



## Facilities Planning and Construction Design and Construction Standards

### **DIVISION 33 – Utilities**

#### **Preface**

The Texas Tech University System's 'Design and Construction Standards', as administrated by Facilities Planning and Construction, are intended to serve as guidelines to the Design Professional and Construction Management teams for design development and construction administration of Texas Tech University System (TTUS) Capital Projects. They communicate the minimum expectations and requirements relative to specific building systems, design provisions, general specification requirements, and administrative procedures for new facilities being constructed on Texas Tech University System (ASU, MSU, TTU, TTUHSC, and TTUHSC El Paso) campuses. Several, but not all requirements for each component Institution or Agency within the TTU System are covered. Design Professionals, Construction Managers at Risk and/or Design-Build Firms shall also refer to provisions covered in their service Agreements, as well as within the project's Basis of Design (BOD) document.

In addition, the 'Design and Construction Standards' shall also be utilized in conjunction with the approved project specific Program and Schematic Design development. In the event of conflict between this document and specific project requirements, Design Professionals, Construction Managers at Risk and/or Design-Build Firms shall contact Facilities Planning & Construction for clarification.

The guidelines within the 'Design and Construction Standards' are not intended to prohibit the use of alternative design solutions, methods, systems, products or devices not covered in this document. Offered alternatives deviating from or not covered in these standards shall be documented by the Design Professional and/or Construction Management teams and submitted to Facilities Planning & Construction for approval prior to implementation.

Throughout the 'Design and Construction Standards' there are references to manufacturer specific products. These are to be considered the 'Basis of Design' to establish the expected

minimum quality requirements. Design Professionals are encouraged to identify and include equivalent products and/or manufacturers offering comparable products to facilitate open bidding environments.

### **General Requirements for Utilities**

#### **Site Preparation**

The Contractor shall notify TTUS FP&C and call Texas Excavation Safety System (Dig TESS) 1-800-344-8377 or 811 at least 48 hours prior to start of work.

Refer to Division 22 Plumbing - **22 11 13 Facility Water Distribution Piping and 22 13 13 Facility Sanitary Sewer** for piping and related components outside the building footprint.

#### **Tree Protection**

Prevent unnecessary damage and mitigate the effects of construction to trees located within the construction zone. Prevent direct root damage, indirect root damage, and trunk and crown disturbances. Prevent soil compaction of critical root zone as defined as that area directly beneath the drip line of the tree canopy. Vehicles, equipment, and materials shall not be parked or stored in the critical root zone of trees to remain. Provide tree preservation fencing around all existing trees to remain. All tree limb and root pruning shall be done at the discretion of the Grounds Maintenance Department or a certified arborist.

If existing trees are destroyed, killed or badly damaged as a result of construction operations, Contract sum will be reduced by the amount of assessed damages. Damages will be evaluated by Grounds Maintenance, using International Shade Tree Conference Standards and following formula: measurement of a cross section of tree trunk will be made at a point 2 feet above existing grade level to determine cross section area in square inches. Assessment for damage will be \$32.00 per square inch.

#### **Erosion, Sedimentation and Dust Control**

The Contractor shall establish, construct and maintain erosion and sediment control measures. Siltation control devices shall be installed in the locations shown in the Storm Water Pollution Prevention Plan (SWPPP) before construction begins. The erosion control structures shall be maintained until permanent ground cover is established. The Contractor with the advice and consultation of the Design Professional shall endeavor to stop all sediment and erosion to a

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level of effort acceptable to the Owner and Design Professional. The Contractor shall exercise precautionary measures to minimize dust emissions which will include, but shall not be limited to, periodic sprinkling or wetting of the site. The Contractor has the option of using a dust palliative. Storm Water Pollution Prevention Plan (SWPPP) The Texas Tech Storm Water Pollution Prevention Program requires preparation of a Storm Water Pollution Prevention Plan (SW3P) for any project that causes a disturbance of soil on any campus of the Texas Tech University System. The plan will incorporate measures in response to and ensure compliance with the terms of the Texas Pollution Discharge Elimination System (TPDES) General Permit for Storm Discharges from Construction Activities.

**Excavation, Trenching, and Backfilling for Utilities**

The Contractor shall call Texas Excavation Safety System (Dig TESS) 1-800-344-8377 or 811 at least 48 hours prior to start of work. The Contractor is responsible for locating and protecting all utilities including the utility tunnels. Utilities shown on the Drawings are based on the available information.

The Contractor shall maintain utility service to the existing buildings throughout construction. Any utility interruption must be approved by and coordinated with the utility Owner and TTUS. Tests shall be performed by an independent laboratory selected by the Owner. Only passing tests shall be paid for by the Owner. Test results shall be submitted to the Design Professional for review.

