slump: 2 to 6 inches
    - c Air content: 5% +/- 1%
  - 3. High Early Strength:
    - a 3-day compressive strength: 3000 psi
    - b Slump: 1 to 3 inches
  - 4. Cement Factor and Maximum Water-Cement Ratio conforming to Table A, Section 704.1(b), Pub. 408 Specifications.

#### 2.2 REINFORCEMENT STEEL

- A. Reinforcement Bars:
  - 1. New billet-steel bars conforming to ASTM A615.
  - 2. Deformed, Grade 60.
- B. Steel Wire Fabric: Conforming to Section 709.3, Pub. 408 Specifications.

#### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. Comply with applicable paragraphs of Section 1001, Pub. 408 Specifications for construction requirements including formwork, curing, and protection and finishing of cement concrete.
- B. Excavate and shape trench bottoms and sides to accommodate thrust block forms, encasement, manhole bases, inlets and vaults.

- C. Support pipe, valves and fittings at the required elevation with brick or concrete block. Do not use earth, rock, wood, or organic material as supports.
- D. Proper grade markers or stakes shall be used by Developer to establish grades for ramps, platforms, sidewalks, slopes to drains and inlets.

## 3.2 CONSTRUCTION

- A. Construct cast-in-place vaults, inlets, endwalls, curbs, sidewalks and miscellaneous reinforced structures of Class A concrete; Class A concrete shall be central-plant-mixed.
- B. Construct reaction and support blocking, cradles, encasements, and miscellaneous mass concrete of Class C concrete; Class C concrete may be from a mobile cement concrete plant or truck-mixed.
- C. Concrete Curbs:
  - 1. Construct of Class A concrete with air entrainment, where indicated on Drawings; use expansion material between curbs and sidewalks and at control joints.
  - 2. Curbs shall include one construction joint every 10' and one expansion joint every 30'.
  - 3. Concrete curbs shall be installed according to local Government requirements.
- D. Construct reinforced and plain cement concrete roadway pavements and base courses of High Early Strength concrete; High Early Strength concrete shall be central-plant-mixed.
- E. Provide spacers, chairs, bolsters, ties and other devices for properly placing, spacing, supporting and fastening reinforcement in place.
- F. Place concrete utilizing all possible care to prevent displacement of pipe or fittings; return displaced pipe or fittings to line and grade immediately.
- G. Insure tie rods, nuts, bolts and flanges are free and clear of concrete.
- H. Do not backfill structures until concrete has achieved its initial set, forms are removed, and concrete work is inspected by the Authority's Engineer.
- I. Perform backfilling and compaction as specified in Section 31 23 17 Trenching, Backfilling and Compacting.

#### 3.3 <u>FINISHING</u>

- A. Integral Finishes: Obtain finishes on concrete slabs without applying separate topping coat, as follows.
  - 1. Broom Finish: Draw stiff broom over previously floated finish, to obtain non-slip finish, on exterior sidewalks, ramps, stairs, pads and similar locations.

#### 3.4 FIELD TESTS OF CONCRETE DURING CONSTRUCTION

- A. Perform compressive strength tests, slump tests, and air content tests for each 50 cubic yards of each class of structural concrete placed, or fraction thereof. Testing is not required for non-structural applications such as sidewalks and other such uses.
- B. Retain an independent testing laboratory to test cylinders.
- C. Keep a slump cone and an air meter in close proximity to all concrete placements.
- D. Sample concrete in accordance with ASTM C172.
- E. Determine slump in accordance with ASTM C143.
- F. Determine air content in accordance with ASTM C231 or ASTM C173 as applicable.
- G. Test Cylinders:
  - 1. Cast at least 5 cylindrical test specimens for each batch.
  - 2. Test two cylinders at 7 days; test two cylinders at 28 days.
  - 3. Hold the remaining cylinder in reserve for testing in the event that any of the other cylinders are damaged prior to testing.
  - 4. Prepare and cure test cylinders in accordance with ASTM C31.
  - 5. Determine concrete compressive strength in accordance with ASTM C39.
  - 6. Compute and evaluate in accordance with ASTM C94.
- H. If test cylinders fail to meet compressive strength requirements, the Authority may require additional core tests in accordance with ASTM C42 at the expense of the Developer.

## END OF SECTION 03 30 53

# SECTION 03 40 00

## PRECAST CONCRETE STRUCTURES

#### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. The Work of this section includes, but is not limited to:
  - 1. Pump Stations
  - 2. Vaults
- B. Related Work Specified Elsewhere:
  - 1. Section 31 20 00 Earthwork

#### 1.2 QUALITY ASSURANCE

- A. Design Criteria:
  - 1. Watertight precast reinforced air-entrained concrete structures designed to ASTM C890 A-16 live loading and installation conditions, and manufactured to conform to ASTM C913.
  - 2. Minimum 28-day Compressive Strength: 5,000 psi
  - 3. Honeycombed or retempered concrete will not be acceptable.
- B. Reference Standards:
  - 1. American Society for Testing and Materials (ASTM):
    - a. A185 Specification for Welded Steel Wire Fabric for Concrete Reinforcement
    - b. A615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
    - c. C33 Specifications for Concrete Aggregate
    - d. C150 Specification for Portland Cement
    - e. C260 Specification for Air-Entraining Admixtures for Concrete
    - f. C858 Underground Precast Concrete Utility Structures
    - g. C890 Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.
    - h. C891 Practice for Installation of Underground Precast Concrete Utility Structures
    - i. C913 Specifications for Precast Concrete Water and Wastewater Structures.
    - j. C990 Specifications for Joints for concrete Pipe, Manholes, and Precast box Sections Using Preformed Flexible Joints Sealants
- C. The precast concrete structures shall have sufficient weight to counteract the buoyancy uplift from ground water that is at a level equal to the top of the structures with a factor of safety of 1.5. Provide calculations demonstrating this requirement is being met. The Developer shall add additional weight as needed by installing a poured-in-plate anchoring collar that is structurally anchored to the precast structure via screwed in dowel rods.

#### 1.3 <u>SUBMITTALS</u>

- A. Shop Drawings and Product Data:
  - 1. Submit detailed shop drawings to the Authority for approval prior to fabrication.
  - 2. Include details of reinforcing steel, joint design, concrete mix design, and loading calculations.
- B. Submit certification from the precast structures manufacturer attesting that the structures meet or exceed Specifications.

#### 1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Transport and handle precast concrete units with equipment designed to protect the units from damage.
- B. Do not place units in position which will cause overstress, warp or twist.
- C. Separate stacked members with battens across the full width of each bearing point.
- D. Stack so that lifting devices are accessible and undamaged, and identification marks are discernible.

# PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Portland Cement: ASTM C150, Type II
- B. Coarse Aggregates: ASTM C33; Graded 1" to No. 4 Sieve.
- C. Sand: ASTM C33; 2.35 fineness modulus
- D. Water: Potable; clean and free of injurious amounts of acids, alkalis, salts, organic materials, or other substances that may be incompatible with concrete or steel.
- E. Air-Entraining Admixtures: ASTM C260
- F. Reinforcing Steel:
  - 1. Deformed Bars: ASTM A615, Grade 40
  - 2. Welded Wire Fabric: ASTM A185
- G. Joint Sealant:
  - 1. ASTM C990

## 2.2 <u>MIXES</u>

A. Design concrete mix to produce the required concrete strength, air-entrainment, watertight properties, and loading requirements.

#### 2.3 FABRICATION AND MANUFACTURE

A. Fabricate precast reinforced concrete structures in accordance with ASTM C913, to the dimensions indicated on the Drawings, and to the specified design criteria.

## PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Unless otherwise specified herein below, the precast units shall be installed in accordance with ASTM C891.
- B. Install precast concrete units to the elevation and location indicated on the Drawings.
- C. Install required pipe connections, valves, baffles and other appurtenances as indicated on the Drawings.

# 3.2 BACKFILLING STRUCTURES

- A. Do not backfill precast concrete structures until after examination and approval of the Authority.
- B. Backfill structures in accordance with Section 31 20 00 Earthwork.

# END OF SECTION 03 40 00

# SECTION 31 20 00

# EARTHWORK

#### PART 1 - GENERAL

#### 1.1 DESCRIPTION

A. The Work of This Section Includes, but is not limited to:

- 1. Excavation and Backfill for Structures
- 2. Dewatering
- 3. Sheeting and Shoring
- 4. Site Grading
- B. Related Work Specified Elsewhere:
  - 1. Section 31 23 17 Trenching, Backfilling & Compacting

## 1.2 QUALITY ASSURANCE

- A. Testing Agency:
  - 1. A qualified independent testing agency or agencies will be under Contract and paid for by the Developer and approved by the Authority during construction of this project on a periodic basis for observation of earthwork activities and performance of in-place soil testing and laboratory testing of soil materials.
- B. Developer's Failure to Meet Contract Requirements:
  - 1. The Authority reserves the right to reject any items which do not meet the requirements of the plans and specifications and will require the Developer to replace these items and bear all expenses in connection with such replacements.
  - The Developer shall pay all costs incurred in providing additional testing and/or analysis (including engineering fees) required because of deficient test results or construction not in compliance with these requirements.
- C. Referenced Standards:
  - 1. American Society for Testing and Materials (ASTM):
    - a. C33 Standard Specification for Concrete Aggregates
    - b. D698 Test for Laboratory Compaction Characteristics of Soil Using Standard Effort
    - c. D1556 Test for Density and Unit Weight of Soil in Place by the Sand Cone Method
    - d. D2922 Test for Density of Soil and Soil Aggregate in Place by Nuclear Methods
    - e. D5080 Test for Rapid Determination of Percent Compaction

- 2. Pennsylvania Department of Transportation (PennDOT): Publication 408 Specifications, as amended.
- D. All materials used in the PennDOT Road right-of-way must be from a certified PennDOT supplier.

# 1.3 JOB CONDITIONS

- A. Department of Environmental Protection Bureau of Land Recycling and Waste Management Clean Fill Policy:
  - 1. See Department of Environmental Protection Bureau of Land Recycling and Waste Management Document No. 258-2182-773.
  - 2. Imported Fill: The Contractor will perform environmental due diligence to determine whether imported fill is clean or regulated as specified in DEP Clean Fill Policy. The Contractor will manage the fill following the guidelines of the policy including the furnishing of any certifications, testing or permits that may be required.
  - 3. Exported Fill: The Contractor will perform environmental due diligence and testing to determine that the excavated material scheduled to be spoiled off site qualifies as clean fill under DEP Clean Fill Policy. Should materials be uncovered that are suspected of being other than clean fill, the Contractor is solely responsible for the proper handling and disposal of the material. If evidence of release of regulated substance is found, material shall be disposed of as regulated fill.
- B. The locations shown for utility facilities are approximate. Proceed with caution in the areas of utility facilities and expose them by hand or other excavation methods such as hydroexcavating and acceptable to the Authority.
- C. Erect sheeting, shoring, and bracing as necessary for protection of persons, improvements, and excavations, when trench is five or more feet deep.
- D. Furnish and maintain barricades, signs and markings for excavated areas.
- E. Select and install a system of dewatering to accomplish groundwater control in excavations.
- F. Preserve, protect and maintain operable existing drainage ways, drains and sewers.

## 1.4 SUBMITTALS

- A. Certificates:
  - 1. Submit a Certificate of Compliance, together with supporting data, from the materials supplier attesting that the composition analysis of backfill materials meets specification requirements.
  - 2. Compaction Equipment List: Submit a list of all equipment to be utilized for compacting, including the equipment manufacturer's lift thickness limitations.
  - 3. Submit certified density testing results from the soils testing laboratory.

- B. Qualification Data:
  - 1. Submit evidence of qualifications for the testing agency.

## PART 2 - PRODUCTS

## 2.1 MATERIALS - GENERAL

- A. On site or imported natural soils as approved by Authority.
- B. Load bearing fill is defined as earth fill or rock fill required for bearing loads imposed by structures or pavement subject to motor traffic and all earth materials necessary to raise the grade from an existing elevation or prepared foundation elevation to the finished elevation in a designated fill area which cannot tolerate settlement. All load bearing fill and backfill shall be compacted to 95% of the standard proctor maximum dry density as determined by ASTM D698.
- C. Nonbearing fill shall be free of roots, rock larger than 4" in size and building debris, capable of minimum compaction of 90% standard proctor density at optimum moisture content established for the soil material by ASTM D698.

## 2.2 MATERIALS FOR BACKFILLING, LOAD BEARING FILLS OR EMBANKMENTS

- A. Well-graded soil aggregate mixture, consisting of inorganic on-site cut soils with rock fragments less than 4 inches nominal diameter and less than 20% by weight of the mass, less than 30% of particles finer than No. 200 sieve, liquid limits less than 50, and plasticity indices greater than 10. Alternatively, PennDOT 2RC and No. 2A coarse aggregate would be acceptable.
- B. Total content of gravel or rock fragments larger than 1/2" shall not exceed 20% by weight of the mass.
- C. Backfill shall not contain topsoil, organic matter, debris, cinders, or frozen material.

## 2.3 SELECT STONE FILL

- A. Compacted stone under slabs.
- B. Stone shall be a coarse aggregate material and shall comply with AASHTO #57(PennDOT 2B), Section 703.2
  (C) of Publication 408 Specifications.

## 2.4 SELECT GRANULAR MATERIAL

A. Compacted in areas of over excavation in load bearing areas.

B. Crushed stone or gravel aggregate conforming to Select Granular Material (PennDOT 2RC), Section 703.3,
 Publication 408 Specifications.

# 2.5 PERVOUS MATERIAL

- A. Natural clean, free-draining sand or gravel conforming to the requirements of ASTM C33 except:
  - 1. Materials passing a No. 100 sieve not to exceed 8%.
  - 2. Materials not passing a No. 200 sieve not to exceed 5%.

## 2.6 SOURCE OF MATERIALS

- A. Use materials for fill only if they meet the requirements specified herein. If sufficient material meeting these requirements is not available from required excavation, obtain requisite material from other sources.
- B. Use only material that has been approved as to quality, location of source and zone of placement for fill.
- C. The Authority has the right to reject material at the job site by visual inspection, pending sampling and testing.

## 2.7 EARTHWORK EQUIPMENT

- A. The Developer shall submit a list of the compaction equipment to be utilized on the project and the recommendations of the equipment manufacturer as to the maximum lift thickness which can be placed and the method of compaction to be used with this equipment to achieve the required compaction. B. Lift Thickness Limitations:
  - 1. In no case shall maximum lift thickness placed exceed the maximum limits specified by the manufacturer's recommendations.
  - 2. However, if the equipment manufacturer's lift thickness recommendation is followed and the specified density is not obtained, the Developer shall, at his own expense, remove, replace, and retest as many times as is required to obtain the specified density.

## PART 3 - EXECUTION

## 3.1 PREPARATION AND LAYOUT

- A. Establish and identify required lines, levels, contours and datum.
- B. Maintain bench marks, monuments and other reference points.
- C. Protect trees, shrubs, lawns and other features remaining as portion of final landscaping.

## 3.2 ROUGH GRADING

- A. Rough grade to uniform contours; form foundations for embankments and load bearing fills.
- B. Construct the finished subgrade to vary not more than 1" above or below the elevation shown.
- C. Rough grade to prevent ponding of water in any area; install temporary swales if necessary to improve surface drainage.
- D. Complete embankment slopes to vary not more than 6" from the slope line shown.
- E. In saturated areas indicating sponginess and instability during earth moving operations shall be excavated and prepared to receive acceptable fill materials as specified; material excavated due to unsuitability shall be removed from site.
- F. Excavated subsoil materials to be used for fill materials shall be approved by Authority; materials rejected by Authority shall be removed from the site.

## 3.3 FOUNDATION PREPARATION OF NEW LOAD BEARING AREAS

- A. A load bearing area is defined as an area supporting loads of a structure or pavement area subject to motor traffic.
- B. After excavating to foundation subgrade elevation, the independent testing agency shall perform soil bearing tests, under the direction of the Authority's Engineer, to confirm bearing capacity of the subgrade meets or exceeds the minimum safe bearing capacity. If the subgrade does not meet the minimum safe bearing capacity, the Authority's Engineer will review and provide direction for change in the work.
- C. Proofrolling should be performed by a piece of heavy, rubber-tired equipment such as a loaded tri-axle dump truck. The piece of equipment used for proofrolling should weigh at least 70,000 pounds, and should be operated with tire pressures of at least 60 pounds per square inch (psi). The proofrolling equipment should traverse the subgrade at 2 to 3 miles per hour (the pace of a slow walk), making at least one pass in each direction. Proofrolling should be observed by an experienced construction inspector who can evaluate the suitability of the subgrade soils and direct the removal and replacement of any unsuitable soils; all soft spots or irregularities within the natural soil, disclosed as the proof-rolling progresses, shall be excavated to sound material and then backfilled or leveled to grade as hereinafter specified; Authority shall be so advised by Developer that additional excavation is necessary to achieve satisfactory proof-rolling. Suitable backfill to replace unacceptable soil in load bearing areas shall be compacted select granular material.
- D. If rock is exposed at design footing grades, the rock shall be over-cut one foot and replaced with select stone fill. No additional payment will be made for this work.

