

## SECTION 22 13 13 - FACILITY SANITARY SEWERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes gravity-flow, nonpressure and force-main, pressure sanitary sewerage outside the building, with the following components:
  - 1. Special fittings for expansion and deflection.
  - 2. Backwater valves.
  - 3. Cleanouts.
  - 4. Corrosion-protection piping encasement.
  - 5. Precast concrete and Fiberglass manholes.

#### 1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene-monomer rubber.
- C. FRP: Fiberglass-reinforced plastic.
- D. LLDPE: Linear low-density, polyethylene plastic.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PVC: Polyvinyl chloride plastic.
- H. RTRF: Glass-fiber-reinforced, thermosetting-resin fitting.
- I. RTRP: Glass-fiber-reinforced, thermosetting-resin pipe.
- J. TPE: Thermoplastic elastomer.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water.
- B. Force-Main, Pressure-Piping Pressure Rating: At least equal to system operating pressure but not less than 100 psig.

## 1.5 SUBMITTALS

### A. Product Data: For the following:

1. Special pipe fittings.
2. Backwater valves.
3. Manholes.

(Each submittal shall contain a certification that no product used contains asbestos.)

### B. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewerage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

### C. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

### D. Field quality-control test reports.

## 1.6 DELIVERY, STORAGE, AND HANDLING

### A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

### B. Protect pipe, pipe fittings, and seals from dirt and damage.

### C. Handle manholes according to manufacturer's written rigging instructions.

## 1.7 PROJECT CONDITIONS

### A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by User or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Do not proceed with interruption of service without User's written permission.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

#### A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy classes.
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
- C. Shielded, Stainless-Steel Couplings: CISPI 310, with ASTM A 666, Type 301, stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
  - 1. Available Manufacturers:
    - a. ANACO.
    - b. Dallas Specialty & Mfg. Co.
    - c. Fernco Inc.
    - d. Ideal Div.; Stant Corp.
    - e. Mission Rubber Company; a division of MCP Industries, Inc.
    - f. Tyler Pipe; Soil Pipe Div.
  - 2. Couplings for NPS 1-1/2 to NPS 4: 2-1/8-inch-wide shield with 2 bands.
  - 3. Couplings for NPS 5 and NPS 6: 3-inch-wide shield with 4 bands.
  - 4. Couplings for NPS 8 and NPS 10: 4-inch-wide shield with 4 bands.
- D. Heavy-Duty, Shielded, Stainless-Steel Couplings, NPS 10 and Smaller: With ASTM A 666, Type 301 or Type 304, stainless-steel shield; 2 or more stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
  - 1. Available Manufacturers:
    - a. ANACO.
    - b. Clamp-All Corp.
    - c. Dallas Specialty & Mfg. Co.
    - d. Ideal Div.; Stant Corp.
    - e. Mission Rubber Company; a division of MCP Industries, Inc.
    - f. Tyler Pipe; Soil Pipe Div.
  - 2. Couplings for NPS 1-1/2 to NPS 4: 3 inches.
  - 3. Couplings for NPS 5 to NPS 10: 4 inches.

- E. Heavy-Duty, Shielded, Stainless-Steel Couplings, NPS 12 and NPS 15. With ASTM A 666, Type 301 or Type 304, stainless-steel shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
  - 1. Available Manufacturers:
    - a. ANACO.
    - b. Ideal Div.; Stant Corp.
    - c. Mission Rubber Company; a division of MCP Industries, Inc.
    - d. Tyler Pipe; Soil Pipe Div.
  - 2. Couplings: 5-1/2-inch-wide shield with 6 bands.
- F. Heavy-Duty, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
  - 1. Couplings for NPS 1-1/2 to NPS 4: 2-1/8-inch-wide housing with 2 bolts.
  - 2. Couplings for NPS 5 and NPS 6: 3-1/8-inch-wide housing with 4 bolts.
  - 3. Couplings for NPS 8 and NPS 10: 4-inch-wide housing with 4 bolts.
- G. Unshielded Couplings: ASTM C 1461, rigid, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
  - 1. Couplings for NPS 1-1/2 to NPS 4: Sleeve with two bands.