All trenches 12 inches or wider, as measured at the top, that are within roadways, or roadway rights-of-way, parking areas, and areas to be paved shall be tested for conformance to compaction requirements as specified. These trenches shall be backfilled and compacted to their full depth or to the bottom of concrete T-cap. Tests shall be made every 100 feet along the pipeline, or a minimum of two tests, and to 4 feet vertical intervals throughout the backfill. Tests taken in 4 feet intervals shall be staggered. Contractor shall maintain a record drawing profile of all depth trench testing.

Compaction in other areas shall not be less than 90% of the Standard Proctor Test ASTM D 698. Tests in other areas shall be one test every 500 feet within the upper 4 feet of fill.

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The Design Professional shall specify backfill requirements based on geotechnical surveys. The Contractor shall perform all excavation to the depths shown on the Drawings or as specified. During excavation, materials suitable for backfilling shall be piled a sufficient distance from the banks of the excavation to avoid overloading and to prevent slides and cave-ins. Excavated materials not suitable or required for fill or back-fill shall be removed from the site. All excavation shall be made by open cut. No tunneling shall be done unless shown on the Drawings. All excavations are to be performed in strict accordance with OSHA Regulations.

Before commencing any trench excavation that will exceed a depth of five feet, Contractor shall provide to Texas Tech a copy of any geotechnical investigations used for preparation of detailed Drawings and Specifications regarding the safety systems to be utilized. The Contractor shall submit a trenching plan that is approved and sealed by a professional engineer registered in the State of Texas and employed by the Contractor. Said engineer cannot be anyone who is employed on this Project by Texas Tech. Receipt of the plan is a prerequisite to the start of trenching. It is the Contractor's responsibility to comply with any additional requirements resulting from any pre-bid conference relating to coordination of geotechnical investigation subjects.

Minimum cover requirements to top of pipe or insulation for utilities:

Low pressure gas ounces	36 inches
High pressure gas pounds	46 inches
Alarm systems	42 inches
Security systems	42 inches
Domestic water	36 inches
Irrigation mains	24 inches
Irrigation laterals	18 inches
Communication	42 inches
Electrical primary voltage	42 inches (including concrete cap)
Electrical secondary voltage	36 inches (less than 600 volts)
Direct bury steam/condensate return	36 inches
Compressed Air	36 inches
Hydronic Systems	36 inches
Reverse Osmosis (RO) water	36 inches
Fire Protection Main	36 Inches

For underground piping, specify bright colored continuously printed plastic ribbon tape. Ribbon shall be not less than six (6) inches wide by minimum four (4) mil thick and shall be manufactured for direct burial service. Warning tape for utilities should be 12 to 16 inches below

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grade. Provide a minimum of 12-gauge tracer wire for all below grade non-metallic piping systems. Metallic warning tape shall not be considered equivalent. Refer to TTU Operating Policies and Procedure 61.11 "Underground Trenching of Utilities" for more specifics.

TTUS FP&C shall be contacted prior to excavation any time pavement or concrete is to be removed.

### **Utility Services**

All buried valves and fittings shall be thoroughly wrapped prior to installation with a polyethylene material meeting the requirements of ASTM D 1248. The polyethylene material shall have a minimum thickness of 8 mils. The wrap shall be secured by 2-inch specialty tape.

Concrete shall be used for thrust-blocking the pipe and fittings and shall conform to the concrete standards as set forth in Division 3 Cast-In-Place Concrete. The blocking shall be poured against solid undisturbed ground or engineered fill. A minimum compressive strength of 3,000 psi will be acceptable.

The Contractor shall disinfect all potable pipelines before being placed in service. The lines shall be disinfected by using a chlorinating agent in accordance with the requirements of AWWA C651 and the most current edition of the international Plumbing Code Section 610.1. The Contractor shall notify the Architect and Owner's Representative 72 hours in advance of disinfection so that the Architect and Owner's Representative may witness the disinfection activities. After disinfection has been completed and the pipe is flushed, the Contractor shall perform a bacteriological test. Samples shall be taken after the pipeline disinfection treatment has been flushed. A minimum of two sets of samples taken 24 hours apart shall be tested and shall include one sample for every 1000 feet of water line plus sample sets at the end of each pipeline branch. If acceptable bacteriological test results are not received, the Contractor shall disinfect the pipe again and provide whatever measures necessary to achieve an acceptable result. Acceptable results shall be the bacteriological requirements for potable water as defined by the Texas Commission on Environmental Quality. Chlorine tablets are not acceptable for disinfecting procedures. Super chlorination (over 200 ppm) is not allowed unless approved by TTUS.