# 3.4 SHORING, SHEETING AND BRACING

- A. Install shoring, sheeting and bracing to comply with Federal, State and local code requirements. Responsibility for the safety of the work, personnel and structures rests solely with the Developer.
- B. Carry the bottom of the support system to depth below the main excavation, adequate to prevent ground movement.
- C. Follow the excavation closely with sheeting and shoring placement.
- D. Perform excavation for the installation of sheeting carefully to minimize the formation of voids.
- E. If unstable material is encountered during excavation, take measures to contain it in place and prevent ground displacement.
- F. Have sufficient quantity of material on hand at all times for sheeting, shoring, bracing and other operations for the protection of the work and for use in case of accident or emergency.
- G. Leave sheeting and shoring in place as long as possible, compatible with the placing and compacting of backfill.

## 3.5 EXCAVATION - GENERAL

- A. Excavate to the neat lines or setback lines for mixed face conditions and grades indicated on the Drawings.
- B. Excavate in sequence and stages which will not subject permanent or temporary structures, installations, or surfaces to unstable conditions.
- C. Excavate as required to provide sufficient working space to permit placing, inspection, and completion of the structures.
- D. Shape excavations accurately to the cross-sections and grades indicated.
- E. Support the sides of excavations as specified or required.
- F. Keep excavations free from water.
- G. Fill all openings and fractures in the excavation bottom and sides with cement grout to preclude potential development of soil piping and pinholes. Obtain Authority's written approval of the foundation excavation before placing any foundation stone bedding or construction concrete.
- H. The Developer's failure to maintain dewatering operations for structure excavations shall not be a basis for payment for removal and replacement of unsuitable materials.

## 3.6 BLASTING

- A. Blasting will be considered on a case by case basis. No blasting will be permitted in areas where proximity of structures, underground facilities, or public safety precludes the use of explosives. Nothing in this Section shall relieve the Developer of his responsibilities for damages, nor shall it result in any responsibility to the Authority.
- B. Blasting work shall be supervised by licensed and experienced personnel and performed in conformance with applicable Federal, State and local codes.

# 3.7 BACKFILLING STRUCTURES

- A. Do not commence backfilling around any structure until such structure has been examined and approved by the Authority. Unexamined structures will be re-excavated so proper inspection can take place.
- B. Do not place backfill until the requirements for concrete curing and waterproofing have been complied with and, if required, test cylinders for the particular structure indicate that the concrete has attained the compressive strength specified.
- C. When backfilling against structures and where applicable, place backfill material in equal lifts and to similar elevations on opposite sides of structures in order to equalize opposing horizontal pressures. Place material in uniform increments over fill area.
- D. Protect structures from damage by construction activity, equipment, and vehicles. Repair or replace damaged structures to the satisfaction of the Owner.

## 3.8 DISPOSAL OF EXCAVATED MATERIAL

A. Surplus excavated materials shall become the property of the Developer and be removed from the project site.

## 3.9 EMBANKMENT AND FILLS

- A. Do not place fill on any part of the embankment foundation until such areas have been examined and approved.
- B. Do not place fill on frozen surface.
- C. Place embankment fill in layers of uniform thickness for entire width so that each layer can be uniformly compacted.
- D. Avoid accumulation of large pieces of material at one location; fill voids and interstices with fine materials.
- E. Compact embankment materials of fills within 5 feet of structures using lightweight compactors; do not overstress the structures.

- F. Construct the finished subgrade to vary not more than 1/2" above or 1" below the elevation shown; complete embankment slopes to vary not more than 6" from the slope line shown.
- G. Place fill material over the fill areas and spread in loose horizontal layers, not exceeding equipment manufacturer's recommended uncompacted thickness; cobble size rock fragments may be placed in the lower three feet in areas where the fill is greater than eight feet; all rock shall have interstices filled with smaller rock sizes; work fill material in a direction parallel to the long axis of the fill section unless otherwise approved by the Authority; the gradation and distribution of fill material shall be such that the area will be free from lenses, pockets, and layers of material differing substantially in texture or gradation from surrounding material; after spreading, harrow fill material if necessary to break up large pieces and blend materials.
- H. Where compacted fill is to be placed on a slope, bench the slope in horizontal and vertical faces of such width and depth as to provide adequate keying of the fill into the slope; in places where the movement of large equipment is restricted, place fill material in maximum 4" layers and compact with smaller vibratory rollers or power tampers; take particular care to thoroughly compact in areas where fill is placed against exposed bedrock.

## 3.10 DENSITY TESTING:

- A. Under the direction of the Authority, the Developer's testing agency shall conduct density tests at locations as follows during backfilling operations:
  - Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one
    (1) test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than 3 tests.
  - 2. Foundation Wall Backfill: At each compacted backfill layer, at least one (1) test for each 100 feet or less of wall length, but no fewer than 2 tests.
- B. Determine density by ASTM D1556 or ASTM D2922.

## 3.11 MOISTURE CONTROL

- A. Control moisture content of fill materials to + 2% of the optimum moisture content as determined by ASTM D698; material that is too wet may be spread and scarified on the fill surface and permitted to dry, until the moisture content is within specified limits; when fill material is too dry, sprinkle each layer of the fill and work moisture into the material until a uniform distribution within the specified limits is obtained; if, in the opinion of the Authority, the top surface of a partial fill section becomes too dry to permit a suitable bond, scarify loosen the dried surface, dampen the loosened material and compact the moistened material.
- B. Keep the top plane of load bearing fill areas under construction sloped for drainage; when rain or inclement weather is expected, flat roll the top of embankment to seal it.

## 3.12 SURFACE DRAINAGE

- A. Intercept and divert surface drainage away from the excavation by the use of dikes, curb walls, ditches, pipes, sumps or other means.
- B. Design surface drainage systems so that they do not cause erosion on or off the site, or cause unwanted flow of water.
- C. Remove the surface drainage system when no longer required.
- D. Remove debris and restore the site or sites to original condition.

## 3.13 DRAINAGE AND DEWATERING OF EXCAVATED AREAS

- A. Provide and maintain ditches to collect surface water and seepage which may enter the excavations and divert.
- B. Install a dewatering system to keep excavations dry and free of water.
- C. Maintain water level below subgrade until concrete work or backfill, or both, have been completed to offset uplift pressures.
- D. Dispose of precipitation and subsurface water clear of the work. Provide necessary sediment and erosion control requirements.
- E. During dewatering operations, water discharged to a watercourse must be clear and free of silt, mud and other deleterious materials. Construct and maintain settling ponds to prevent stream degradation. Comply with the requirements for dewatering or discharging to a watercourse as required by Federal, State or local codes.
- F. Backfill drainage ditches, sumps, and settling basins when no longer required with granular material or other material as approved by the Authority.

## 3.14 FINISHING

A. On completion of the work, clean ditches and channels and finish the site in a neat and presentable condition. Slope areas to provide positive drainage.

# END OF SECTION 31 20 00

# SECTION 31 23 17

## TRENCHING, BACKFILLING, AND COMPACTING

#### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. The Work of This Section Includes, but is not limited to:
  - 1. Trench excavation, backfill and compaction
  - 2. Support of excavation
  - 3. Pipe bedding requirements
  - 4. Control of excavated material
  - 5. Restoration of unpaved surfaces
- B. Related Work Specified Elsewhere:
  - 1. Section 31 20 00 Earthwork
  - 2. Section 33 05 23 Boring and Jacking
  - 3. Section 33 31 13 Sanitary Sewer Pipe
- C. Applicable Standard Details:
  - 1. 03-01 Concrete Cradle and Encasement Details
  - 2. 03-02 Concrete Anchors for Steeply Sloped Pipe
  - 3. 03-03 Thrust Block for Bends, Tees, and Caps
  - 4. 03-04 -Thrust Block for Vertical Bends
  - 5. 31-01 Pipe Trench Detail
  - 6. 31-02 Pipe Bedding Details
  - 7. 31-04 Vertical Water Main Clearance
  - 8. 31-05 Stream Crossing Detail
  - 9. 31-06 Clay Dike Detail
  - 10. 32-01 Trench Repaving Detail

#### 1.2 QUALITY ASSURANCE

- A. Testing Agency: Density testing shall be performed by an independent soils testing laboratory engaged and paid for by the Developer and approved by the Authority's Representative. B. Referenced Standards:
  - 1. Pennsylvania Department of Transportation (PENNDOT):
    - Regulations Governing Occupancy of Highways by Utilities (67 PA Code, Chapter 459)

- b. Publication 408 Specifications
- c. Pennsylvania Test Method, PTM 106
- d. Pennsylvania Test Method, PTM 402
- e. Publication 213, Work Zone Traffic Control
- 2. American Society for Testing and Materials (ASTM):
  - a. D698 Test for Laboratory Compaction Characteristics of Soil Using Standard Effort
  - b. D1556 Test for Density and Unit Weight of Soil in Place by the Sand Cone Method
  - c. D2922 Test for Density of Soil and Soil Aggregate in Place by Nuclear Methods
- B. All materials used in the PennDOT Road right-of-way must be from a certified PennDOT supplier.
- C. Density Testing:
  - 1. Conduct a minimum of two (2) density tests per manhole section or pipeline. Conduct one (1) test in the lower half of the trench and one (1) test in the upper half of the trench at locations as directed by the Authority's Engineer during backfilling operations. If any test fails, the Developer shall take remedial steps to correct the compaction and rerun the test until compliance with the density requirements are shown. A density test that fails does not count toward the number of tests to be taken. The cost of the initial test and any required retesting is the responsibility of the Developer.
  - 2. Determine density by ASTM D1556 or ASTM D2922.

## 1.3 SUBMITTALS

- A. Certificates:
  - 1. Submit, prior to delivery of the material to the job site, a Statement of Compliance from the materials supplier, together with supporting data, attesting that the composition analysis of pipe bedding and select material stone backfill materials meets specification requirements. Should a change in source of materials be made during construction, submit a new Statement of Compliance from the new source for approval before the material is delivered to the job site.
  - 2. Submit certified density testing results from the soils testing laboratory.
    - a. Compaction testing equipment must have a current calibration certificate.
- B. Compaction Equipment List: Submit a list of all equipment to be utilized for compacting, including the equipment manufacturer's lift thickness limitations.
- C. Agreements with Property Owners: Prior to storing or disposing of excavated materials on private property, submit a copy of the written agreement with the property owner.

## 1.4 JOB CONDITIONS

- A. Control of Traffic: Employ traffic control measures in accordance with Pennsylvania Department of Transportation Publication 213, "Work Zone Traffic Control". B. Protection of Existing Utilities and Structures:
  - Take all precautions and utilize all facilities required to protect existing utilities and structures. In compliance with Act 121 of the General Assembly of Pennsylvania, PA One Call System and Common Grounds Alliance Best practices Manual, advise in advance of intent to excavate, do demolition work or use explosives and give the location of the job site. Request cooperative steps of the Utility and suggestions for procedures to avoid damage to its lines.
  - 2. Advise each person in physical control of powered equipment or explosives used in excavation or demolition work of the type and location of utility lines at the job site, the Utility assistance to expect, and procedures to follow to prevent damage.
  - 3. Immediately report to the Utility and the Authority and the Authority's Engineer any break, leak or other damage to the lines or protective coatings made or discovered during the work and immediately alert the occupants of premises of any emergency created or discovered.
  - 4. Allow free access to Utility personnel at all times for purposes of maintenance, repair and inspection.
- B. Department of Environmental Protection Bureau of Land Recycling and Waste Management Clean Fill Policy:
  - 1. See Department of Environmental Protection Bureau of Land Recycling and Waste Management Document No. 258-2182-773.
  - 2. Imported Fill: The Developer will perform environmental due diligence to determine whether imported fill is clean or regulated as specified in DEP Clean Fill Policy. The Developer will manage the fill following the guidelines of the policy including the furnishing of any certifications, testing or permits that may be required.
  - 3. Exported Fill: The Developer will perform environmental due diligence and testing to determine that the excavated material scheduled to be spoiled off site qualifies as clean fill under DEP Clean Fill Policy. Should materials be uncovered that are suspected of being other than clean fill, the Developer will immediately notify the Authority. If evidence of release of regulated substance is found, material shall be disposed of as regulated fill.

## PART 2 - PRODUCTS

#### 2.1 PIPE BEDDING MATERIAL

A. Ductile Iron and PVC Pipe Bedding Material: Crushed stone or gravel aggregate conforming to AASHTO No.
 8 (PennDOT 1B) as specified in Section 703.2, Publication 408 Specifications, as shown in Standard Detail.

B. Fine Aggregate Sand for Bedding of Copper Pipe: Natural or manufactured sand consisting of hard, durable, and uncoated inert particles conforming to Section 703.1, Publication 408 Specifications. Limestone materials shall not be used for bedding of copper pipe.

## 2.2 BACKFILL MATERIAL

- A. Select Granular Material Backfill: Crushed stone or gravel aggregate conforming to Select Granular Material (PennDOT 2 RC), Section 703.3, Publication 408/2011 Specifications.
- B. Suitable Backfill Material (All Roads and Highways):
  - 1. From top of pipe bedding material to subgrade elevation:
    - a. Select Material Stone Backfill as specified in paragraph 2.2.A. or
    - b. Flowable backfill as specified in Section 220, Publication 408 Specifications.
  - 2. See Standard Detail for pipe trench detail.

C. Suitable Backfill Material (Other than Roads and Highways):

- 1. From top of pipe bedding material to 24" over top of pipe:
  - a. Material excavated from the trench if free of stones larger than 4" in size and free of wet, frozen, or organic materials.
- 2. From 24" above pipe to subgrade elevation:
  - a. Material excavated from the trench if free of stones larger than 8" in size and free of wet, frozen, or organic materials.
- 3. See Standard Detail for pipe trench detail.
- D. Unsuitable Backfill Material: Where the Authority's Engineer or Representative deems backfill material to be unsuitable and rejects all or part thereof due to conditions prevailing at the time of construction, remove the unsuitable material and replace with select material stone backfill as specified in paragraph 2.02.A or suitable foreign backfill material.

#### 2.3 CLAY DIKE MATERIAL

- A. Clay dike material conforming to the following:
  - 1. Percent passing the #200 sieve 70%
  - 2. Unified Soil Classification Soils CL & CH
  - 3. Plastic Index >10

#### 2.4 DETECTABLE UNDERGROUND UTILITY MARKING TAPE

- A. Tape shall consist of a minimum 5-mil (0.005") overall thickness, with no less than a 35 gauge (0.00035") solid aluminum foil core. The foil must be visible from BOTH sides. The layers shall be laminated together with the extrusion lamination process, not adhesives. Further, there shall be NO inks or printing extending to the edges of the tape. The adhesive will NOT contain any dilutants, pigments or contaminants and is specially formulated to resist degradation by elements normally encountered in the soil. All printing shall be encased to avoid ink rub-off.
- B. Test Data:

Property	<u>Method</u>	Value
Thickness	ASTM D2103	5.0 mils
Tensile strength	ASTM D 882	25 lbs./inch (5500 psi)
Elongation	ASTM D 882-88	<50% at break
Printability	ASTM D2578	>50 dynes/cm <sup>2</sup>
Flexibility	ASTM D 671-81	Pliable
hand		
Inks	Mfg. specs.	Heat set
Mylex Message repeat	Mfg. specs.	Every 20"
Foil	Mfg. specs.	Dead soft/annealed
Top Layer	Mfg. specs.	Virgin PET
Bottom layer	Mfg. specs.	Virgin LDPE
Adhesives	Mfg. specs.	>30%, solid 1.5#/R
Bond strength	Boiling H <sup>2</sup> O	
	@ 100°C	5 hours w/o peel
Colors	APWA code	See below

- C. Color Code shall be as follows:
  - 1. Safety Red: Electric power, distribution and transmission and municipal electric systems.
  - 2. High Visibility Safety Yellow: Gas and oil distribution and transmission, dangerous materials, product and steam.
  - 3. Safety Alert Orange: Telephone and telegraph systems, police and fire communications, and cable television.
  - 4. Safety Precaution Blue: Water systems and slurry pipelines.
  - 5. Safety Green: Sanitary and storm sewer systems.
  - 6. Safety Brown: Force mains, reclaimed water lines and effluent reuse lines.
  - 7. Alert Purple: Reclaimed non-potable water lines.

#### PART 3 - EXECUTION

#### 3.1 MAINTENANCE AND PROTECTION OF TRAFFIC

- A. Coordinate the work to ensure the least inconvenience to traffic and maintain traffic in one or more unobstructed lanes unless closing the street is authorized.
- B. Maintain access to all streets and private drives.
- C. Provide and maintain signs, flashing warning lights, barricades, markers, and other protective devices as required to conform with construction operations and to keep traffic flowing with minimum restrictions.
- D. Comply with State and local codes, permits and regulations.

#### 3.2 CUTTING PAVED SURFACES

- A. Where excavation includes breaking a paved surface, make cuts in a neat uniform fashion forming straight lines parallel with the centerline of the trench. Cut offsets at right angles to the centerline of the trench. Saw cut concrete surfaces; saw cut other hard surfaces or make straight cuts with jackhammer. No paving shall be broken except that which has been previously cut.
- B. Protect edges of cut pavement during excavation to prevent raveling or breaking; square edges prior to pavement replacement.

#### 3.3 BLASTING

- A. Blasting will be permitted on a case by case basis. No blasting will be allowed in areas where the proximity of structures, underground facilities, or public safety precludes the use of explosives. Nothing in this section shall relieve the Developer of his responsibilities for damages, nor shall it result in any responsibility to the Authority or the Authority's Engineer.
- B. Blasting work shall be supervised by licensed and experienced personnel and performed in conformance with applicable Federal, State and local codes.