#### 2.4 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS

- A. Pipe: ASTM A 746, for push-on joints.
- B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.
- C. Compact Fittings: AWWA C153, for push-on joints.
- D. Gaskets: AWWA C111, rubber.

#### 2.5 DUCTILE-IRON PRESSURE PIPE AND FITTINGS

- A. Pipe: AWWA C151, for push-on joints.
- B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.
- C. Compact Fittings: AWWA C153, for push-on joints.
- D. Gaskets: AWWA C111, rubber.

## 2.6 STAINLESS-STEEL PIPE AND FITTINGS

- A. Pipe and Fittings: ASME A112.3.1, stainless-steel, pipe and fittings with socket and spigot ends fabricated with ASTM A 666, Type 304L, stainless steel for gasketed joints.
- B. Gaskets: Lip seals shaped to fit socket groove, with plastic backup ring.
  - 1. General Applications: EPDM, unless otherwise indicated.
  - 2. Applications for Fluids Containing Gasoline or Oil: NBR, unless otherwise indicated.

## 2.7 ABS PIPE AND FITTINGS

- A. ABS Sewer Pipe and Fittings: ASTM D 2751, with bell-and-spigot ends for gasketed joints.
  - 1. NPS 3 to NPS 6: SDR 26.
  - 2. NPS 8 to NPS 12: SDR 42.
  - 3. Gaskets: ASTM F 477, elastomeric seals.

## 2.8 PVC PIPE AND FITTINGS

- A. PVC Pressure Pipe: AWWA C900, Class 150, for gasketed joints and using ASTM F 477, elastomeric seals.
  - 1. Fittings NPS 4 to NPS 8: PVC pressure fittings complying with AWWA C907, for gasketed joints and using ASTM F 477, elastomeric seals.
  - 2. Fittings NPS 10 and Larger: Ductile-iron, compact fittings complying with AWWA C153, for push-on joints and using AWWA C111, rubber gaskets.
- B. PVC Water-Service Pipe and Fittings: ASTM D 1785, Schedule 80 pipe, with plain ends for solvent-cemented joints with ASTM D 2466, Schedule 80, socket-type fittings.
- C. PVC Cellular-Core Pipe and Fittings: ASTM F 891, Sewer and Drain Series, PS 50 minimum stiffness pipe with ASTM D 3034, SDR 26, socket-type fittings for solvent-cemented joints.
- D. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 26, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.
- E. PVC Sewer Pipe and Fittings, NPS 18 and Larger: ASTM F 679, T-2 wall thickness, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.
- F. PVC Profile Gravity Sewer Pipe and Fittings: ASTM F 794 pipe, with bell-and-spigot ends; ASTM D 3034 fittings, with bell ends; and ASTM F 477, elastomeric seals.

## 2.9 FIBERGLASS PIPE AND FITTINGS

- A. Fiberglass Sewer Pipe: ASTM D 3262, RTRP for gasketed joints fabricated with Type 2, polyester or Type 4, epoxy resin.

1. Liner: 1, reinforced thermoset.
2. Grade: Reinforced, surface layer matching pipe resin.
3. Stiffness: B, 18 psig.

B. Fiberglass Nonpressure Fittings: ASTM D 3840, RTRF for gasketed joints.

1. Laminating Resin: Type 1, polyester or Type 2, epoxy resin.
2. Reinforcement: Grade with finish compatible with resin.

C. Gaskets: ASTM F 477, elastomeric seals.

## 2.10 CONCRETE PIPE AND FITTINGS

A. Nonreinforced-Concrete Sewer Pipe and Fittings: ASTM C 14, Class 1 or 2, with bell-and-spigot or groove and tongue ends for gasketed joints with ASTM C 443, rubber gaskets.

B. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76, with bell-and-spigot or groove and tongue ends for gasketed joints with ASTM C 443, rubber gaskets.