#### 3.4 TRENCH EXCAVATION

- A. Topsoil Stripping and Stockpiling: Strip topsoil encountered during trench excavation to its full depth and stockpile for reuse.
- B. Depth of Excavation:
  - 1. Gravity Pipelines:
    - a. Excavate trenches to the depth and grade shown on the profile drawings for the invert of the pipe plus 6 inches for placement of pipe bedding material.
    - b. Excavation for laterals shall provide a straight uniform grade from the main pipeline or riser stack to the elevation at the right-of-way line, plus 6 inches for placement of pipe bedding

material. The minimum slope of laterals shall be 1% except that laterals shall connect to the sewer main by means of a 1/8 bend. See Section 33 31 13, Sanitary Sewer Pipe.

- 2. Pressure Pipelines:
  - a. Excavate trenches to the minimum depth necessary to place required pipe bedding material and to provide 4' from the top of the pipe to the finish ground elevation, except where specific depths are otherwise indicated on the Drawings.
  - b. Where unsuitable bearing material is encountered in the trench bottom, continue excavation until the unsuitable material is removed, solid bearing is obtained or can be established, or concrete cradle can be placed. If no concrete cradle is to be installed, refill the trench to required pipeline grade with pipe bedding material.
  - c. Where the Developer, by error or intent, excavates beyond the minimum required depth, backfill the trench to the required pipeline grade with pipe bedding material.
- C. Width of Excavation:
  - 1. Excavate trenches, including laterals, to a width necessary for placing and jointing the pipe and for placing and compacting bedding and backfill around the pipe.
  - 2. Shape trench walls completely vertical from trench bottom to at least 24" above the top of the pipe.
  - 3. For pressure pipeline fittings, excavate trenches to a width that will permit placement of concrete thrust blocks. Provide earth surfaces for thrust blocks that are perpendicular to the direction of thrust and are free of loose or soft material.
  - 4. Where rock is encountered in the sides of the trench, remove the rock to provide a minimum clearance between the pipe and rock of 6".
- D. Length of Open Trench: Do not advance trenching operations more than 400' ahead of completed pipeline. Trenches may not remain open during non-working hours. All pipe ends and clean outs must be securely capped or plugged at the end of each day. Duct tape will not be acceptable.

## 3.5 SUPPORT OF EXCAVATION

- A. Support excavations with approved shoring or a "trench box" as required to comply with Federal and State laws and codes. Install adequate excavation supports to prevent ground movement or settlement to adjacent structures, pipelines or utilities. Damage due to settlement because of failure to provide support or through negligence or fault of the Developer in any other manner shall be repaired at the Developer's expense.
- B. Withdraw shoring as backfilling proceeds unless otherwise directed by the Authority.

## 3.6 CONTROL OF EXCAVATED MATERIAL

A. Keep the ground surface within a minimum of 2' of both sides of the excavation free of excavated material.

- B. In areas where pipelines parallel or cross streams, ensure that no material slides, is washed, or dumped into the stream course. Remove cofferdams immediately upon completion of pipeline construction.
- C. Maintain accessibility to all fire hydrants, valve pit covers, valve boxes, curb boxes, fire and police call boxes, and other utility controls at all times. Keep gutters clear or provide other satisfactory facilities for street drainage. Do not obstruct natural watercourses. Where necessary, provide temporary channels to allow the flow of water either along or across the site of the work.
- D. Provide temporary barricades to prevent excavated material from encroaching on private property, walks, gutters, and storm drains.
- E. Do not place or store excavated material on private property without a written agreement signed by the property owner.

## 3.7 DEWATERING

- A. Keep excavations dry and free of water. Remove precipitation and subsurface water clear of the work area.
- B. Maintain pipe trenches dry until pipe has been jointed, inspected, and backfilled, and concrete work has been completed. Prevent trench water from entering pipelines under construction. All pipe ends and cleanouts must be securely capped or plugged at the end of each day. Duct tape is not acceptable.
- C. Intercept and divert surface drainage away from excavations. Maintain storm drainage facilities, gutters, and natural surface watercourses open and in operation. Provide and install temporary facilities to maintain excavations free of water as required. Design surface drainage systems so that they do not cause erosion on or off the site, or cause unwanted flow of water. When mechanical equipment is utilized to control water conditions, provide and maintain sufficient standby units onsite.
- D. Comply with all Federal, State and Local requirements for dewatering to any watercourse, prevention of stream degradation, and erosion and sediment control.

## 3.8 <u>PIPE BEDDING REQUIREMENTS</u>

- A. Bedding:
  - 1. Depth and type of bedding material aggregate as shown on Standard Detail.
  - 2. Provide Type IV bedding for PVC pipes.
  - 3. Provide Type II bedding for ductile iron pipes.
- B. Shape recesses for the joints or bell of the pipe by hand. Assure that the pipe is supported on the lower quadrant for the entire length of the barrel.

#### 3.9 PIPE LAYING

A. Lay pipe as specified in the appropriate Section of these Specifications for pipeline construction.

#### 3.10 THRUST RESTRAINT

A. Provide pressure pipe with concrete thrust blocking or use restrained joint fittings at all bends, tees, valves, and changes in direction, in accordance with the Specifications, Drawings and Standard Details.

#### 3.11 BACKFILLING TRENCHES

- A. After pipe installation and inspection, backfill trenches from the top of pipe bedding material with specified backfill material hand placed and carefully compacted with hand-operated mechanical tampers in layers of suitable thickness to provide specified density. Backfill and compact the remainder of the trench with specified backfill material.
- B. Exposed Joints for Testing:
  - 1. The Developer has the option to test the pipe prior to backfilling the trench. If this option is selected, install reaction blocks where required and place 2' of thoroughly compacted backfill over the pipe leaving pipe joints partially exposed.
  - 2. If the Developer elects to completely backfill the trench prior to testing, he shall be responsible for locating and uncovering leaks which may cause the test to fail.
- C. Lift Thickness Limitations:
  - 1. In no case shall maximum lift thickness placed exceed the maximum limits specified by the manufacturer's recommendations. However, if the equipment manufacturer's lift thickness recommendation is followed and the specified density is not obtained, the Developer shall, at his own expense, remove, replace, and retest as many times as is required to obtain the specified density.
  - 2. Compact each layer of backfill to 95% of the standard proctor maximum dry density as determined by ASTM D698 for roads and load bearing areas and 90% for all other areas.
  - 3. Lift thickness limitations specified for state highways, shoulders, or embankments govern over the compaction equipment manufacturer's recommendations.
  - 4. Notwithstanding the specified requirements for trench backfill compaction, trenches that settle below the surrounding grade prior to final completion shall be filled to surrounding grade level with appropriate materials.
- D. Uncompacted Backfill:
  - 1. Where uncompacted backfill is indicated on the Drawings, backfill the trench from one foot above the pipe to the top of the trench with material excavated from the trench, crowned over the trench to a sufficient height to allow for settlement to grade after consolidation.

#### 3.12 STREAM CROSSINGS

A. Construct pipeline stream crossings as shown on Standard Detail.

B. After backfilling, protect the surfaces of the disturbed area within the stream channel with a 1 foot thick layer of rip rap stone.

#### 3.13 CLAY DIKES

- A. Install clay dikes adjacent to stream crossings as shown on Standard Detail and where indicated on the Drawings.
- B. Construct dikes impervious to the flow of water by backfilling the trench with compacted clay as shown on Standard Detail.

#### 3.14 UTILITY MARKING TAPE

A. Install magnetically detectable utility marking tape as specified above all non-ferrous pipelines, 12"-18" below final grade.

#### 3.15 DISPOSAL OF EXCAVATED MATERIAL

A. Excavated material remaining after completion of backfilling shall remain the property of the Developer. The Developer shall remove said material from the job site and legally dispose of it.

#### 3.16 RESTORATION OF UNPAVED SURFACES

A. Restore unpaved surfaces disturbed by construction to equal the surface condition prior to construction.

(SEE ATTACHED TABLE)

# END OF SECTION 31 23 17

# SECTION 32 12 16

# PAVING RESTORATION

# PART 1 - GENERAL

# 1.1 DESCRIPTION

- A. The Work of this section includes, but is not limited to:
  - 1. Temporary Paving
  - 2. Permanent Paving
  - 3. Driveways
- B. Related Work specified elsewhere:
  - 1. Section 31 23 17 Trenching, Backfilling and Compacting
  - 2. Section 03 30 53 Concrete for Utility Construction

## 1.2 QUALITY ASSURANCE

- A. Use only materials which are furnished by a bulk bituminous concrete producer regularly engaged in production of hot-mix, hot-laid bituminous concrete and as listed in PADOT Bulletin 41, List of Commercial Producers of Bituminous Mixtures.
- B. All materials used in the PADOT Road right-of-way must be from a certified PADOT supplier.
- C. Referenced Standards:
  - 1. Pennsylvania Department of Transportation (PADOT):
    - a. Publication 408/2011 Specifications
    - b. Publication 27 Specification for Bituminous Materials (Bulletin 27)
    - c. Publication 37 Specification for Bituminous Materials (Bulletin 25)
    - d. Publication 41 List of Commercial Producers of Bituminous Mixtures (Bulletin 41)
    - e. Publication 213 Work Zone Traffic Control

# 1.3 SUBMITTALS
- A. Submit a Statement of Compliance together with supporting data, from bituminous and aggregate suppliers attesting that the materials provided conform to the State specifications.
- B. Submit batch tickets for each load of bituminous concrete delivered to the project site.

# 1.4 JOB CONDITIONS

- A. Weather Limitations:
  - 1. Construct binder and wearing courses only when the air and surface temperature is above 40 degrees F and when base is dry.
  - 2. Aggregate base courses may be placed when the air temperature is above 35 degrees F and rising. Do not place aggregate base course material on soft, muddy or frozen areas.
- B. Employ measures to control traffic to allow safe and expeditious movement of all traffic through the work area.
- C. Implement traffic control measures in accordance with Publication 408/2011, Pennsylvania Department of Transportation Specifications, all sections of 901 except 901.4. Also, comply with Publication 213.
- D. Do not allow traffic on repaved areas until authorized by the Engineer.
- E. Restore existing paving outside the limits of the work that is damaged by the Contractor's operations to its original condition, at the expense of the Contractor.

## 1.5 TESTING

- A. Thickness Testing:
  - 1. Obtain a minimum of one 6" diameter core sample for each 500 linear feet of permanent paving, or fraction thereof, for test of depth of bituminous material courses.
  - 2. Take core samples at locations as directed by the Engineer after final compaction rolling.
  - 3. Bituminous concrete courses deficient more than 1/4" from the specified depth in any one sample, or uniformly more than 1/8" in three or more samples, shall be removed and replaced to the correct depth.
  - 4. Refill and compact test holes with material acceptable to, and under the direction of, the Engineer.

- B. Surface Smoothness:
  - 1. Test finished surface of each bituminous concrete course for smoothness using 10' straightedge applied parallel with, and at right angles to, centerline of paved area.
  - 2. Surfaces will not be acceptable if exceeding 1/4" tolerance for smoothness.
  - 3. Check surfaces areas at intervals as directed by the Engineer.
  - 4. Ponding to a depth of 1/4" over a 20 square foot area shall be corrected as directed by the Engineer.
- C. Density Testing:
  - 1. Acceptance will be based on the results of nuclear density tests performed by a licensed nuclear gage operator, employed by an independent testing laboratory paid by the Contractor, and witnessed by the Engineer.
    - a. Use one of the following nuclear gages or equal:
      - 1) Troxler electronics, Model 3411B
      - 2) Campbell Pacific Nuclear, Model MC-2
      - 3) Seaman Nuclear, Model MC-2
    - Use nuclear gage calibrated in accordance with AASHTO test method T-238-86. Submit certification of annual calibration of gages and documentation of licensed operator's training to the Engineer. Recalibrate any gage which is damaged and/or repaired.
  - 2. A minimum of three (3) tests per each 1,000 square yards or portion thereof meeting the requirement below will be required for each course.
    - a. Binder and Wearing Courses>/=92 percent of Theoretical Density

## PART 2 - PRODUCTS

- 2.1 CONCRETE
  - A. See Section 03 30 53.
- 2.2 BITUMINOUS PAVING MATERIALS
  - A. Pennsylvania Department of Transportation Specifications, Form 408/2011.
    - 1. Bituminous Binder Course, Superpave Asphalt Mixture Design HMA, Section 309.
    - 2. Bituminous Wearing Course, Superpave Asphalt Mixture Design HMA, Section 409.

- 3. Bituminous Tack Coat, Section 460.
- 4. Subbase, Section 350.
- 5. Select Granular Material (2RC), Section 703.3.

## PART 3 - EXECUTION

## 3.1 TEMPORARY PAVING

- A. Place temporary paving immediately upon completion of trench backfilling. Unpaved trenches shall not remain unpaved longer than three (3) working days after backfilling.
- B. Grade and compact subgrade material, then place and compact crushed stone base course to the required thickness.
- C. Place temporary paving material. Compact to required minimum thickness with trench roller having minimum 300 pounds per inch-width of compaction roll.
- D. Continuously maintain temporary paving to the satisfaction of the Engineer, as required by permit requirements, and the local road department.
- E. Temporary paving on roads must remain in place for a minimum of 90 days.

#### 3.2 PERMANENT PAVING

- A. Commence final repaving work only upon written instructions from the Engineer.
- B. Trim existing paving to remove damaged areas; cut straight joint lines and right angle offsets.
- C. Remove temporary paving material.
- D. Apply proper joint sealer to cut edges of bituminous paving.
- E. Construct permanent base and surface courses to the required compacted thicknesses shown on the Contract Drawings, and in accordance with Publication 408/2011 Specifications.
- F. Maintain permanent paving to the satisfaction of the Engineer and the local road department throughout the contract guaranty period.

#### 3.3 DRIVEWAYS

- A. Trim concrete and bituminous driveway surfaces to remove damaged areas.
- B. Saw cut straight joint lines parallel to the centerline of the trench.
- C. Cut offsets at right angles to the trench centerline.
- D. Restore existing concrete driveways trenched through with 4" select concrete base and 6" Class A concrete reinforced with 6 x 6 4/4 wire mesh.
- E. Restore stone or gravel driveways in kind.

## 3.4 BITUMINOUS OVERLAY

- A. Where indicated on the Drawings, Standard Details, or as directed by the Engineer, construct an overlay of bituminous wearing course Superpave Asphalt Mixture, Section 409, Pennsylvania Department of Transportation Form 408/2011 Specifications.
- B. Broom clean full width of roadway surface and shoulder.
- C. Apply E-1 bituminous tack coat material at 0.05 to 0.07 gallon per square yard, in accordance with Section 460, Form 408/2011 Specifications.
- D. Construct overlay in accordance with Section 401.3 of Publication 408/2011 Specifications.

END OF SECTION 32 12 16

## SECTION 33 01 32

#### SEWER AND MANHOLE TESTING

#### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. The Work of this section includes, but is not limited to:
  - 1. Vacuum Testing Sewer Manholes
  - 2. Testing Gravity Sewer Pipelines:
    - a. Low-pressure Air Test
    - b. Infiltration Test
  - 3. Hydrostatic Testing Pressure Pipelines
  - 4. Deflection Testing Plastic Pipelines
  - 5. Closed Circuit Television Inspection of New Sewer Mains
- B. Related Work specified elsewhere:
  - 1. Section 33 01 33 Closed Circuit Television Inspection of Existing Sewer Mains and Connections to Existing Manhole
  - 2. Section 33 31 13 Sanitary Sewer Pipe
  - 3. Section 33 39 10 Manholes

#### 1.2 QUALITY ASSURANCE

- A. Reference Standards:
  - 1. American Society for Testing and Materials (ASTM):
    - a. C1244 Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test
    - b. F1417 Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines
      Using Low-Pressure Air
- B. Test Acceptance:
  - 1. No test will be accepted until the results are below the specified maximum limits.
  - 2. The Developer shall determine and correct the causes of test failure and retest until successful test results are achieved.

#### 1.3 SUBMITTALS

- A. Submit the following prior to start of testing:
  - 1. Testing procedures
  - 2. List of test equipment
  - 3. Testing sequence schedule
  - 4. Provisions for disposal of flushing and test water
  - 5. Current certification of test gauge calibration must be provided.
  - 6. Deflection mandrel drawings and calculations

#### 1.4 JOB CONDITIONS

- A. Do not allow personnel in manholes during vacuum or pressure testing.
- B. Provide relief valves set at 10 psig to avoid accidentally over-pressurizing gravity sewer line during low pressure air testing.
- C. Provide 72 hours' notice to Authority prior to testing.

#### PART 2 - PRODUCTS

#### 2.1 VACUUM TESTING EQUIPMENT

- A. Vacuum pump
- B. Vacuum line
- C. Vacuum tester base with compression band seal and outlet port
- D. Shut-off valve
- E. Stop watch
- F. Plugs
- G. Vacuum gauge, calibrated to 0.1" Hg

#### 2.2 AIR TEST EQUIPMENT

- A. Air compressor
- B. Air supply line

- C. Shut-off valves
- D. Pressure regulator
- E. Pressure relief valve
- F. Stop watch
- G. Plugs
- H. Pressure gauge, calibrated to 0.1 psi

#### 2.3 HYDROSTATIC TEST EQUIPMENT

- A. Hydro pump
- B. Pressure hose
- C. Water meter
- D. Test connections
- E. Pressure relief valve
- F. Pressure gauge, calibrated to 0.1 psi

#### 2.4 DEFLECTION TEST EQUIPMENT

- A. Go, No-Go mandrels
- B. Pull/retrieval ropes

#### PART 3 - EXECUTION

#### 3.1 <u>TESTING MANHOLES</u>

- A. Manhole construction must be complete and base course in place before testing can occur.
- B. Vacuum test in accordance with ASTM C1244 and as follows:
  - 1. Plug all pipe openings; take care to securely brace the plugs and pipe.

- Inflate the compression band to effect a seal between the vacuum base and the structure; connect the vacuum pump to the outlet port with the valve open; draw a vacuum to 10" of Hg; close the valve; start the test.
- 3. Test:
  - a. Determine the test duration for the manhole from the following table:

Manhole Diameter	Test Period			
48"	60 sec.			
60"	75 sec.			
72"	90 sec.			

VACUUM TEST TABLE

 Record the vacuum drop during the test period; if the vacuum drop is greater than 1.0" of Hg during the test period, the manhole shall be repaired and retested; if a vacuum drop of 1" of

Hg does not occur during the test period, the test shall be discontinued and the manhole will be accepted.

c. If the vacuum test fails to meet a 1" Hg drop in the specified time after repair, the unit shall be subjected to repair and retest as necessary.

#### 3.2 <u>PIPELINE PREPARATION</u>

- A. Backfill trenches in accordance with Section 31 23 17.
- B. Provide pressure pipeline with concrete reaction support blocking or the use of restrained mechanical joint glands.
- C. Remove all debris, rocks, bituminous sealants and other debris from manholes and flow channels.
- D. Clean pipelines by means of a high velocity hydraulic sewer cleaner manufactured specifically for the purpose. Clean from the upstream manhole to the downstream manhole capturing and removing any debris removed from the sewer. An alternative physical cleaning is permitted using a porcupine and swab both specifically manufactured for this purpose. The Contractor must demonstrate to the Authority's representative that this procedure produces satisfactory cleaning. Chimney brushes and other devices not manufactured specifically for this purpose are not acceptable.
- E. Plug outlets, wye-branches and laterals; brace plugs to offset thrust.

#### 3.3 TESTING GRAVITY SEWER PIPELINES

A. Low-pressure Air Test:

- 1. Test each newly installed section of gravity sewer line between manholes.
- 2. Slowly introduce air pressure to approximately 4.0 psig.
  - a. If ground water is present, determine its elevation above the springline of the pipe for every foot of ground water above the springline of the pipe, increase the starting air test pressure reading by 0.43 psig; do not increase pressure above 9 psig.
- 3. Allow pressure to stabilize for at least five minutes. Adjust pressure to 3.5 psig or the increased test pressure as determined above if ground water is present. Start the test.
- 4. Test:
  - a. Determine the test duration for a sewer section with a single pipe size from the following table at the end of this specification. No allowance will be made for laterals.
  - Record the drop in pressure during the test period; if the air pressure has dropped more than 1.0 psig during the test period, the line is presumed to have failed; if the 1.0 psig air pressure drop has not occurred during the test period, the test shall be discontinued and the line will be accepted.
  - c. If the line fails, determine the source of the air leakage, make corrections and retest; the Contractor has the option to test the section in incremental stages until the leaks are isolated; after the leaks are repaired, retest the entire section between manholes.

#### 3.4 TESTING PRESSURE SEWER PIPELINES

- A. Hydrostatic Leakage Test:
  - Test each newly laid pressure pipeline, including any valved section thereof, hydrostatically at 1.5 times the working pressure of the pipeline based on the elevation of the lowest point in the pipeline corrected to the elevation of the test gauge; obtain test pressure from the Authority.
  - 2. Slowly fill the section to be tested with water, expelling air from the pipeline at the high points. Install corporation cocks at high points if necessary. After all air is expelled, close air vents and corporation cocks and raise the pressure to the specified test pressure.
  - 3. Observe joints, fittings and valves under test. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage. Retest.
  - 4. After visible deficiencies are corrected, continue testing at the same test pressure for an additional two hours to determine the leakage rate. Maintain pressure within plus or minus 5.0 psig of test pressure. Leakage is defined as the quantity of water supplied to the pipeline necessary to maintain test pressure during the period of the test.
  - 5. Compute the maximum allowable leakage by the following formula:

 $L = ND (P)^{1/2}$ 

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Where: L is the allowable leakage in gallons/hour N is the number of joints in the section tested D is the nominal diameter of the pipe in inches P is the average test pressure in psig

If line under test contains sections of various diameters, the allowable leakage shall be the sum of the computed leakage for each size.

6. If the test of the pipe indicates leakage greater than that allowed, locate the source of the leakage, make corrections and retest until leakage is within allowable limits. Correct visible leaks regardless of the amount of leakage.

#### 3.5 DEFLECTION TESTING OF PLASTIC SEWER PIPE

- A. Perform vertical ring deflection testing on all portions of PVC and ABS sewer piping, in the presence of the Authority, after backfilling has been in place for at least 30 days but not longer than 12 months.
- B. The maximum allowable deflection for installed plastic sewer pipe shall be limited to 5% of the original vertical internal diameter.
- C. Perform deflection testing using a properly sized 'Go, No-Go' mandrel; the mandrel(s) shall be provided at the Contractor's expense and subject to the approval of the Authority.
- D. The mandrel shall have a diameter not less than 95% of the base or average inside diameter of the pipe as determined by the specific ASTM Specification to which the pipe is manufactured. The pipe shall be measured in compliance with ASTM D2122.
- E. The test shall be performed without mechanical pulling devices.
- F. Pipe exceeding the allowable deflection shall be located, excavated, replaced, and retested.

#### 3.6 <u>CLOSED CIRCUIT TELEVISION INSPECTION OF NEW SANITARY SEWER MAINS</u>

- A. Authority will perform closed circuit television inspection of completed sanitary sewers if deemed necessary.
- B. Costs of CCTV inspection will be paid by the installation Contractor.
- C. If deemed necessary a re-inspection will be performed at the cost of the installation Contractor.

# END OF SECTION 33 01 32

# SECTION 33 05 23 BORING AND JACKING

#### PART 1 - GENERAL

#### 3.5 DESCRIPTION

- A. The Work of this section includes, but is not limited to:
  - 1. Approach trench excavation
  - 2. Installation of casing pipe
  - 3. Installation of carrier pipe
- B. Related Work specified elsewhere:
  - 1. Section 31 23 17 Trenching, Backfilling & Compacting

#### 3.6 QUALITY ASSURANCE

- A. Reference Standards:
  - 1. ASTM A53 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
  - 2. ASTM A139 Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
  - 3. ASTM C144 Specification for Aggregate for Masonry Mortar
  - 4. ASTM C150 Specification for Portland Cement
  - 5. ANSI/AWWA Ductile Iron Pipe, Centrifugally Cast for Water or C151/A21.51 Other Liquids
  - 6. AASHTO M6 Fine Aggregate for Portland Cement Concrete
- B. Contractor's Qualifications Construction operations shall be undertaken only by a contractor well experienced in operations of similar magnitude and having had similar experience boring and jacking under transportation arteries and under surface areas which cannot be disturbed.
- C. Design Criteria:
  - 1. Pipe and joints of leakproof construction design for the earth and/or other pressures present, plus highway H20 live loading with the associated recommended impact loading.
  - 2. Design bracing, backstops, and use jacks of sufficient rating so that the jacking can proceed without stoppage, except for adding pipe sections and, as conditions permit, to minimize the tendency of the ground material to "freeze" around the casing pipe.
- D. Allowable Tolerances:
  - 1. Do not overcut excavation by more than 1" greater than the outside diameter of the casing pipe.

- 2. Install casing pipe with the determined vertical and horizontal alignment prior to installation of the carrier pipe.
- 3. Maintain a minimum 1" design clearance between casing spacer runner O.D. and the casing I.D.
- E. Reference Codes and Specifications:
  - 1. Comply with applicable Federal, State and local ordinances, codes, statutes, rules and regulations, and affected jurisdictional bodies.
  - 2. Pennsylvania Department of Transportation (PennDOT): Publication 408/2011 Specifications, as amended.

## 3.7 <u>SUBMITTALS</u>

- A. Certificates: Submit certification from materials manufacturers attesting that the materials provided and installed conform to specification requirements.
- B. Submit history of previous work completed of equivalent nature and scope. Include qualification and experience of key personnel.
- C. Submit description of proposed construction methods, including methods to establish and maintain vertical and horizontal alignment.
- D. Submit installation detail to Authority for approval in regards to boring and jacking operation.
  - 1. All boring must conform to State and railroad (as needed) requirements.

## 3.8 JOB CONDITIONS

- A. Conduct operations so as not to interfere with, interrupt, damage, destroy, or endanger the integrity of surface or subsurface structures or utilities and landscape in the immediate or adjacent areas.
- B. When boring and jacking under State highways and public rights-of-way, comply with applicable right-of-way occupancy permits.
- C. If boring is obstructed, relocate or jack crossing as approved by the Authority's Engineer.

#### PART 2 - PRODUCTS

#### 3.9 STEEL CASING PIPE

A. ASTM A53; Grade 8, Black, Asphalt Coated; minimum thickness 0.375 inches; minimum yield strength 35,000 psi.

- B. Coat pipe, inside and outside, with a petroleum asphaltic coating 1 mil thick; coating shall be continuous, smooth, neither brittle when cold nor sticky when exposed to the sun and adhere to pipe.
- C. Full circumference welded joints.
- D. Diameter and wall thickness as indicated on the Drawings.

#### 3.10 CARRIER PIPE

A. Ductile iron, ANSI/AWWA C151/A21.51, class as indicated on the Drawings.

#### 3.11 CASING SPACERS

- A. Casing spacers shall be all non-metallic (polypropylene), molded in segments for field assembly without any special tools. Spacer segments shall be secured around carrier pipe by insertion of a Slide-Lock. The casing spacer polymer shall contain ultraviolet inhibitors and shall have a minimum compressive strength of 3,000 psi, an 800 Volts/mil dielectric strength and impact strength of 1.5 ft-lbs./inch. Each casing spacer shall have full length, integrally molded skids extending beyond the bell or mechanical joint of the carrier pipe.
- B. The casing spacers shall be the PSI Ranger II<sup>®</sup> Casing Spacers as manufactured by Pipeline Seal and Insulator, Inc., Houston, Texas, or equal.

Carrier Pipe Diameter Inches	Model Number
0.83 to 3.07"	Micro
2.48 to 5.51"	Mini
5.51 to 16.65"	Midi
16.77 to 25.98"	Medi
25.98 to 37.60"	Maxi

#### 3.12 TIMBER SKIDS

A. Pressure treated, cut to a cross-sectional size to allow placement of the carrier pipe in the casing and to support the barrel of the carrier pipe. Provide with notches to accommodate fastening. Treat notches at time of pipe installation.

#### 3.13 SAND (FINE AGGREGATE)

A. AASHTO M6, Latest Edition

#### 3.14 <u>GROUT</u>

A. One part portland cement (ASTM C150) and 6 parts mortar sand (ASTM C144) mixed with water to a consistency applicable for pressure grouting.

#### 3.15 STONE DUST

A. AASHTO #10, crushed stone dust, 3/8" top size.

#### PART 3 - EXECUTION

#### 3.16 APPROACH TRENCH

- A. Excavate approach trench using methods as site conditions require.
- B. Ensure pipe entrance face as near perpendicular to alignment as conditions permit.
- C. Establish a vertical entrance face at least 1 foot above top of casing.
- D. Install adequate excavation supports as specified in Section 02221, Trenching, Backfilling and Compacting.

#### 3.17 CASING PIPE INSTALLATION METHODS

- A. Boring:
  - 1. Push the pipe into the ground with a boring auger rotating within the pipe to remove the soil.
  - 2. Do not advance the cutting head ahead of the casing pipe except for that distance necessary to permit the cutting teeth to cut clearance for the pipe.
  - 3. The machine bore and cutting head arrangement shall be removable from within the pipe.
  - 4. Arrange the face of the cutting head to provide a barrier to the free flow of soft material.
  - 5. If unstable soil is encountered during boring, retract the cutting head into the casing to permit a balance between the pushing pressure and the ratio of pipe advancement to quantity of soil.
  - 6. If voids should develop greater than the outside diameter of the pipe by approximately one inch, grout to fill voids; grouting to fill voids will be at the expense of the Developer.
- B. Jacking:
  - 1. Construct adequate thrust wall normal to the proposed line of thrust.
  - 2. Impart thrust load to the pipe through a suitable thrust ring that is sufficiently rigid to ensure distribution of the thrust load on the pipe.
- C. Drilling and Jacking:

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- 1. Use an oil field type rock roller bit or plate bit made up of individual roller cutter units solidly welded to the pipe which is turned and pushed for its entire length by the drilling machine to give the bit the necessary cutting action.
- 2. Inject a high density slurry (oil field drilling mud) to the head as a cutter lubricant.
- 3. Inject slurry at the rear of the cutter units to prevent jetting action ahead of the pipe.
- D. Mining and Jacking: Utilize manual hand-mining excavation from within the casing pipe as it is advanced with jacks, allowing minimum ground stand up time ahead of the casing pipe.

#### 3.18 DEWATERING

- A. Intercept and divert surface drainage precipitation and groundwater away from excavation through the use of dikes, curb walls, ditches, pipes, sumps or other means.
- B. Develop a substantially dry subgrade for the prosecution of subsequent operations.
- C. Comply with Federal and State requirements for dewatering to any watercourse, prevention of stream degradation, and erosion and sediment control.

#### 3.19 PRESSURE GROUTING

A. Pressure grout the annular space between the casing pipe and surrounding earth.

#### 3.20 CARRIER PIPE INSTALLATION

- A. All provisions regarding cleaning, inspection and handling specified under pipe material sections apply to this work.
- B. Exercise care to prevent damage to pipe joints when carrier pipe is placed in casing.
- C. Support pipeline within casing so that no external loads are transmitted to carrier pipe; attach timber skids or casing spacers to barrel of carrier pipe; do not rest carrier pipe on bells.
- D. Space timber skids approximately three per joint of pipe or one timber skid per every 6'-7'.
- E. After the carrier pipe has been installed in the encasing pipe and has been tested, fill the encasing pipe with stone dust.
  - 1. Close one end of encasing pipe with brick and mortar before filling encasing pipe. Close other end of encasing pipe with brick and waterproofed mortar after filling encasing conduit or as the filling operation dictates.

## END OF SECTION 33 05 2

## SECTION 33 11 13

## WATER MAINS

## PART 1 - GENERAL

## 1.1 DESCRIPTION

- A. The Work of this section includes, but is not limited to:
  - 1. Water Distribution Lines and Fittings
- B. Related Work specified elsewhere:
  - 1. Section 03 30 53 Concrete for Utility Construction
  - 2. Section 31 23 17 Trenching, Backfilling & Compacting
  - 3. Section 33 12 19 Valves
  - 4. Section 33 13 00 Testing & Disinfecting Water Mains

## 1.2 REFERENCES

- A. American National Standards Institute (ANSI): American Water Works Association (AWWA):
  - 1. ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings
  - 2. ANSI B16.3 Malleable Iron Threaded Fittings
  - 3. ANSI/AWWA C104/A21.4 Cement Mortar Lining for Ductile Iron and Gray Iron Fittings for Water
  - 4. ANSI/AWWA C110/A21.10 Ductile Iron and Gray Iron Fittings, 3" Through 48", for Water and Other Liquids
  - 5. ANSI/AWWA C111/A21.11 Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
  - 6. ANSI/AWWA C150/A21.50 Thickness Design of Ductile Iron Pipe
  - 7. ANSI/AWWA C600 Installation of Gray and Ductile Cast Iron Water Mains and Appurtenances
- B. American Society for Testing and Materials (ASTM):
  - 1. ASTM B62 Specification for Composition Bronze or Ounce Metal Castings
- 1.3 SUBMITTALS

- A. Submit manufacturers' catalog information for each type of pipe, fittings, couplings, adapters, gaskets and assembly of joints for approval of the Engineer; include manufacturers' recommendations for deflection in pipe joints.
- B. Submit a Statement of Compliance, together with supporting data, from the materials suppliers of each type of pipe, fitting, gasket, lubricant or other joint materials attesting that each of the products provided meets or exceeds specifications requirements.

## 1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Do not place materials on private property without written permission from the property Owner.
- B. During loading, transporting and unloading, exercise care to prevent damage to materials.
- C. Do not drop pipe or fitting.
- D. Avoid shock or damage at all times.
- E. Use padded slings, hooks and tongs to prevent damage to the exterior surface or internal lining of the pipe.
- F. Pipe may be strung along alignment where approved by the Engineer.
- G. Do not stack higher than Maximum Stacking Heights shown in AWWA C600 or as recommended by the pipe manufacturer.
- H. Keep interior of pipe and fittings free from dirt or other foreign matter.
- I. Store gaskets for mechanical and push-on joints in cool location out of direct sunlight and not in contact with petroleum products.

## PART 2 - PRODUCTS

- 2.1 PIPE, FITTINGS AND JOINTS
  - 1. Ductile Iron:
    - a. Pipe, ANSI/AWWA C151/A21.50, Special Thickness Class 52; standard cement mortar lining, ANSI/AWWA C104/A21.4, outside coated.
    - b. Ductile Iron Fittings: ANSI/AWWA C110/A21.10; 350 psi class for mechanical joint to be cement mortar lined and outside coated as for ductile iron pipe.
    - C. Joints:

1) Mechanical or push-on conforming with ANSI/AWWA C111/A21.11.