1. Class II, Wall A.
2. Class III, Wall A.
3. Class IV, Wall A.
4. Class V, Wall A.

## 2.11 NONPRESSURE-TYPE PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Concrete Pipes: ASTM C 443, rubber.
2. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
3. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
4. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:

- a. Dallas Specialty & Mfg. Co.
- b. Fernco Inc.
- c. Logan Clay Products Company (The).
- d. Mission Rubber Company; a division of MCP Industries, Inc.
- e. NDS Inc.

- f. Plastic Oddities, Inc.
  
- D. Shielded, Flexible Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - 1. Available Manufacturers:
    - a. Cascade Waterworks Mfg.
    - b. Dallas Specialty & Mfg. Co.
    - c. Mission Rubber Company; a division of MCP Industries, Inc.
  
- E. Ring-Type, Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.
  - 1. Available Manufacturers:
    - a. Fernco Inc.
    - b. Logan Clay Products Company (The).
    - c. Mission Rubber Company; a division of MCP Industries, Inc.
  
- F. Nonpressure-Type, Rigid Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

## 2.12 PRESSURE-TYPE PIPE COUPLINGS

- A. Reducing or transition, metal, bolted, sleeve-type, reducing or transition coupling, for joining underground pressure piping. Include 150-psig minimum pressure rating and ends of same sizes as piping to be joined.
  
- B. Tubular-Sleeve Couplings: AWWA C219, with center sleeve, gaskets, end rings, and bolt fasteners.
  - 1. Available Manufacturers:
    - a. Cascade Waterworks Mfg.
    - b. Dresser, Inc.; DMD Div.
    - c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
    - d. JCM Industries.
    - e. Romac Industries, Inc.
    - f. Smith-Blair, Inc.
    - g. Viking Johnson.
  
  - 2. Center-Sleeve Material: Stainless steel.
  - 3. Gasket Material: Natural or synthetic rubber.
  - 4. Metal Component Finish: Corrosion-resistant coating or material.

- C. Split-Sleeve Couplings: With split sleeve with sealing pad and closure plates, O-ring gaskets, and bolt fasteners.
  - 1. Sleeve Material: Stainless steel.
  - 2. Sleeve Dimensions: Of thickness and width required to provide pressure rating.
  - 3. Gasket Material: O-rings made of EPDM rubber, unless otherwise indicated.
  - 4. Metal Component Finish: Corrosion-resistant coating or material.

## 2.13 SPECIAL PIPE FITTINGS

- A. Ductile-Iron, Flexible Expansion Joints: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include 2 gasketed ball-joint sections and 1 or more gasketed sleeve sections, rated for 250-psig minimum working pressure and for offset and expansion indicated.
  - 1. Available Manufacturers:
    - a. EBAA Iron Sales, Inc.
    - b. Romac Industries, Inc.
    - c. Star Pipe Products.
- B. Ductile-Iron Deflection Fittings: Compound coupling fitting with ball joint, flexing section, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include rating for 250-psig minimum working pressure and for up to 15 degrees of deflection.
- C. Ductile-Iron Expansion Joints: Three-piece assembly of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Include rating for 250-psig minimum working pressure and for expansion indicated.
  - 1. Available Manufacturers:
    - a. Dresser, Inc.; DMD Div.
    - b. EBAA Iron Sales, Inc.
    - c. JCM Industries.
    - d. Smith-Blair, Inc.

## 2.14 BACKWATER VALVES

- A. Gray-Iron Backwater Valves: ASME A112.14.1, gray-iron body and bolted cover, with bronze seat.
  - 1. Available Manufacturers:
    - a. Josam Company.
    - b. Smith, Jay R. Mfg. Co.
    - c. Wade Div.; Tyler Pipe.
    - d. Watts Industries, Inc.

- e. Watts Industries, Inc.; Enpoco, Inc. Div.
  - f. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
- 2. Horizontal Type: With swing check valve and hub-and-spigot ends.
  - 3. Combination Horizontal and Manual Gate-Valve Type: With swing check valve, integral gate valve, and hub-and-spigot ends.
  - 4. Terminal Type: With bronze seat, swing check valve, and hub inlet.
- B. PVC Backwater Valves: Horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.
- 1. Available Manufacturers:
    - a. Canplas Inc.
    - b. IPS Corporation.
    - c. NDS Inc.
    - d. Plastic Oddities, Inc.
    - e. Sioux Chief Manufacturing Company, Inc.
    - f. Zurn Light Commercial Specialty Plumbing Products; Zurn Plumbing Products Group.