2) Retainer glands shall be used on all fittings. Glands shall be Ford UFR 1400-DA Epoxy Coated Wedge Action Restraint Gland

## 2.2 DEAD ENDS

- A. Ball valve curb stop shall be Ford B11-777 2" threaded brass curb stop, stop and waste type.
- B. Tyler curb box.

## PART 3 - EXECUTION

## 3.1 EXCAVATION

- A. Excavate trenches as specified in Section 31 23 17 Trenching, Backfilling and Compacting.
- B. Provide at least 4'- 0" of cover from the top of the pipe to the finished grade elevation.

#### 3.2 PIPE BEDDING

- A. Provide Type II pipe bedding for ductile iron pipelines, as specified in Section 31 23 17 Trenching, Backfilling and Compacting.
- B. Shape recesses for the joints or bell of the pipe by hand.
- C. Assure that the pipe is supported on the lower quadrant for the entire length of the barrel.

## 3.3 PIPE LAYING

- A. Clean and inspect each length of pipe or fitting before lowering into the trench.
- B. Do not lower pipe into the trench except that which is to be immediately installed.
- C. Lay pipe to a uniform line with the barrel of the pipe resting solidly in pipe bedding material throughout its length.
- D. Excavate recesses in pipe bedding material to accommodate joints, fittings, and appurtenances.
- E. Do not subject pipe to a blow or shock to achieve solid bearing or grade.
- F. Lay each section of pipe in such a manner as to form a close concentric joint with adjoining section and to avoid offsets.

- G. Lubricate pipe and gaskets as recommended by the manufacturer; assemble to provide tight, flexible joints that permit movement caused by expansion, contraction, and ground movement.
- H. Grade Check:
  - 1. Check each pipe installed as to line and grade in place.
  - 2. Correct deviations immediately.
  - 3. Deflection of pipe joints in excess of maximum recommended by manufacturer will be cause for rejections.
- I. Install fittings and valves as pipe laying progresses; do not support weight of fittings and valves from pipe.
- J. When the work is not in progress, and at the end of each work day, securely plug the ends of pipe and fittings to prevent trench water, earth, or other substances from entering the pipes or fittings.
- K. Backfill concurrently with pipe laying to hold installed pipe in place.
- L. When pipe laying is terminated for any reason, provide at least 24" of backfill over all pipe except the last piece laid.
- M. Push-on Joints:
  - 1. Clean the inside of the bell and the outside of the spigot.
  - 2. Insert rubber gasket into the bell recess.
  - 3. Apply a thin film of gasket lubricant to either the inside of the gasket or the spigot end of the pipe, or both.
  - 4. Insert the spigot end of the pipe into the socket using care to keep the joint from contacting the ground.
  - 5. Complete the joint by forcing the plain end to the bottom of the socket.
  - 6. Mark pipe that is not furnished with a depth mark before assembly to assure that the spigot is fully inserted.

## 3.4 CUTTING PIPE

- A. Cut pipe without damaging pipe or lining.
- B. Grind cut ends and rough edges smooth.
- C. Bevel end for push-on joints.
- D. Do not field cut reinforced concrete pipe; provide special lengths to make up distances shown.
- 3.5 DEFLECTION

- A. When it is necessary to deflect water mains from a straight alignment horizontally or vertically, do not exceed limits as follows:
  - 1. Ductile Iron Pipe: Per manufacturer's recommendations.

## 3.6 THRUST RESTRAINT

A. Provide pressure pipeline with restrained joints and concrete thrust blocking at all bends, tees, dead ends and changes in direction; construct concrete thrust blocking as shown on the Contract Documents. Submit design calculations showing determination of restrained lengths and submit joint restraint details. Method of joint restraint shall utilize devices specifically designed for the application for which manufacturer's data is available for the application. Submit manufacturer's literature for approval.

## 3.7 BLOW-OFFS

- A. Install a blow-off on the dead ends of all water mains or as shown on Drawings.
- B. Blow-offs shall be plugged, drilled and tapped for 2" blow-off with curb stop and curb box per 2.2A.

## 3.8 SPECIAL CONDITIONS

- A. Connections:
  - 1. Wherever an existing water main is to be cut and closed, or extended or connected to the proposed new lines, construct connections as approved by the Authority.
  - 2. For connecting pipe of different materials, use solid sleeve transition fittings as recommended by the manufacturer and approved by the Authority.
  - 3. Connection to existing asbestos cement pipe must be completed in such a manner as to minimize airborne particles and shall comply with PADEP regulations.

## 3.9 TESTING AND DISINFECTING

A. Test and disinfect water mains as specified in Section 33 13 00 - Testing and Disinfecting Water Mains.

# END OF SECTION 33 11 13

## SECTION 33 12 13

## WATER SERVICE CONNECTIONS

#### PART 1 GENERAL

#### LI 1.1 DESCRIPTION

A. The Work of this section includes, but is not limited to:

1. Tapping water mains by installation of corporation stops or other suitable fittings or couplings.

- 2. Installation of service pipe and fittings, curb stops, and meter boxes.
- B. Related Work specified elsewhere:
  - 1. Section 31 23 17 Trenching, Backfilling & Compacting
  - 2. Section 33 11 13 Water Mains
  - 3. Section 33 13 00 Testing and Disinfecting Water Mains

#### LII 1.2 QUALITY ASSURANCE

- A. Referenced Standards:
  - 1. American National Standards Institute (ANSI):
    - a. B16.1 Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800
  - 2. American Society for Testing and Materials (ASTM):
    - a. B62 Specification for composition Bronze or Ounce Metal Castings
    - b. B88 Specification for Seamless Copper Water Tube
    - c. B584 Standard Specification for Copper Alloy Sand Castings for General Applications
  - 3. American National Standards Institute (ANSI)/American Water Works Association (AWWA):
    - a. ANSI/AWWA C509 Resilient-Seated Gate Valves for Water-Supply Service
      - b. ANSI/AWWA C515 Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
    - c. ANSI/AWWA C800 Underground Service Line Valves and Fittings
  - 4. NSF International:
    - a. NSF 61 Drinking Water System Components
    - b.NSF 372 Lead Content Certification

#### LIII 1.3 SUBMITTALS

A. Manufacturer's Literature: Submit manufacturer's literature for each size and type of corporation stop, curb stop, curb box, pipe, fitting, and coupling.

B. Shop Drawings and Samples: Submit shop drawings, and samples as directed, of all products to be assembled by the Contractor at site for prior approval of the Engineer.

C. Certificates: Submit a Statement of Compliance, together with supporting data, from the materials suppliers attesting that products and materials provided meet or exceeds specification requirements.

#### LIV 1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Product Delivery: During loading, transporting and unloading of all materials and products, exercise care to prevent any damage.

B. Storage: Store all products and materials off the ground and under protective coverings and custody, away from walls and in a manner to keep these clean and in good condition until used.

# PART 2 PRODUCTS

#### LV 2.1 PIPE OR TUBING AND FITTINGS

- A. Copper Water Tubing:
  - 1. ASTM B88, Type K, Seamless
  - 2. Matching Fittings of Flared, or Compression Type
  - 3. CTS 250 PSI NSF POLY Pipe

#### LVI 2.2 TAPPING ACCESSORIES

- A. Tapping Sleeves:
  - 1. Mechanical Joint, or as indicated on the Contract Drawings.
  - 2. 200 psi working pressure.
  - 3. Outlet Flange: ANSI B16.1, Class 125.
- B. Tapping Valves:
  - 1. ANSI/AWWA C509.
  - 2. Inlet Flange, Class 125.

#### LVII 2.3 CORPORATION STOP ASSEMBLY

- A. Corporation Stops:
  - 1. 3/4" Ball Corp AWWA Quick Joint CTS (FB100-3Q-NL)
  - 2. 1" Ball Corp AWWA Quick Joint CTS (FB1000-4Q-NL)
  - 3. 1-1/2" Ball Corp AWWA Quick Joint CTS (FB100-6Q-NL)
  - 4. Brass or Red Brass alloy body conforming to ASTM B62.
  - 5. Inlet end threaded for tapping according to ANSI/AWWA C800.
  - 6. Outlet end suitable for service pipe specified.
- B. Service Saddles:

1. A double strap type, designed to hold pressures in excess of the working pressure of the pipe.

- 2. Ford Ductile Iron Service Saddles
- 3. Use FC202 for AC and Iron Pipe
- 4. Epoxy Coated, with a stainless steel strap
- C. Service Line Fittings:
  - 1. Ford C-44-33-Q-NL (3/4" X 3/4")
  - 2. Ford C-44-33-Q-NL (3/4" X 1")

#### LVIII 2.4 CURB STOP ASSEMBLY

- A. Curb Stops:
  - 1. 3/4" Ball Valve Curb Stop CTS Quick Joint (B44-333Q-NL)
  - 2. 1" Ball Valve Curb Stop CTS Quick Joint (FB1000-4Q-NL)
  - 3. 1-1/2" Ball Valve Curb Stop CTS Quick Joint (B44-666Q-NL)
  - 4. Brass body conforming to AWWA C800 (ASTM B62 and ASTM B584).
  - 5. Ball Type Valve, molded EPDM seats, fluorocarbon-coated brass ball.
  - 6. Watertight, non-directional valve.
  - 7. 300 PSI Working Pressure.
  - 8. Insert PVC sleeves on all curb stops over valve. Extend sleeve to grade with removable plug.
- B. Curb Boxes and Covers:
  - 1. Tyler Union 32 U Heavy Duty Service Boxes and Componets (6500 Screw Type).
  - 2. Bingham & Taylor Curb Boxes Type 93.
  - 3. Lid with inscription 'Water', with Pentagon Plug.

## 2.6 <u>ACCESSORIES</u>

- A. Provide insert sleeves on all service connections.
- B. Inset Stiffeners to be Ford 50/70 series.
- C. Pipe coupling to be Romac Industries XR501, Macro HP, and Alpha.

## LIX 2.7 METER SETTING EQUIPMENT

i Meter Pit and Cover:

1 Old Castle Meter Pit with Heavy Wall / Ford Monitor Cover with Locking Lid.

- ii Meter Setter for Pit:
  - 1 Ford 70 Series Coppersetter (VBHC72-24W-44-33-Q-NL)
- iii Outside Meter Setting:

1 Meter Yokes; Copper or Iron, riser type assembly with bronze inlet inverted key angle valve expansion type outlet connection and Ell fitting; flared copper tubing connections both ends.

2 Meter Yokes; Copper or Iron, inlet and outlet horizontal/vertical setting with matching couplings, fittings and stops.

- iv Inside Meter Setting:
  - 1 Meter Yokes; Copper or Iron, to suit installation conditions.

2 Inlet and Outlet Horizontal/Vertical setting with matching couplings, fittings and stops.

v Cast Iron Meter Boxes: Comprising a base, a vertically adjustable 2 piece body and a separate lid; domestic cast-iron, ASTM A48, Class 30 or better.

vi Covers, Lids and Frames: Domestic cast-iron, ASTM A48, Class 30 or better with contact surfaces machined and matched; lid shall be cast-iron, minimum 10" opening, words "water meter" cast into the lid; bronze worm lock with standard waterworks pentagon bolt head; lid to have a recess to engage a lug on the key permitting the key to become a handle for lifting the lid.

- vii Wrench and Lid Key:
  - 1 Cadmium plated cast steel.
  - 2 Supply key and wrench for each type meter box.

#### PART 3 EXECUTION

#### LX 3.1 PREPARATION

A. Establish location of curb stops for each service connection.

B. Excavate trench to the line and grade shown on the Contract Drawings and as specified; jack or bore service lines underneath paved highways where approved by the Engineer.

#### LXI 3.2 CONNECTIONS

A. General: Provide pipe joints and coupling materials suitable in size, design and material of pipe and service fittings with which it is used.

B. Screwed Joints: Use sharp cut threads of standard gauge and length; after threading, ream all pipe ends to the size of bore and clean out all chips; sufficient quantity of select pipe dope of graphite and oil shall be used for lubrication of assembly.

#### LXII 3.3 TAPPING WATER MAINS

A. Each connection for different kind of water mains shall be tapped using suitable materials, equipment and methods approved by the Engineer.

B. Provide service clamps for all mains other than those of cast or ductile iron.

C. Screw corporation stops directly into a tapped and threaded iron main at 10 and 2 o'clock positions on the main's circumference; locate corporation stops at least 12" apart longitudinally and staggered.

D. Use proper seals or other devices to ensure that no leaks are left in the water mains at the points of tapping; do not backfill and cover the service connection until approved by the Engineer.

#### LXIII 3.4 SERVICE LINE AND FITTINGS

A. Use bends to connect the service pipe or tubing to the tapping fitting or corporation stops to provide flexibility to counteract the effects of settlement or expansion/contraction in the line.

B. Lay each section of the service line in a manner to form a tight joint with the adjoining section; avoid offsets, kinks or awkward bends to ensure a smooth flow line.

C. Clean and inspect each pipe and part of the fitting before installing and assemble to provide a flexible joint; use joints or lubricants recommended by the manufacturers and as specified by the Engineer.

D. Install service fittings and appurtenances on suitable brick or concrete supports as shown on the Contract Drawings; do not use earth, rocks, wood or other organic materials as supports.

E. Prevent displacement of pipes and fittings at the time of placing concrete for thrust blocks or for any structures and until initial setting of concrete is assured.

F. Operate each corporation stop before and after installation.

G. When the work is not in progress and at the end of each work day, securely plug the ends of pipe and fittings to prevent any dirt or foreign substances from entering the lines.

H. Provide concrete thrust blocking or restrained joints at all bends, tees and changes in direction.

I. Provide all pipes passing through concrete or masonry construction with Wall Sleeves of the type and size indicated.

J. Test and disinfect mains and service lines as specified in Section 33 13 00.

## END OF SECTION

## SECTION 33 12 19

## VALVES AND FIRE HYDRANTS

#### PART 1 GENERAL

#### 1.1 DESCRIPTION

- A. The Work of this section includes, but is not limited to:
  - 1. Water Main and Service Valves
  - 2. Fire Hydrants
- B. Related Work specified elsewhere:
  - 1. Section 33 11 13 Water Mains
  - 2. Section 33 12 13 Water Service Connections

## 1.2 QUALITY ASSURANCE

- A. Reference Standards:
  - American National Standards Institute (ANSI); American Water Works Association (AWWA):
    a. ANSI/AWWA C502 Dry-Barrel Fire Hydrants
    - b. ANSI/AWWA C515 Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
  - NSF International:
    a. NSF 61 Drinking Water System Components
    b. NSF 372 Lead Content Certification

#### 1.3 <u>SUBMITTALS</u>

A. General: Submit in accordance with Section 01 30 00.

B. Certificates: Submit a Statement of Compliance, together with supporting data, from the materials suppliers attesting that valves, hydrants, and accessories provided meet or exceed ANSI/AWWA Standards and specification requirements.

C. Product Data: Submit manufacturer's latest published literature including illustrations, installation instructions, maintenance instructions and parts lists.

#### 1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Prepare valves, hydrants, and accessories for shipment according to AWWA Standards and seal valve and hydrant ends to prevent entry of foreign matter into product body.

B. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.

## PART 2 - PRODUCTS

## 2.1 GATE VALVES

A. Iron body, bronze trim conforming to ANSI/AWWA C515

- 1. Resilient wedge gate, ductile iron body.
- 2. Non-rising stem; O-ring stem seals.
- 3. Two inch square operating nut; open counterclockwise unless otherwise indicated.
- 4. Flanged, mechanical joint or bell end connections.
- 5. Provide valves 16 inches and larger with bypass valves and gear operators.
- 6. Gate Valves to be American Flow Control 2500 Series or Kennedy Valve 7571.

## 2.2 VALVE BOXES

- A. 12" Valves and Smaller: Domestic cast iron, two-piece, screw type.
- B. Valves Larger than 12": Domestic cast iron, three-piece, screw type; round base.
- C. Cast iron lid.
- D. Valve Box to be Tyler Union 32 U Heavy Dut Valve Box and Components (6850 Screw Type)

## 2.3 FIRE HYDRANTS

- A. Dry-barrel break-away type conforming to AWWA C502.
  - 1. Bury Depth: 4'-6", or as indicated on the Contract Drawings.
  - 2. Inlet Connection: 6".
  - 3. Valve Opening: 5-1/4".
  - 4. Mechanical Joint or Bell End.
  - 5. Corrosion resistant bolts and nuts.
- B. One pumper, two hose nozzles.
  - 1. Obtain thread type and size from local fire department.
  - 2. Attach nozzle caps by separate chains.
- C. American Darling 5-1/4" B62B Hydrant OL (2NS-HN 5 IN) (2) 2-1/2" and (1) 4-1/2" Nozzle w/storz lock fitting.
  - D. Hydrant tees to be Tyler Union Class 153 Ductile or Tyler Union Class 110 Ductile Iron.

## 2.4 AIR RELEASE VALVES

- A. Air Release valves to be manufactured by Crispin.
- B. Cast iron body and cover, stainless steel float, orifice seat, linkage mechanism, mountings and trim. Buna-N orifice valve designed for maximum venting capacity under normal main pressure.
- C. 150 psi minimum rated working pressure; hydrostatically tested to 2 times rated working pressure.

#### 2.5 Blowoff Valve

A. Blowoff Valves to be Kupferle Truflo TF-500.

- 1. NSF/ANSI 372 Certified.
- 2. 2" FIP Horizontal Inlet
- 3. 2" MJ Inlet Iron Adapter
- 4. 2" MIP Outlet
- 5. 5-1/4" Valve Box
- 6. Set in 4 cu ft of crushed stone for proper drainage.

#### PART 3 EXECUTION

#### 3.1 GENERAL

A. Determine the exact location and size of valves from the Contract Drawings; the Standard Details represent typical details only; obtain all necessary clarification and directions from Authority staff or Engineer prior to the execution of work.

- B. Perform trench excavation, backfilling and compaction in accordance with Section 31 23 17.
- C. Install pipe and tubing in accordance with Sections 33 11 13 and 33 12 13.

#### 3.2 GATE VALVES

- A. Install valves in conjunction with pipe laying; set valves plumb.
- B. Provide buried valves with valve boxes installed flush with finished grade.
- C. Furnish one tee wrench to the Authority.

#### 3.3 FIRE HYDRANTS

A. Install fire hydrants as shown on the Contract Drawings; provide support blocking and drainage gravel as shown; do not block drain hole.

B. Set hydrants plumb with pumper nozzle facing the roadway; set hydrants with centerline of pumper nozzle at least 18 inches above finished grade and the safety flange not more than 6 inches nor less than 2 inches above grade.

- C. Paint hydrants in accordance with local color scheme.
- D. After hydrostatic testing, flush hydrants and check for proper drainage.

## END OF SECTION

## **SECTION 33 13 00**

## TESTING AND DISINFECTING WATER MAINS

## PART 4 - GENERAL

- 4.1 DESCRIPTION
  - A. The Work Of This Section Includes, but is not limited to:
    - Testing water pipeline: 1.
      - a. Hydrostatic pressure testing
      - b. Leakage testing
    - 2. Disinfecting:
      - a. Preliminary flushing
      - b. Chlorine application methods
      - c. Final flushing
      - d. Bacteriological testing
  - Β. **Related Work Specified Elsewhere:** 
    - 1. Section 33 11 13 - Water Mains
    - 2. Section 33 12 19 - Valves

#### 4.2 QUALITY ASSURANCE

- Α. Testing Agency: Bacteriological testing shall be performed by a testing laboratory approved by the State Health Department, engaged and paid for by the Contractor and approved by the Engineer.
- Β. **Referenced Standards:**

American National Standards Institute (ANSI); American Water Works Association 1. (AWWA): Standard for HypoChlorites ANSI/AWWA B300 ndard for li uid Chl ANSI/AWWA B301

ANSI/AWWA B301	Standard for Liquid Chlorine
ANSI/AWWA C600	Standard for Installation of Gray and Ductile Cast-Iron
	Water Mains and Appurtenances, Section 4, Hydrostatic
	Testing
AWWA C651	Standard for Disinfecting Water Mains

- C. Test Acceptance:
  - 1. No test will be accepted until the results are below the specified maximum limits.
  - 2. The Contractor shall, at his own expense, determine and correct the sources of leakage and retest until successful test results are achieved.

#### 4.3 SUBMITTALS

- Α. Test Procedures: Submit a testing sequence schedule including a list of testing equipment to be used.
- Certificates: Β.
  - Submit a Statement of Compliance, together with supporting data, from the materials 1. suppliers attesting that the chlorine form composition provided meets specification requirements and is NSF 61 certified.
  - 2. Submit, prior to starting testing, certification attesting that the pressure gauges to be used have been calibrated and are accurate to the degree specified in Part 2, Products.
- C. Test Reports: Submit two copies of the testing laboratory certified test reports of each bacteriological test.

## PART 5 - PRODUCTS

#### HYDROSTATIC TEST EQUIPMENT 5.1

- Hydro pump A.
- Pressure hose Β.
- C. Test connections
- Water meter D.
- E. Pressure gauge, calibrated to 0.1 lbs./sq.in.
- Pressure relief valve F.

#### 5.2 DISINFECTING CHEMICALS

- Liquid chlorine, calcium hypochlorite, or sodium hypochlorite conforming to ANSI/AWWA Α. Standards B300 and B301.
- Certified by NSF 61. Β.

## PART 6 - EXECUTION

## 6.1 PREPARATION

- A. Backfill trenches in accordance with Section 31 23 17.
- B. Provide the water line under test with reaction thrust blocking; hydrostatic testing shall not begin until the concrete thrust blocking has set; allow 2000 psi 28-day strength concrete to set (cure) for a minimum of 7 days prior to testing; if High Early Strength 3,000 psi 3-day strength concrete is used, hydrostatic testing may not begin until the concrete has set a minimum of 2 days.
- C. Provide pumps, piping, tanks, connections, polyurethane pigs, and appurtenances as necessary to complete the work. Authority will provide the necessary water for testing. Water for retests that result from failure of the initial test will be at the expense of the Contractor.

## 6.2 TESTING WATER LINES

- A. Hydrostatic Testing: Test each newly installed section of water line by hydrostatic test procedure in accordance with the recommended practice established by AWWA, Standard C600, Section 5, hydrostatic testing, as modified herein below.
  - 1. Pressure Test:
    - a. Conduct pressure tests for a period of not less than 2 hours at 150 psig or at a pressure of not less than 1.25 times the working pressure based upon the elevation of the lowest point in line under test corrected to the elevation of the test gauge, but shall not exceed 150 psi.
- B. Observe joints, fittings and valves under test; remove and renew cracked pipe, joints, fittings, and valves showing visible leakage; retest.
  - 1. Leakage Testing:
    - a. Conduct the leakage test concurrently with the pressure test for the 2-hour period at the specified test pressure.
    - b. Water pipe installation is deemed to have failed the leakage test if the leakage obtained is greater than that determined by the formula or the leakage exceeds 10 gal per inch pipe diameter in 24-hours.

Where:

L is allowable leakage in gallons/hour

- N is number of joints in the section tested
- D is nominal diameter of pipe in inches

P is average test pressure in pounds per square inch gauge

- c. If the line under test contains sections of various diameters, the allowable leakage shall be the sum of the computed leakage for each size.
- d. If test results indicate that the pipe has leakage greater than specified, locate and repair the defective joints, fittings, pipe or valves and retest until leakage is within allowable limits; repair visible leaks regardless of the amount of leakage.

## 6.3 DISINFECTION

- A. General:
  - After completion of satisfactory pressure and leakage testing, disinfect the water lines in accordance with the recommended practice established in AWWA Standard C651; conduct water line disinfection in the following steps: Preliminary flushing Chlorine application Final flushing Bacteriological tests
- B. During construction, place calcium hypochlorite granules at the upstream end of the first section of pipe, at the upstream end of each branch main and at 500-ft. intervals. (Refer to Table 1 at the end of this section for quantity of granules to be used.)
  - 1. CAUTION: This procedure must not be used on solvent welded plastic or on screwed joint steel pipe because of the danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite.
- C. Preliminary Flushing Use one of the following two methods:
  - 1. Prior to disinfection, except when the tablet method is used, flush the line with pipe cleaning plugs or "pigs"; these "pigs" shall be polyurethane blown elastomer foam bullets hydraulically propelled; the "pigs" shall have the ability to negotiate fabricated mitered bends and short radius elbows and pass through tees, crosses, and multi-dimensional sizes of pipe and valves; the "pigs" shall be approved for use in potable water systems by governing regulatory agency; dispose of flushing water used with "pigs".
  - 2. Prior to disinfection, except when the tablet method is used, the main shall be filled to eliminate air pockets and shall be flushed to remove particulates; the flushing velocity in the main shall be not less than 2.5 fps unless the Engineer determines that conditions do not permit the required flow to be discharged to waste; (Refer to Table 3 at the end of this section for the rates of flow to produce a velocity of 2.5 fps in pipes of various sizes.) Flushing water shall be safely disposed of in a manner acceptable to the governing regulatory agency.
- D. Chlorine Form: The chlorine form to be applied to the system shall be either liquid chlorine, calcium hypochlorite or sodium hypochlorite; the Engineer's written approval of the chlorine form to be used is required.

- E. Chlorine Application:
  - 1. Tablet Method:
    - a. <u>CAUTION</u>: The tablet method cannot be used unless the main is kept clean and dry during construction because the preliminary flushing step must be eliminated; do not use the tablet method in mains having diameters over 24 in.
    - b. During construction, place 5g calcium hypochlorite tablets in each section of pipe and place one such tablet in each hydrant, hydrant branch and other appurtenances to achieve the required dose of 25 mg/l available chlorine; (Refer to Table 2 at the end of this section for the proper number of 5g calcium hypochlorite tablets needed.) attach all the tablets inside and at the top of the main with an adhesive; there shall be no adhesive on the tablet except on the broad side attached to the surface of the pipe; attach the tablets before the pipe section is placed in the trench and mark their position on the section so it can be readily determined that the pipe is installed with the tablets at the top.
    - C. When pipeline installation is completed, fill the main with water at a rate such that water within the main will flow at a velocity not greater than 1 fps; retain the water in the pipe for 24 hours; if the water temperature is less than 41degrees F, retain the water in the pipe for at least 48 hours; position valves so that the strong chlorine solution in the main being treated will not flow into water mains in active service.
  - 2. Continuous Feed Method:
    - a. The continuous feed method consists of placing calcium hypochlorite granules in the main during construction (at the option of the Engineer), completely filling the main to remove all air pockets, flushing the completed main to remove particulates and filling the main with potable water chlorinated so that after a 24-hour holding period in the main there will be a free chlorine residual of not less than 10 mg/l.
    - b. At a point not more than 10 feet downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water entering the new main will not have less than 25 mg/l free chlorine; assure this concentration is provided by measuring chlorine concentration; Engineer shall approve of the method before proceeding with disinfection.
    - c. During the application of chlorine, position valves so that the strong chlorine solution in the main being treated will not flow into water mains in active service.
    - d. Retain the chlorinated water in the main for a 24-hour period. During the 24-hour treatment, operate valves, curb stops and hydrants in order to disinfect appurtenances and pipe branches; at the end of this 24-hour period, the treated water in all portions of the main shall have a residual of not less than 10 mg/l of free chlorine.
  - 3. Slug Method:

- a. The slug method consists of placing calcium hypochlorite granules in the main during construction, completely filling the main to eliminate all air pockets, flushing the main to remove particulates, and slowly flowing through the main a slug of water dosed with chlorine to a concentration of 100 mg/l in order that all parts of the main and its appurtenances will be exposed to the highly chlorinated water for a period of not less than 3 hours.
- b. Chlorinate the main as specified in AWWA C651, Section 5.3.
- c. During the 3-hour treatment, operate all valves, curb stops and hydrants in order to disinfect appurtenances and pipe branches.
- F. Final Flushing:
  - 1. Flush the heavily chlorinated water from the system under treatment until the chlorine concentration in the water leaving the system is no higher than that generally prevailing in the system or is acceptable for domestic use.
  - 2. Comply with Federal, State and local laws when discharging the flushed chlorine solution.
- G. Bacteriological Testing:
  - 1. After final flushing is completed and before the water main is placed in service, test the line for bacteriological quality.
  - 2. Collect a minimum of one sample at the end of each new main for each test, and one sample of the incoming water from the existing water system for comparison.
  - 3. Collect samples in sterile bottles treated with sodium thiosulphate.
  - 4. Sampling tap shall consist of corporation stop installed in the main with copper tube gooseneck assembly through which a portion of the chlorinated water has been allowed to flow; sterilize the tap, valves and pipe in a manner similar to the sterilization of the main; do not use hose or fire hydrant to collect samples.
  - 5. Provide bacteriological test reports to the Authority and the Engineer; failure to meet State health standard requirements will be cause for the Contractor to rechlorinate and retest the system until acceptable results are attained.
  - 6. If trench water has entered the main, or if in the opinion of the Engineer, excessive quantities of dirt or debris have entered the main, take bacteriological samples at intervals of approximately 200 ft. from the water that has stood in the main for at least 16 hours after final flushing has been completed.

## SEE ATTACHED TABLES

END OF SECTION 33 13 00

TABLE 1
Ounces of Calcium Hypochlorite Granules to be Placed at
Beginning of Main and at each 500-ft Interval

Cal	Calcium Hypochlorite		
Pipe Diameter (in.)	Granules (Oz)		
4	1.7		
6	3.8		
8	6.7		
10	10.5		
12	15.1		
14 and larger	D <sup>2</sup> x15.1*		
	<u>d</u>		
*D is the inside pipe diame	eter in feet D = 12		

TABLE 2	
Number of 5g Hypochlorite Tablets Required for Dose of 25mg/l a	

	Length of Pipe Section (feet)				
Pipe Diameter	13	18	20	30	40
(inches)	or less				
4	1	1	1	1	1
6	1	1	1	2	2
8	1	2	2	3	4
10	2	3	3	4	5
12	3	4	4	6	7
16	4	6	7	10	13

<sup>a</sup> Based on 3.25g available chlorine per tablet, any portion of tablet rounded to next higher number.

BH			

(40 psi Residual Pressure in Water Main)			
Pipe	Flow Required to		
Diameter	Produce 2.5 fps	Hydrant	Outlets
(inches)	Velocity in Main	Number	Size
	(gpm)	(inches	)
4	100	1	2-1/2
6	220	1	2-1/2
8	400	1	2-1/2
10	600	1	2-1/2
12	900	2	2-1/2
16	1600	2	2-1/2

TABLE 3 Required Flow and Openings to Flush Pipelines <sup>a</sup>

<sup>a</sup> With a 40 psi pressure in the main with the hydrant flowing to atmosphere, a 2-1/2" hydrant outlet will discharge approximately 1000 gpm; a 4-1/2" hydrant nozzle will discharge approximately 2500 gpm.

Pipe	100%	1% Chlorine
Diameter	Chlorine	Solution
(inches)	lbs.	Gal.
4	.013	.16
6	.030	.36
8	.054	.65
10	.085	1.02
12	.120	1.44
16	.217	2.60

# TABLE 4 Chlorine Required to Produce 25 mg/l Concentration in 100 Ft. of Pipe

33 13 00
# SECTION 33 31 13

### SANITARY SEWER PIPE

### PART 1 - GENERAL

### 1.1 **DESCRIPTION**

- A. The Work of this section includes, but is not limited to:
  - 1. Sanitary sewer gravity pipelines
  - 2. Laterals/service connections
- B. Related Work specified elsewhere:
  - 1. Section 31 23 17 Trenching, Backfilling, and Compacting
  - 2. Section 33 01 30 Sewer and Manhole Testing
  - 3. Section 33 39 13 Manholes

# 1.2 **QUALITY ASSURANCE**

- A. Reference Standards:
  - 1. American National Standards Institute (ANSI):
    - a. ANSI/AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings, 3" through 48", for Water and Other Liquids
    - b. ANSI/AWWA C111/A21.11 Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
    - c. ANSI/AWWA C153/A21.53 Ductile-Iron Compact Fittings For Water Service
    - d. ANSI/AWWA C151/A21.51 Ductile-Iron Pipe Centrifugally Cast
  - 2. American Society for Testing and Materials (ASTM):
    - a. ASTM D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
    - b. ASTM D3262 Standard Specifications for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
    - c. ASTM D4161 Standard Specifications for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
    - d. ASTM F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
    - e. ASTM F2764 Standard Specification for 30 to 60 in. Polypropylene Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications
- B. Materials contaminated with gasoline, lubricating oil, liquid or gaseous fuel, aromatic compounds, paint solvent, paint thinner, or acid solder will be rejected.

# 1.3 SUBMITTALS

- A. General: Submit in accordance with Section 01 30 00.
- B. Submit each manufacturer's certification attesting that the pipe, pipe fittings, joints, joint gaskets and lubricants meet or exceed specification requirements.

### 1.4 **PRODUCT DELIVERY, STORAGE AND HANDLING**

- A. Do not place materials on private property without written permission of the property owner.
- B. During loading, transporting and unloading, exercise care to prevent damage to materials.
- C. Do not drop pipe or fittings.
- D. Avoid shock or damage at all times.
- E. Take measures to prevent damage to the exterior surface or internal lining of the pipe.
- F. Do not stack pipe higher than recommended by the pipe manufacturer.
- G. Store gaskets for mechanical and push-on joints in a cool, dry location out of direct sunlight and not in contact with petroleum products.

### PART 2 - PRODUCTS

#### 2.1 **DUCTILE-IRON PIPE**

- A. Pipe, ANSI/AWWA C151/A21.51, outside coated.
  - 1. Force Mains: Pressure Class 150 psi
  - 2. Class 52 Ductile Iron Pipe for pressure mains, SDR 21 for pressure laterals
- B. Pipe lining:
  - 1. High build epoxy, Cor-Cote SC, Sewer-Cote as manufactured by Sherwin Williams, or equal.
- C. Ductile Iron Fittings:
  - 1. ANSI/AWWA C110/A21.10 or C153/A21.53; fittings psi pressure rating to match required pipe rating above.
  - 2. Fittings to be lined and outside coated as specified for ductile iron pipe.
  - 3. SDR 21 Gasketed Compression Fitting (200psi) for laterals
- D. Joints (ANSI/AWWA C111/A21.11): Where not specifically indicated on the Contract Drawings, joints may be either mechanical joint or push-on joint.
- E. Rubber Gaskets, Lubricants, Glands, Bolts and Nuts: ANSI/AWWA C111/A21.11.