## 2.15 CLEANOUTS

- A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
- 1. Available Manufacturers:
    - a. Josam Company.
    - b. MIFAB Manufacturing Inc.
    - c. Smith, Jay R. Mfg. Co.
    - d. Wade Div.; Tyler Pipe.
    - e. Watts Industries, Inc.
    - f. Watts Industries, Inc.; Enpoco, Inc. Div.
    - g. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
  - 2. Top-Loading Classification: Heavy and Extra-heavy duty.
  - 3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.
- B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to clean-out of same material as sewer piping.
- 1. Available Manufacturers:
    - a. Canplas Inc.
    - b. IPS Corporation.
    - c. NDS Inc.

- d. Plastic Oddities, Inc.
- e. Sioux Chief Manufacturing Company, Inc.
- f. Zurn Light Commercial Specialty Plumbing Products; Zurn Plumbing Products Group.

## 2.16 CORROSION-PROTECTION PIPING ENCASEMENT

### A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105.

1. Form: Sheet or tube.
2. Material: LLDPE film of 0.008-inch minimum thickness.
3. Material: LLDPE film of 0.008-inch minimum thickness or high-density, crosslaminated PE film of 0.004-inch minimum thickness.
4. Material: High-density, cross-laminated PE film of 0.004-inch minimum thickness.
5. Color: Black.

## 2.17 MANHOLES

### A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

1. Diameter: 48 inches minimum, unless otherwise indicated.
2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
3. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
4. Riser Sections: 4-inch minimum thickness, and of length to provide depth indicated.
5. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
6. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
7. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
8. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. .
9. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
11. Protective Coating: Plant-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint; 15-mil minimum thickness applied to exterior and interior surfaces.
12. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."

- a. Material: ASTM A 536, Grade 60-40-18 ductile iron, unless otherwise indicated.
  - b. Protective Coating: Foundry-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint; 15-mil minimum thickness applied to all surfaces, unless otherwise indicated.
  
- B. Designed Precast Concrete Manholes: ASTM C 913; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
  1. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole as required to prevent flotation.
  2. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
  3. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
  4. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals.
  5. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
  6. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
  7. Protective Coating: Plant-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint; 15-mil minimum thickness applied to exterior and interior surfaces.
  8. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
    - a. Material: ASTM A 536, Grade 60-40-18 ductile iron, unless otherwise indicated.
    - b. Protective Coating: Foundry-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint; 15-mil minimum thickness applied to all surfaces, unless otherwise indicated.
  
- C. Fiberglass Manholes: ASTM D 3753, fabricated, FRP.
  1. Available Manufacturers:
    - a. Associated Fiberglass Enterprises.
    - b. Containment Solutions, Inc.
    - c. L.F. Manufacturing, Inc.
  2. Diameter: 48 inches minimum, unless otherwise indicated.
  3. Ballast: Increase thickness of concrete base as required to prevent flotation.
  4. Base Section: Concrete, 6-inch minimum thickness.
  5. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
  6. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals.

7. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
  8. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
  9. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
    - a. Material: ASTM A 536, Grade 60-40-18 ductile iron, unless otherwise indicated.
    - b. Protective Coating: Foundry-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint; 15-mil minimum thickness applied to all surfaces, unless otherwise indicated.
- D. Manhole Cover Inserts: Manufactured, plastic form, of size to fit between manhole frame and cover and designed to prevent stormwater inflow. Include handle for removal and gasket for gastight sealing.
1. Available Manufacturers:
    - a. FRW Industries; a Syneco Systems, Inc. company.
    - b. Knutson Enterprises.
    - c. L.F. Manufacturing, Inc.
    - d. Parson Environmental Products, Inc.
  2. Type: With drainage and vent holes.
- E. Manhole adjusting rings: level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required adjusting manhole cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
1. Available Manufacturers:
    - a. EJ Group, Inc.
    - b. EJ Prescott
    - c. Turner Manhole Risers, Inc.
    - d. Accucast
    - e. Neenah Foundry