#### 2.2 **POLYVINYL CHLORIDE (PVC) SEWER PIPE**

- A. Gravity Sewer Pipe and Fittings:
  - 1. 4" to 15" Nominal Pipe Size: ASTM D3034, SDR-35; Material ASTM D1784, 12454-B
  - 2. Flexible Elastomeric Seals: ASTM D3212
  - 3. Seal Material: ASTM F477
- B. Gravity Sewer laterals to be SDR 35 or 40 PVC.

# 2.3 DETECTABLE UNDERGROUND UTILITY MARKING TAPE

A. Tape shall be 2" and consist of a minimum 5-mil overall thickness, with no less than a 35 gauge solid aluminum foil core. The foil must be visible from BOTH sides. The layers shall be laminated together with the extrusion lamination process, not adhesives. Further, there shall be NO inks or printing extending to the edges of the tape. The adhesive will NOT contain any dilutants, pigments or contaminants and is specially formulated to resist degradation by elements normally encountered in the soil. All printing shall be encased to avoid ink rub-off.

### B. Test Data:

Property	Method	Value	
Thickness	ASTM D2103	5.0 mils	
Tensile Strength	ASTM D882	25 lbs/inch (5,500 psi)	
Elongation	ASTM D882-88	< 50% at break	
Printability	ASTM D2578	> 50 dynes/cm2	
Flexibility	ASTM D671-81	Pliable hand	
Inks	Mfg. Specs.	Heat Set Myflex	
Message Repeat	Mfg. Specs.	Every 20 inches	
Foil	Mfg. Specs.	Dead soft/annealed	
Top Layer	Mfg. Specs.	Virgin PET	
Bottom Layer	Mfg. Specs.	Virgin LDPE	
Adhesives	Mfg. Specs.	> 30%, solid 1.5#/R	
Bond Strength	Boiling Water @ 100 degrees C	5 hours without peel	
Colors	APWA Code	See below	

- C. Color Code shall be as follows:
  - 1. Safety Red: Electric power, distribution and transmission and municipal electric systems.
  - 2. High Visibility Safety Yellow: Gas and oil distribution and transmission, dangerous materials, product and steam.
  - 3. Safety Alert Orange: Telephone and telegraph systems, police and fire communications, and cable television.
  - 4. Safety Precaution Blue: Water systems and slurry pipelines.
  - 5. Safety Green: Sanitary and storm sewer systems.
  - 6. Safety Brown: Force mains, reclaimed water lines and effluent reuse lines.
  - 7. Alert Purple: Reclaimed non-potable water lines.

# 2.4 FLEXIBLE COUPLINGS

- A. Elastomeric plastic sleeve resistant to chemicals and normal sewer gases leakproof and rootproof; positive seal against infiltration and exfiltration; stainless steel clamp bands.
- B. Manufacturer: Fernco, Davison Michigan, or equal.

C. PCX 02 Series, 5002-RC Series, Max Adapter

#### 2.5 SEWER SERVICE SADDLES

A. Romac Industries Style CB sewer saddle

#### PART 3 - EXECUTION

#### 3.1 **PREPARATION**

- A. Perform trench excavation to the line and grade indicated on the Contract Drawings and as specified in Section 31 23 17 Trenching, Backfilling and Compacting.
- B. Unless otherwise indicated on the Contract Drawings, provide for a minimum cover of 4 feet above the top of piping laid in trenches.
- C. Provide pipe bedding as specified in Section 31 23 17 Trenching, Backfilling and Compacting for each type of pipe used.
- D. Provide Type IV pipe bedding for all pipe.
- E. Place aggregate in a manner to avoid segregation, and compact to the maximum practical density so that the pipe can be laid to the required tolerances.

#### 3.2 LAYING PIPE IN TRENCHES

- A. Give ample notice to the Engineer in advance of pipe laying operations.
- B. Use laser alignment instruments.
- C. Lower pipe into trench using handling equipment designed for the purpose to assure safety of personnel and to avoid damage to pipe. Do not drop pipe.
- D. Lay pipe proceeding upgrade with the bell or groove pointing upstream.
- E. Lay pipe to a true uniform line with the barrel of the pipe resting solidly in pipe bedding material throughout its length.
- F. Excavate recesses in pipe bedding material to accommodate joints, fittings and appurtenances.
- G. Do not subject pipe to a blow or shock to achieve solid bearing or grade.
- H. Lay each section of pipe in such a manner as to form a close concentric joint with the adjoining section and to avoid offsets in the flow line.
- I. Clean and inspect each section of pipe before joining.
- J. Assemble to provide tight, flexible joints that permit movement caused by expansion, contraction, and ground movement.

- K. Use lubricant recommended by the pipe or fitting manufacturer for making joints.
- L. If unusual joining resistance is encountered or if the pipe cannot be fully inserted into the bell, disassemble joint, inspect for damage, reclean joint components, and reassemble joint. M. Assemble joints in accordance with recommendations of the manufacturer.
- N. Push-on Joints:
  - 1. Clean the inside of the bell and the outside of the spigot.
  - 2. Insert rubber gasket into the bell recess.
  - 3. Apply a thin film of gasket lubricant to either the inside of the gasket or the spigot end of the pipe, or both.
  - 4. Insert the spigot end of the pipe into the socket using care to keep the joint from contacting the ground.
  - 5. Complete the joint by forcing the plain end to the bottom of the socket.
  - 6. Mark pipe that is not furnished with a depth mark before assembly to assure that the spigot is fully inserted.
- O. Mechanical Joints:
  - 1. Wash the socket and plain end.
  - 2. Apply a thin film of soapy water.
  - 3. Slip the gland and gasket over the plain end of the pipe.
  - 4. Apply soapy water to gasket.
  - 5. Insert the plain end of the pipe into the socket and seat the gasket evenly in the socket.
  - 6. Slide the gland into position, insert bolts, and finger-tighten nuts.
  - 7. Bring bolts to uniform tightness; tighten bolts 180 degrees apart alternately. P. Disassemble and

remake improperly assembled joints using a new gasket.

- Q. Grade Check:
  - 1. Check each pipe installed as to line and grade in place.
  - 2. Correct deviation from grade immediately.
  - 3. A deviation from the designed grade as shown on the Contract Drawings, or deflection of pipe joints, will be cause for rejection.
- R. Place sufficient backfill on each section of pipe, as it is laid, to hold firmly in place.
- S. Clean interior of the pipe as work progresses; where cleaning after laying is difficult because of small pipe size, use a suitable swab or drag in the pipe and pull forward past each joint immediately after the jointing has been completed.
- T. Keep trenches and excavations free of water during construction.
- U. When the work is not in progress, and at the end of each workday, securely plug open ends of pipe and fittings to prevent trench water, earth, or other substances from entering the pipes or fittings.

#### 3.3 WYE BRANCHES AND TEES

- A. Install wye branches or pipe tees at locations indicated on the Contract Drawings concurrently with pipe laying operations.
- B. Use standard fittings of the same material and joint type as the pipeline into which they are installed.

### 3.4 LATERALS

- A. Construct laterals from the wye branch to a terminal point at the right-of-way or property line or as designated on the Contract Drawings.
- B. Where the depth of the main pipeline warrants, construct riser type laterals from the wye branch in accordance with the Contract Drawings.
- C. The determination as to the type of riser, slope, and depth of lateral pipe at the termination point will be made by the Engineer in the field.
- D. Install an approved watertight plug, braced to withstand pipeline test pressure thrust, at the termination of the lateral.
- E. Install a temporary marker stake extending from the end of the lateral to 1 foot above finished grade.

#### 3.5 CAST-IN-PLACE CONCRETE CONSTRUCTION

A. Conform to the applicable requirements of Section 03 30 53 - Concrete for Utility Construction.

#### 3.6 CRADLES AND ENCASEMENT

A. Provide concrete cradles and encasement for pipeline where indicated on the Contract Drawings, or as directed by the Engineer.

#### 3.7 STREAM CROSSINGS

- A. Construct sanitary sewer pipeline stream crossings in accordance with the Contract Drawings.
- B. Provide concrete encased mechanical joint ductile-iron pipe backfilled with minimum 3 inch size stone to the level of the stream bed, between the limits of the stream crossing.
- C. Do not backfill until concrete has achieved its initial set and concrete work is examined by the Engineer.

#### 3.9 BACKFILLING TRENCHES

- A. Backfill pipeline trenches only after examination of the pipe laying by the Engineer.
- B. Backfill trenches as specified in Section 31 23 17 Trenching, Backfilling and Compacting.

#### END OF SECTION 33 31 13

### SECTION 33 32 17

### SEWAGE GRINDER PUMPS

#### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. The work of this section includes, but is not limited to, sewage grinder pumping stations with sump, grinder pumps, piping, controls, and all appurtenances for a complete installation.
- B. Sewage grinder pumps for service to individual homes pumping to a gravity system. More complex low pressure system shall be designed to meet the specific needs of the project. Design of the system and all components shall be subject to the review and approval of the Authority. The use of a grinder pump must be approved by the Authority and shall be installed and maintained at the Property Owner's expense.

### 1.2 QUALITY ASSURANCE

- A. Design Criteria:
  - 1. Provide a complete unit with all necessary appurtenances, UL and NSF listed, free of noise, odor, and electrical, fire and health hazards.
  - 2. Number of Pumps: One (1) unless otherwise directed by the Authority
  - 3. The pumps shall be designed for each site specific condition under which they will be used. The pump(s) must also be capable of operating under all conceivable conditions without overloading the motor(s).
- B. Grinder pump system shall be manufactured by Barnes. Exact model and size will be determined based on site specific conditions.
- C. The manufacturer shall provide a warranty of thirty-six (36) months for the pump and twenty-four (24) months for other parts after date of installation. Defective equipment shall be repaired or replaced and shipped back to customer at no charge.

# PART 2 - PRODUCTS

# 2.1 GENERAL DESCRIPTION:

A. A complete installation shall be provided consisting of a fiberglass reinforced polyester basin with watertight cover, submersible sewage grinder pumps, mercury switch level controls, discharge piping, check valves with hydraulically sealed coupling, gate valve, pump slide rail supports, pump lifting chain, pump control panel, alarms and other necessary appurtenances.

#### 2.2 <u>SEWAGE GRINDER PUMPS</u>

A. The pump shall be a custom designed, integral, vertical rotor, motor driven, solids handling pump of the recessed vortex type with a mechanical seal. Pump shall be capable of handling sewage liquid, solids, stringy materials and slurry with no possibility of clogging.

- B. The volute, seal plates and motor housing shall be constructed of high quality ASTM A-48 class 30 cast iron. The pump shall be painted with air dry enamel of 2 mil minimum thickness. All exposed hardware shall be 300 series stainless steel. Discharge connection shall be minimum 1.25 inch NPT.
- C. The pump impeller shall be of the recessed, vortex design. Pumps with standard centrifugal semiopen impeller designs shall not be acceptable. The impeller shall be dynamically balanced and made of cast iron.
- D. The pump shall be a three bearing design consisting of an upper ball bearing, an intermediate ball bearing restrained for the purpose of carrying the thrust loads, and an oil lubricated lower bronze sleeve bearing to carry radial loads and prevent shaft deflection imposed by the pump impeller and grinder operation. The oil lubricated sleeve bearing shall be located between two mechanical seals. Lip type seals are not acceptable. Designs reducing the number of bearings or substituting sleeve bearings for ball bearings will not be considered equal.
- E. Stainless steel shaft and hardware.

# 2.3 SEWAGE GRINDER

- A. Sewage grinder assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed so as to minimize clogging and jamming under all normal operating conditions including starting. Sufficient vortex action shall be created to scour the tank free of deposits or sludge banks which would impair the operation of the pump..
- B. Grinder shall include a hardened stainless steel radial cutter located immediately below pump impeller. Grinder unit shall be capable of cutting solid material found in normal domestic sewage, including reasonable amounts of foreign objects, such as paper, wood, plastic, glass, rubber, sanitary napkins, disposable diapers, cleaning wipes and panty hose into a fine slurry that will pass freely through the pump, service line and force main.
- C. Stationary shredding ring located below grinder shall be made of hardened stainless steel with a staggered tooth pattern and shall be reversible.

#### 2.4 ELECTRIC MOTOR

- A. Motor shall be a sealed submersible; minimum 2 HP; maximum 3450 RPM, 240 Volt 60 Hertz, 1 Phase. Non-overloading throughout entire range of pump curve.
- B. Motor shall have capacitor start with integral overload protection. Sensors to reset automatically when safe temperature is attained.
- C. Motor shall be oil filled squirrel cage induction type with Class B installation and low starting current.
- D. Motor housing shall be cast iron and shaft shall be stainless steel.
- E. Provide moisture sensors in pump seal chamber.
- F. The pumps shall be equipped with type SOW power cable connected to the motor via quick disconnect pin terminals. A Buna-N o-ring shall provide isolation sealing between terminal block

and the motor housing. The plug assembly shall be guaranteed by the manufacturer to meet UL approval for submersion.

# 2.5 MECHANICAL SEAL

- A. The pump shall utilize a tandem mechanical shaft seal arrangement and shall operate in an oil atmosphere. Each seal shall be double floating, self-aligning rotary shaft seals to prevent leakage between the motor and pump.
- B. The seal shall have a stationary ceramic seat and carbon rotating surface with faces precision lapped and held in position by a stainless steel spring.

### 2.6 <u>TANK</u>

- A. The manufacturer shall furnish a complete Pump Station(s). The pump station shall consist of a basin package, high level alarm, pump and all necessary power and control systems to make the grinder unit fully functional.
- B. The Basin Package shall include the following: fiberglass basin with anti-flotation collar, isolation valve, mechanical floats, basin cover, check valve, lifting rope, field locatable conduit fitting, and bug free station vent. All equipment in the wet well shall be capable of constant submerge in sewage to a minimum depth of 30 feet without electrical power being energized.
- C. The High Level Alarm Panel shall include a water-tight panel with a top mounted Alarm light, a test/silence switch, a power on light and an 85db (A) alarm horn with a mechanical float. The liquid level alarm system is designed specifically for lift pump chambers and sump pump basins. The float switch is lowered into the tank and secured at the desired alarm level. When the liquid rises (high level alarm) or lowers (low level alarm), the float tips and activates the horn and light on the alarm panel.
- D. The tank shall be factory tested for leak tightness.
- E. Fiberglass cover shall be grass green color. Steel cover shall be black in color. Aluminum cover shall be natural silver color.
- G. The cover shall interlock with basin and have a load rating of 150 lbs per square foot.
- H. The basin shall be furnished with one flexible inlet flange (shipped loose to facilitate field location) to accept a 4.50" OD DWV pipe. Inlet location can vary to accommodate ease of installation.
- I. Basin capacities and dimensions shall be as determined for the specific installation. The basin FRP wall laminate thickness shall vary with the wetwell depth to provide the aggregate strength to meet the tensile and flexural physical property requirements. The basin FRP wall and floor must be designed to withstand wall collapse, buckling and upload based on a hydrostatic pressure exerted by saturated soil exerted at maximum burial depth. The basin laminate must be constructed to withstand or exceed 150% of the assumed loading on any depth.
- J. The finished FRP laminate will have a Barcol hardness of at least 90% of the resin manufactures specified hardness for the fully cured resin. The Barcol Hardness shall be the same for both interior and exterior surfaces. Manufacture must submit documentation including calculation and production certification that basin (s) on the project are in compliance with the above requirements.

- K. All piping inside the basin silhouette shall be at a level in the station that is lower than the frost depth or depth of bury specified for the low pressure sewer piping, whichever is lowest.
- L. The accessway design and construction shall enable field adjustment of the station height in increments of 4" or less without the use of any adhesives or sealants requiring cure time before installation can be completed.
- M. The station shall have all necessary penetrations molded in and factory sealed. To ensure a leak free installation no field penetrations will be acceptable.
- N. The accessway shall include a single NEMA 6P Electrical Quick Disconnect (EQD) for all power and control functions, factory installed with accessway penetrations warranted by the manufacturer to be watertight.
  - 1. The EQD will be supplied with 32 feet of useable Electrical Supply Cable (ESC) outside the station, to connect to the alarm panel.
  - 2. The ESC shall be installed in the basin by the manufacturer.
  - 3. The EQD shall require no tools for connecting, seal against water before the electrical connection is made, and include radial seals to assure a watertight seal regardless of tightening torque.
  - 4. The EQD shall be so designed to be conducive to field wiring as required.

### 2.7 DISCHARGE PIPING AND VALVES

- A. All discharge piping shall be constructed of Schedule 80 PVC and terminate outside the stations with a bulkhead female NPT fitting. The manufacturer shall guarantee all bulkhead penetrations watertight.
- B. The pump discharge shall be equipped with a factory installed, manual true union ball valve. Valve shall be constructed of 304 stainless steel, with a minimum rated pressure of 150 PSI. All valves shall be operable from ground level. Shut off valve must be replaceable without excavating basin exterior. Shut off valves shall be equal to the size of the station discharge.
- C. The pump discharge shall be equipped with a factory installed, gravity operated, flapper-type integral check valve built into the stainless steel discharge piping. The check valve will provide a full-ported passageway when open, and shall introduce a friction loss of less than 6 inches of water at maximum rated flow. Moving parts shall be made of a 300 Series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low back-pressure. The valve body shall be an injection molded part made of an engineered thermoplastic resin. The valve shall be rated for continuous operating pressure of 235 psi.
- D. The pump discharge shall be equipped with a factory-installed, gravity-operated, flapper-type integral anti-siphon valve built into the stainless steel discharge piping. Moving parts will be made of 300 Series stainless steel and fabric-reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly, providing a maximum degree of freedom to ensure proper operation even at a very low pressure. The valve body shall be injection-molded from an engineered thermoplastic resin. The anti-siphon port diameter shall be no less than 60% of the inside diameter of the pump discharge piping.