## 2.18 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
1. Cement: ASTM C 150, Type II.
  2. Fine Aggregate: ASTM C 33, sand.
  3. Coarse Aggregate: ASTM C 33, crushed gravel.
  4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
  2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.
- C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
    - a. Invert Slope: 2 percent through manhole.
  2. Benches: Concrete, sloped to drain into channel.
    - a. Slope: 8 percent.
- D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
  2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

## 2.19 MISCELLANEOUS MATERIALS

- A. Paint: SSPC-Paint 16.
- B. PE Sheeting: ASTM D 4397, with at least 8-mil thickness or other equivalent, impervious material.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

### 3.2 PIPING APPLICATIONS

- A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
  1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.
    - a. Unshielded flexible or rigid couplings for same or minor difference OD pipes.

- b. Unshielded, increaser/reducer-pattern, flexible or rigid couplings for pipes with different OD.
    - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
  2. Use pressure-type pipe couplings for force-main joints.
- B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
- C. Gravity-Flow, Nonpressure Sewer Piping: Use any of the following pipe materials for each size range:
  1. NPS 3: Hub-and-spigot, [Extra-Heavy] [Service] class, cast-iron soil pipe and fittings; [gaskets; and gasketed] [calking materials; and calked] joints.
  2. NPS 3: Hubless cast-iron soil pipe and fittings; [shielded, stainless-steel] [heavy-duty, shielded, stainless-steel] [heavy-duty, cast-iron] [unshielded] couplings; and coupled joints.
  3. NPS 3; NPS 6 ductile-iron, gravity sewer pipe or NPS 3 or NPS 4 ductile-iron pressure pipe; ductile-iron standard fittings; gaskets; and gasketed joints.
  4. NPS 3): Stainless-steel drainage pipe and fittings, gaskets, and gasketed joints. Use EPDM-compound gaskets, unless otherwise indicated. Use nitrile-rubber-compound gaskets for wastes containing gasoline or oil.
  5. NPS 3: ABS, SDR 35, sewer pipe and fittings; gaskets; and gasketed joints.
  6. NPS 3: PVC water-service pipe; PVC Schedule 80, water-service-pipe fittings; and solvent-cemented joints.
  7. NPS 3: NPS 4 PVC sewer pipe and fittings, gaskets, and gasketed joints.
  8. NPS 3 : NPS 4 Class 2, nonreinforced-concrete sewer pipe and fittings, gaskets, and gasketed joints.
  9. NPS 4: Hub-and-spigot, Extra-Heavy class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  10. NPS 4: Hubless cast-iron soil pipe and fittings; stainless-steel or heavy-duty, shielded, stainless-steel couplings; and coupled joints.
  11. NPS 4 : NPS 6 ductile-iron, gravity sewer pipe or NPS 4 ductile-iron pressure pipe; ductile-iron standard fittings; gaskets; and gasketed joints.
  12. NPS 4 : Stainless-steel drainage pipe and fittings, gaskets, and gasketed joints. Use EPDM-compound gaskets, unless otherwise indicated. Use nitrile-rubber-compound gaskets for wastes containing gasoline or oil.
  13. NPS 4 : ABS, SDR 35, sewer pipe and fittings; gaskets; and gasketed joints.
  14. NPS 4 : PVC water-service pipe; PVC Schedule 80, water-service-pipe fittings; and solvent-cemented joints.
  15. NPS 4 : PVC sewer pipe and fittings, gaskets, and gasketed joints.
  16. NPS 4 : Class 2, nonreinforced-concrete sewer pipe and fittings, gaskets, and gasketed joints.
  17. NPS 5 and NPS 6 : Hub-and-spigot, Extra-Heavy class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  18. NPS 5 and NPS 6 : Hubless cast-iron soil pipe and fittings; shielded, stainless-steel couplings; and coupled joints.

19. NPS 5 and NPS 6 : NPS 6 ductile-iron, gravity sewer pipe; ductile-iron standard fittings; gaskets; and gasketed joints.
20. NPS 5 and NPS 6 : NPS 6 stainless-steel drainage pipe and fittings, gaskets, and gasketed joints. Use EPDM-compound gaskets, unless otherwise indicated. Use nitrile-rubber-compound gaskets for wastes containing gasoline or oil.
21. NPS 5 and NPS 6 : NPS 6 ABS, SDR 35, sewer pipe and fittings; gaskets; and gasketed joints.
22. NPS 5 and NPS 6 : NPS 6 cellular-core PVC pipe, PVC sewer pipe fittings, and solvent-cemented joints.
23. NPS 5 and NPS 6 : NPS 6 PVC sewer pipe and fittings, gaskets, and gasketed joints.
24. NPS 5 and NPS 6 : NPS 6 Class 2, nonreinforced-concrete sewer pipe and fittings, gaskets, and gasketed joints.
25. NPS 8 and NPS 10 : Hub-and-spigot, Extra-Heavy class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
26. NPS 8 and NPS 10 : Hubless cast-iron soil pipe and fittings; shielded, stainless-steel couplings; and coupled joints.
27. NPS 8 and NPS 10 : Ductile-iron, gravity sewer pipe; ductile-iron standard fittings; gaskets; and gasketed joints.
28. NPS 8 and NPS 10 : ABS, SDR 42, sewer pipe and fittings; gaskets; and gasketed joints.
29. NPS 8 and NPS 10 : Cellular-core PVC pipe, PVC sewer pipe fittings, and solvent-cemented joints.
30. NPS 8 and NPS 10 : PVC sewer pipe and fittings, gaskets, and gasketed joints.
31. NPS 8 and NPS 10 : PVC profile gravity sewer pipe and fittings, gaskets, and gasketed joints.
32. NPS 8 and NPS 10 : Fiberglass Type 2 or 4, Class III; sewer RTRP; Type 1 or 2 RTRF, gaskets, and gasketed joints.
33. NPS 8 and NPS 10 : Nonreinforced-concrete sewer pipe and fittings, gaskets, and gasketed joints.
34. NPS 12 and NPS 15 : Hub-and-spigot, Extra-Heavy class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
35. NPS 12 and NPS 15 : Hubless cast-iron soil pipe and fittings; heavy-duty, shielded, stainless-steel couplings; and coupled joints.
36. NPS 12 to NPS 16 : Ductile-iron, gravity sewer pipe; ductile-iron standard fittings; gaskets; and gasketed joints.
37. NPS 12: ABS, SDR 42, sewer pipe and fittings; gaskets; and gasketed joints.
38. NPS 12 and NPS 15: PVC sewer pipe and fittings, gaskets, and gasketed joints.
39. NPS 12 and NPS 15: PVC profile gravity sewer pipe and fittings, gaskets, and gasketed joints.
40. NPS 12 to NPS 16: Fiberglass Type 2 or 4, Class III; sewer RTRP; Type 1 or 2 RTRF, gaskets, and gasketed joints.
41. NPS 12 and NPS 15: Nonreinforced-concrete sewer pipe and fittings, gaskets, and gasketed joints.
42. NPS 12 and NPS 15: Reinforced-concrete sewer pipe and fittings, gaskets, and gasketed joints.
43. NPS 18 to NPS 24: Ductile-iron, gravity sewer pipe; ductile-iron standard fittings; gaskets; and gasketed joints.
44. NPS 18 to NPS 24: PVC sewer pipe and fittings, gaskets, and gasketed joints.
45. NPS 18 to NPS 24: PVC profile gravity sewer pipe and fittings, gaskets, and gasketed joints.

46. NPS 18 to NPS 24: Fiberglass Type 2 or 4, Class III; sewer RTRP; Type 1 or 2 RTRF, gaskets, and gasketed joints.
47. NPS 18 to NPS 24: Nonreinforced-concrete sewer pipe and fittings, gaskets, and gasketed joints.
48. NPS 18 to NPS 24: Reinforced-concrete sewer pipe and fittings, gaskets, and gasketed joints.