# 2.8 CONTROLS

- A. Level detection for controlling pump and alarm operation shall be accomplished by use of a detection mechanism specifically designed for use in a sewage using an all stainless steel band clamp. Switches utilized in the system shall be hermetically sealed in a submersible, watertight protective casing. Level detection mechanism shall be a wide angle, pipe mounted, piggy back mechanical floats.
- B. Level detection mechanism shall not require any regular, preventive maintenance. The level detection mechanism shall consist of one piggyback on/off pump control float and one high level mechanical float. The level controls shall be serviceable without the need for a confined space entry as defined by OSHA. Use of mercury floats will not be acceptable.

### 2.9 ALARM PANEL:

- A. Each grinder pump station shall include a water tight NEMA 4X, UL-listed alarm panel suitable for wall or pole mounting. The NEMA 4X enclosure shall be manufactured of thermoplastic polyester to ensure corrosion resistance. The entire alarm panel, as manufactured and including any of the following options, shall be listed by Underwriters Laboratories, Inc.
- B. The alarm panel shall include the following features
  - 1. External audible alarm
  - 2. Top mounted 4X rated visual alarm
  - 3. Push-to-silence switch
  - 4. High level alarm capability.
- H. The alarm sequence is to be as follows when the pump and alarm breakers are on:
  - 1. When liquid level in the sewage wet-well rises above the alarm level, audible and visual alarms are activated.
  - 2. The audible alarm may be silenced by means of the externally mounted, push-to-silence button.
  - 3. Visual alarm remains illuminated until the sewage level in the wet-well drops below the "off" setting of the alarm pressure switch.

#### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install grinder pump units in accordance with manufacturer's instructions.
- B. Provide necessary piping, fittings, and valves as required for a complete operable unit as intended.

#### 3.2 START-UP

- A. Prior to start-up, provide Operation and Maintenance Manuals to owner along with pump documents.
- B. Upon completion of installation, examine, adjust and test each unit for proper operation under the direction of the manufacturer's field engineer.

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C. Check and adjust liquid level control and alarm settings.

# 3.3 PERFORMANCE TESTING

- A. Test each unit with clean water through minimum of four complete cycles including high-level and low-level conditions to demonstrate correct sequence of pump operation, control settings, alarm settings, freedom from pump vibration, noise and overheating.
- B. Provide a report documenting start-up activities and performance test results.

# END OF SECTION 33 32 17

# SECTION 33 39 13

### MANHOLES

#### PART 1 - GENERAL

#### 1.1 **DESCRIPTION**

- A. The Work of this section includes, but is not limited to:
  - 1. Precast Concrete Manholes
  - 2. Manhole Steps
  - 3. Manhole Covers and Frames
- B. Related Work specified elsewhere:
  - 1. Section 03 30 53 Concrete for Utility Construction
  - 2. Section 31 20 00 Earthwork
  - 3. Section 31 23 17 Trenching, Backfilling, and Compacting
  - 4. Section 33 01 30.13 Sewer and Manhole Testing
  - 5. Section 33 31 13 Sanitary Sewer Pipe

# C. QUALITY ASSURANCE

- 1. Pennsylvania Department of Transportation (PennDOT):
  - a. Publication 408/2011 Specifications.
- 2. American Society for Testing and Materials (ASTM):
  - a. A48 Specification for Gray Iron Castings
  - b. A496 Specifications for Steel Wire, Deformed, for Concrete Reinforcement
  - c. C478 Specifications for Precast Reinforced Concrete Manhole Sections
  - d. C497 Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile
  - e. C923 Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes
  - f. C990 Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
  - g. D448 Standard Sizes of Coarse Aggregate for Highway Construction
  - h. D4101 Specification for Propylene Plastic Injection and Extrusion Materials
- 3. Federal Country-of-Origin Marking Law:
  - a. United States Federal Law requires that imported castings (manhole frame and covers) are subject to specific country-of-origin markings in order to legally enter the United States.
- D. SUBMITTALS
  - 1. Submit certification from material suppliers attesting that materials meet or exceed specification requirements.
  - 2. Shop Drawings:

- a. Submit detailed shop drawings of manhole sections and precast bases if used.
- b. Submit detailed shop drawings of manhole frames and covers.
- c. Submit detailed shop drawings of manhole steps.
- 4. Submit manufacturers' descriptive literature and installation instructions for the resilient pipe-to-manhole connection and for the joint sealant compound.

#### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Crushed Stone Subbase: ASTM D448, Size 57 (AASHTO M-43)
- B. Cement Concrete: Section 03 30 53 Concrete for Utility Construction

### 2.2 MANHOLES

- A. Precast Concrete Manhole Sections:
  - 1. Monarch Products Company manholes.
  - 2. Concrete shall have compressive strength of 5,000 psi at 28 days.
  - 3. Conforming to ASTM C478, with 5.5 percent plus or minus 1 percent air-entrained cement concrete.
  - 4. Provide flat slab top sections for manholes less than 4 feet deep or as indicated on Contract Drawings.
  - 5. Provide eccentric cone sections for manholes greater than 4 feet in depth, except as indicated on Contract Drawings.
  - 6. Provide 24 inches minimum access opening.
  - 7. Precast riser sections of length to suit.
  - 8. Precast bases of a design similar to the precast riser sections. Base to be integral with first riser section, minimum height of riser 24 inches.
- B. Interior Coating:
  - 1. Lining with HDPE, fiberglass and/or PVC where required at the Authority's direction
- C. Exterior Coating:
  - 1. Factory applied bitumastic coating to manhole exterior.
  - 2. Prepare surface for coating application in accordance with coating manufacturer's instructions.
  - 3. Apply coating to minimum 20-mil dry film thickness.
- D. Manhole Steps:
  - 1. Steel reinforced copolymer polypropylene meeting the following specifications:
    - a. ASTM C478
    - b. ASTM C497, Method of test
    - c. ASTM D4101, PP0344B33534Z02 copolymer polypropylene
    - d. ASTM A496, D20, 1/2" reinforced rod

- E. Manhole Frames and Covers:
  - Cast Iron Castings: AASHTO M306/ASTM A48, AASHTO M105/Class 35B or better; free of bubbles, sand and air holes, and other imperfections. Designed for AASHTO Highway Loading H-25.
  - 2. Cover Gasket: One piece O-ring gasket factory installed in a machined dovetail groove in the frame.
    - a. Gasket material of neoprene composition having good abrasion resistance, low compression set Type D, 40 durometer hardness and suited for use in sanitary sewer manholes.
    - b. Gluing of gasket is not permitted.
  - 3. Contact surfaces machined and matched.
  - 4. Cast cover inscription with pipeline service:
    - a. Comply with Federal Country-of-Origin Markings law required on imported castings.
    - b. Cast cover inscription with pipeline service.
  - 5. Neenah R-1642, East Jordan Iron Works 1045AGS, or equal.
  - 6. Watertight assembly where required:
    - a. Bolt cover to frame with 4 1/2"-13 stainless steel hex bolts, with stainless steel washer and neoprene washer.
    - b. Watertight assembly shall have same frame and cover dimensions as non-watertight assembly.
    - c. Assembly shall be Neenah R-1916-F, East Jordan Iron Works 1045-12ZPT, or equal. E.

Joint Sealant: ASTM C990.

F. Resilient Pipe-to-Manhole Connection: ASTM C923.

# PART 3 - EXECUTION

#### 3.1 EXCAVATION

- A. Perform excavation to the line and grade indicated on the Contract Drawings and as specified in 31 20 00 Earthwork.
- B. Location and depth of manholes as indicated on the Contract Drawings.

### 3.2 CONSTRUCTION

- A. Construct watertight manholes of precast concrete sections of the type and size indicated on the Contract Drawings.
- B. Construct drop connections of the required type as indicated on the Contract Drawings.
- C. Provide precast concrete bases.
  - 1. Install precast bases as shown on the Contract Drawings.
    - a. Set the precast base on 6 inches of crushed stone subbase.
    - b. Provide a sealed, flexible resilient connection between pipe and precast base section.

- D. Flow Channels:
  - 1. Form flow channels in manhole bases as indicated on the Contract Drawings.
  - 2. Slope channels uniformly from influent invert to effluent invert, minimum 1 inch drop.
  - 3. Construct bends of the largest possible radius. Form channel sides and invert smooth and uniform; free of cracks, holes or protrusions.
- E. Do not permit pipe to project more than 2 inches into the manhole.
- F. Joint Sealant:
  - 1. Seal joints between precast concrete manhole sections with joint sealant compound.
  - 2. Apply joint sealant compound in accordance with instructions of the manufacturer. Place compound on the interior and exterior sides of the joint to be squeezed out by the weight of the upper section.
  - 3. Trowel sealant compound smooth with manhole interior.
  - 4. Do not apply rigid mortar to the joints between manhole sections.
- G. Install manhole sections with steps in proper vertical alignment.
- H. Precast Manhole Rings:
  - 1. Use precast manhole rings to achieve elevation indicated for frame and cover.
  - 2. Do not adjust elevation more than 1 foot with precast rings.
  - 3. Seal joints between precast rings with joint sealant compound.
- I. Install Manhole Frames and Covers:
  - 1. Set top of frames at finished grade elevation or other elevation indicated on the Contract Drawings.
  - 2. Anchor manhole covers installed in unpaved areas as indicated on the Contract Drawings.
  - 3. Seal joint between manhole frame and manhole with joint sealant compound.
- J. Where new manholes are to be constructed on existing pipelines, carefully excavate around existing pipeline for placement of the new manhole base; take all measures necessary to control flow through the existing pipeline and to prevent leakage into the new base; after completion of the manhole, carefully remove the top portion of the existing pipeline to its centerline.

# 3.3 BACKFILLING

- A. Test manhole as specified in Section 33 01 30.13 Sewer and Manhole Testing prior to backfilling.
- B. Perform backfilling as specified in 31 20 00 Earthwork.
- C. Place backfill in approximately equal lifts on opposite sides of manhole to equalize opposing horizontal pressures.

# END OF SECTION 33 39 13

PRESS SEAL GASKET (TYP) OUTLET PIPE					45° 1 CON TER LINE 45° 1 DOW W/3"	WYE
	2, ).4.21 Y.207	YYYYAXUU <u>SEC</u>	TION		6" Si FOR W/N	ELECT STONE BASE M FLOW CHANNEL ON-SHRINK GROUT
(	<u>SIZE OF SEWER</u> 8" 10" 12" *15" DR	(MIN) DROP 1'-9' 2'-0" 2'-2" 3'-2" OP MAN	(MAX) DROP 2'-8' 2'-10" 3'-3" 6'-8"	REMARKS 1. * - INDICATES DIMENS FABRICATED FITTINGS TYPE A	IONS FROM	
	NOT TO	SCALE				
	DRN ANNERS ST	NHOLES GETTYSBURG ANDARD CONS	G MUNICIPAL A	UTHORITY ECIFICATIONS	PROJECT NO : DATE : DRAWN BY : CHECKED BY : © BUCHART HORN, INC.	SHEET TILE:

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PRECAST MANHOLE -









FSZDATA/PROJ1988445/STAKDARD CONSTRUCTION SPECS/CADIMANHOLES\_D6 DEEP PRECAST CONCIMI DI/IGMICANICAD2 2:56 PM/
































BUCHART HORN ENGINEERS + ARCHITECTS + PLANNERS

GETTYSBURG MUNICIPAL AUTHORITY STANDARD CONSTRUCTION SPECIFICATIONS

PROJECT NO :	
DATE :	
DRAWN BY :	SHEET NO:
CHECKED BY :	
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BUTTRESS FOR TEES



SECTION A-A BUTTRESS FOR HORIZONTAL BENDS



SECTION A-A BUTTRESS FOR TEES

**BUTTRESS FOR HORIZONTAL BENDS** SIZE OF BRANCH (D) BEND 16" 4" 6" 8" 10" 12" 1'-4" 4" 8" 10" 1'-0" 6" Α 11 1/4° 5" 1'-0" В 7" 8" 9" 10" 1/32 С 5" 7" 7" 8" 8" 9" 2'-3" 6" 1'-0" 1'-6" 1'-9" 9" А 22 1/2° 1'-0" 6" 7" 8" 9" 10" В 1/16 С 6" 8" 9" 10" 11" 1'-2" 10" 1'-3" 2'-1" 2'-6" 3'-4" 1'-8" А 45° 7" 7" 8" 9" 11" 1'-3" В 1/8 7" 8" 9" 10" 11" 1'-2" С 3'-0" 5'-0" 1'-6" 2'-6" 3'-6" 2'-0" А 90° 1'-6" 6" 6" 9" 1'-0" 1'-3 В 1/4 1'-5" С 1'-6" 1'-10" 1'-9" 1'-8" 1'-7" 6" 6" 8" 8" 10" 1'-0" Ε 1'-4" CAPS 9" 1'-0" 1'-8" 2'-0" 2'-9" F 1'-11" 1'-5" 2'-5" G 11" 2'-10" 3'-9" 6" 1'-2" С 8" 9" 10" 1'-0" 9" 1'-2" 6" 8" 10" 1'-0" н 6" 9" 1'-0" 1'-11" TEES 1'-3" 1'-5" 1





NOTES: 1. ALL BUTTRESSES TO BE CARRIED TO UNDISTURBED EARTH.

6"

6"

4"

6"

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2. ALL CONCRETE TO BE AS SPECIFIED FOR MASS CONCRETE.

 BUTTRESS DIMENSIONS SHOWN ARE FOR MINIMUM DIMENSIONS AND ARE BASED UPON SOIL BEARING PRESSURE OF 3,000 P.S.F. AND STATIC WATER PRESSURE OF 150 PSI WHERE PRESSURE EXCEEDS 150 PSI OR WHERE SOIL BEARING PRESSURE IS LESS THAN 3,000 P.S.F. SPECIAL BUTTRESS DESIGN IS REQUIRED.

8"

8"

10"

8"

1'-0"

8"

1'-4"

10"

4. USE DIMENSIONS SHOWN UNDER 4" PIPE FOR ALL PIPES LESS THAN 4"Ø.

THRUST BLOCK FOR HORIZONTAL BENDS, TEES AND CAPS

NOT TO SCALE



BUTTRESS FOR VERTICAL BENDS								
BEND		SIZE						
		4"	6"	8"	10"	12"	16"	
	А	4"	6"	8"	10"	1'-0"	1'-4"	
11 1/4°	В	5"	7"	8"	9"	10"	1'-0"	
1,02	С	5"	7"	7"	8"	8"	9"	
	А	6"	9"	1'-0"	1'-6"	1'-9"	2'-3"	
22 1/2°	В	6"	7"	7"	8"	10"	1'-0"	
-, -0	С	6"	7"	7"	8"	8"	9"	
	А	10"	1'-3"	1'-8"	2'-1"	2'-6"	3'-4"	
45° 1/8	В	7"	7"	8"	9"	11"	1'-3"	
1,0	С	7"	7"	8"	10"	11"	1'-3"	

ANCHORAGE FOR VERTICAL BENDS								
BEND		SIZE						
		4"	6"	8"	10"	12"	16"	
	А	1'-4"	1'-6"	1'-6"	2'-6"	3'-0"	4'-0"	
11 1/4° 1/32	В	1'-0"	1'-6"	1'-9"	2'-0"	2'-6"	2'-6"	
_, = _	С	2'-0"	2'-0"	2'-6"	3'-0"	3'-0"	4'-0"	
	А	1'-8"	2'-0"	3'-4"	3'-8"	4'-0"	4'-4"	
22 1/2° 1/16	В	1'-6"	1'-9"	2'-3"	2'-3"	2'-3"	2'-6"	
_, _ 0	С	2'-0"	3'-0"	2'-8"	3'-10"	4'-0"	5'-9"	
. = 0	А	2'-3"	2'-6"	3'-0"	4'-0"	4'-6"	5'-2"	
45° 1/8	В	1'-9"	2'-6"	2'-9"	3'-0"	3'-6"	4'-0"	
_, 0	С	2'-6"	3'-0"	4'-0"	4'-6"	4'-9"	6'-6"	

## NOTES:

- USE 3 #6 REINFORCING BARS AS SHOWN. IMBED 30 DIAMETERS IN CONCRETE AND PAINT EXPOSED SURFACE WITH 2 COATS OF APPROVED BITUMINOUS PAINT.
- 2. ALL CONCRETE TO BE CLASS AS SPECIFIED FOR MASS CONCRETE.
- 3. ALL BUTTRESSES TO BE CARRIED TO UNDISTURBED EARTH.
- 4. BUTTRESS DIMENSIONS SHOWN ARE MINIMUM. DIMENSIONS ARE BASED UPON SOIL BEARING PRESSURE OF 3,000 P.S.F. AND STATIC WATER PRESSURE OF 150 PSI WHERE PRESSURE EXCEEDS 150 P.S.I. OR WHERE SOIL BEARING PRESSURE IS LESS THAN 3,000 P.S.F. SPECIAL BUTTRESS DESIGN IS REQUIRED.
- 5. USE DIMENSIONS SHOWN UNDER 4" PIPE FOR ALL PIPES LESS THAN 4"Ø.

## THRUST BLOCK FOR VERTICAL BENDS

NOT TO SCALE