D. Force-Main, Pressure Piping: Use any of the following pipe materials for each size range:

1. NPS 2: PVC Schedule 80, water-service pipe; PVC Schedule 80, water-service-pipe fittings; and solvent-cemented joints.
2. NPS 3: Ductile-iron, gravity sewer pipe or ductile-iron pressure pipe; ductile-iron standard or compact fittings; gaskets; and gasketed joints.
3. NPS 3: PVC Schedule 80, water-service pipe; PVC Schedule 80, water-service-pipe fittings; and solvent-cemented joints.
4. NPS 4: Ductile-iron, gravity sewer pipe or ductile-iron pressure pipe; ductile-iron standard or compact fittings; gaskets; and gasketed joints.
5. NPS 4: PVC pressure pipe, PVC pressure fittings, gaskets, and gasketed joints.
6. NPS 6 to NPS 8: Ductile-iron sewer pipe; standard- or compact-pattern, ductile-iron fittings; gaskets; and gasketed joints.
7. NPS 6 to NPS 8: PVC pressure pipe, PVC pressure fittings, gaskets, and gasketed joints.
8. NPS 10 and NPS 12: Ductile-iron sewer pipe; standard- or compact-pattern, ductile-iron fittings; gaskets; and gasketed joints.
9. NPS 10 and NPS 12: PVC pressure pipe; compact-pattern, ductile-iron fittings; gaskets; and gasketed joints.

### 3.3 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or combination of both.
- F. Install gravity-flow, nonpressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 2 percent, unless otherwise indicated.
  2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
  3. Install piping with 36-inch minimum cover.
  4. Install piping below frost line.
  5. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
  6. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
  7. Install ductile-iron, gravity sewer piping according to ASTM A 746.
  8. Install ductile-iron and special fittings according to AWWA C600 or AWWA M41.
  9. Install stainless-steel drainage piping according to ASME A112.3.1.
  10. Install ABS sewer piping according to ASTM D 2321 and ASTM F 1668.
  11. Install PVC cellular-core piping according to ASTM D 2321 and ASTM F 1668.
  12. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
  13. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
  14. Install fiberglass sewer piping according to ASTM D 3839 and ASTM F 1668.
  15. Install nonreinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
  16. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
- G. Install force-main, pressure piping according to the following:
1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
  2. Install piping with 36-inch minimum cover.
  3. Install piping below frost line.
  4. Install ductile-iron pressure piping according to AWWA C600 or AWWA M41.
  5. Install ductile-iron special fittings according to AWWA C600.
  6. Install PVC pressure piping according AWWA M23 or ASTM D 2774 and ASTM F 1668.
  7. Install PVC water-service piping according ASTM D 2774 and ASTM F 1668.
- H. Install corrosion-protection piping encasement over the following underground metal piping according to ASTM A 674 or AWWA C105:
1. Hub-and-spigot, cast-iron soil pipe.
  2. Hubless cast-iron soil pipe and fittings.
  3. Ductile-iron pipe and fittings.
  4. Special pipe fittings.
- I. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

### 3.4 PIPE JOINT CONSTRUCTION

- A. Basic piping joint construction is specified in Division 22 Section "Common Work Results for Plumbing" Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. Join gravity-flow, nonpressure, drainage piping according to the following:
1. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
  2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
  3. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
  4. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.
  5. Join ductile-iron and special fittings according to AWWA C600 or AWWA M41.
  6. Join stainless-steel drainage piping according to ASME A112.3.1.
  7. Join ABS sewer piping according to ASTM D 2321 and ASTM D 2751 for elastomeric-seal joints.
  8. Join PVC cellular-core piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
  9. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
  10. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
  11. Join fiberglass sewer piping according to ASTM D 4161 for elastomeric-seal joints.
  12. Join nonreinforced-concrete sewer piping according to ASTM C 14 and ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
  13. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
  14. Join dissimilar pipe materials with nonpressure-type, flexible or rigid couplings.
- C. Join force-main, pressure piping according to the following:
1. Join ductile-iron pressure piping according to AWWA C600 or AWWA M41 for push-on joints.
  2. Join ductile-iron special fittings according to AWWA C600 or AWWA M41 for push-on joints.
  3. Join PVC pressure piping according AWWA M23 for gasketed joints.
  4. Join PVC water-service piping according ASTM D 2855.
  5. Join dissimilar pipe materials with pressure-type couplings.

### 3.5 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.

- C. Construct cast-in-place manholes as indicated.
- D. Install PE sheeting on earth where cast-in-place-concrete manholes are to be built.
- E. Install FRP manholes according to manufacturer's written instructions.
- F. Form continuous concrete channels and benches between inlets and outlet.
- G. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 6 inches above finished surface elsewhere, unless otherwise indicated.
- H. Install manhole adjustment rings in frame and immediately below cover.

### 3.6 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318/318R.

### 3.7 BACKWATER VALVE INSTALLATION

- A. Install horizontal-type backwater valves in piping where indicated.
- B. Install combination horizontal and manual gate valve type in piping and in manholes where indicated.
- C. Install terminal-type backwater valves on end of piping and in manholes where indicated. Secure units to sidewalls.

### 3.8 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
  - 1. Use medium-duty, top-loading classification cleanouts in earth or foot-traffic areas.
  - 2. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
  - 3. Use extra-heavy-duty, top-loading classification cleanouts in roads.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

### 3.9 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains within 5 feet of building.

- B. Make connections to existing piping and underground manholes.
1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi .
  2. Make branch connections from side into existing piping, NPS 4 to NPS 20 . Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi .
  3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
    - a. Use concrete that will attain minimum 28-day compressive strength of 3000 psi , unless otherwise indicated.
    - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
  4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- C. Connect to grease interceptors as shown on drawings.

### 3.10 CLOSING ABANDONED SANITARY SEWERAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
1. Close open ends of piping with at least 8-inch-thick, brick masonry bulkheads.
  2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Manholes: Excavate around manhole as required and use either procedure below:
1. Remove manhole and close open ends of remaining piping.
  2. Remove top of manhole down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
- C. Backfill to grade according to Division 31 Section "Earth Moving."

### 3.11 PAINTING

- A. Clean and prepare concrete manhole surfaces for field painting. Remove loose efflorescence, chalk, dust, grease, oils, and release agents. Roughen surface as required to remove glaze. Paint the following concrete surfaces as recommended by paint manufacturer:
  - 1. Precast Concrete Manholes: All exterior and interior.
- B. Prepare ferrous frame and cover surfaces according to SSPC-PA 1 and paint according to SSPC-PA 1 and SSPC-Paint 16. Do not paint surfaces with foundry-applied corrosion-resistant coating.

### 3.12 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
  - 1. Use warning tape or detectable warning tape over ferrous piping.
  - 2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

### 3.13 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
  - 1. Submit separate report for each system inspection.
  - 2. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    - c. Crushed, broken, cracked, or otherwise damaged piping.
    - d. Infiltration: Water leakage into piping.
    - e. Exfiltration: Water leakage from or around piping.
  - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  - 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
  - 1. Do not enclose, cover, or put into service before inspection and approval.
  - 2. Test completed piping systems according to requirements of authorities having jurisdiction.

3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
  4. Submit separate report for each test.
  5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
    - a. Allowable leakage is maximum of 50 gal./inch of nominal pipe size per mile of pipe, during 24-hour period.
    - b. Close openings in system and fill with water.
    - c. Purge air and refill with water.
    - d. Disconnect water supply.
    - e. Test and inspect joints for leaks.
    - f. Option: Test ductile-iron piping according to AWWA C600, "Hydrostatic Testing" Section. Use test pressure of at least 10 psig.
  6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
    - a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
    - b. Option: Test concrete gravity sewer piping according to ASTM C 924.
  7. Force Main: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig.
    - a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
    - b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.
  8. Manholes: Perform hydraulic test according to ASTM C 969.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

### 3.14 CLEANING

- A. Clean interior of piping of dirt and superfluous material. Flush with potable water.

END OF SECTION 22 13 13