**33 05 00 Common Work Results for Utilities**

Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces. Coordinate size and location of concrete bases. Formwork, reinforcement, and concrete requirements are specified in Section 03 30 00 Cast-in-Place Concrete.

Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed. Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

For piping to be abandoned in place, drain piping. Fill abandoned piping with flowable fill, and cap or plug piping with same or compatible piping material. Disconnect and cap services and remove equipment.

For equipment to be removed and reinstalled, disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

For equipment to be removed and salvaged, disconnect, and cap services and remove equipment and deliver to Owner.

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Install pipe markers on each system. Include arrows showing normal direction of flow. Provide stenciled markers according to ASME A13.1. Provide plastic markers with application systems. Install on insulation segment if required for hot non-insulated piping.

Locate pipe markers on exposed piping according to the following near (1) each valve and control device, (2) near each branch (mark each pipe at branch if flow pattern is not obvious) excluding short takeoffs for equipment and terminal units, (3) near locations where pipes pass through walls or floors or enter inaccessible enclosures, (4) at manholes and similar access points that permit view of concealed piping, (5) near major equipment items and other points of origination and termination. Relocate identifying devices that become visually blocked by Work of this or other Divisions.

Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, Structural Welding Code - Steel.

Steel Piping Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, Welding and Brazing Qualifications. Comply with provisions in ASME B31 Series, Code for Pressure Piping. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

This section includes general minimal requirements and defines quality standards for the following:

- 1) Piping joining materials.
- 2) Transition fittings.
- 3) Dielectric fittings.
- 4) Sleeves.
- 5) Identification devices.
- 6) Grout.
- 7) Flowable fill.
- 8) Piping installation.
- 9) Concrete bases.
- 10) Metal supports and anchorages.

**Pipe Joining Materials:**

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Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, unless otherwise indicated. Full-Face Type: For flat-faced flanges, Class 125, cast-iron and cast-bronze flanges. Narrow-Face Type for raised-face flanges, Class 250, cast-iron and steel flanges. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

Solvent Cements for Joining Plastic Piping:

- 1) ABS Piping: ASTM D 2235.
- 2) CPVC Piping: ASTM F 493.
- 3) PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- 4) PVC to ABS Piping Transition: ASTM D 3138.

Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

**Transition Fittings:**

Same manufacturer and size as, and with pressure rating equal to and with ends compatible with, piping to be joined.



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**Dielectric Fittings:**

Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

**Sleeves:**

Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, plain ends.

Cast-Iron Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

**Identification Devices:**

Equipment Nameplates: Accessible and visible metal permanently fastened to equipment with data engraved or stamped indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.

Stencils: Standard stencils prepared with letter sizes complying with recommendations in ASME A13.1. Minimum letter height is 1-1/4 inches for ducts, and 3/4 inch for access door signs and similar operational instructions. Stencil paint to be exterior, oil-based, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated. Paint may be in pressurized spray-can form.

Pressure-Sensitive Pipe Markers: Manufacturer's standard pre-printed, ASME 13.1 color-coded, pressure-sensitive-vinyl type with permanent adhesive.

Valve Tags: Stamped or engraved polished brass, stainless steel, or aluminum with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener.

Engraved Plastic-Laminate Signs: ASTM D 709, Type I, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine sub-core, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

**Grout:**

ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.

**Flowable Fill:**

Low-strength-concrete, flowable-slurry mix. Cement per ASTM C 150, Type I, Portland with aggregates per ASTM C 33, natural sand, fine and crushed gravel, or stone, coarse. Water, comply with ASTM C 94/C 94M. Strength: 1,200 psi at 28 days.

**Piping and Equipment Installation:**

Install piping and sleeves according to the following requirements and utilities Sections specifying piping systems. Shop Drawings are to indicate exact locations and arrangements of piping systems and are to be used to size pipes and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination Drawings by Engineer of Record and TTUS FP&C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise. Install piping to permit valve servicing. Install piping at indicated slopes. Install piping free of sags and bends. Install fittings for changes in direction and branch connections. Select system components with pressure rating equal to or greater than system operating pressure.

Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before joining pipes and fittings. Join thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Construct welded joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Quality Assurance requirements. Join flanged joints with appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

Make piping connections according to the following, unless otherwise indicated:

- 1) Install unions, in piping NPS 2 inches and smaller, adjacent to each valve and at

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final connection to each piece of equipment.

- 2) Install flanges, in piping NPS 2-1/2 inches and larger, adjacent to flanged valves and at final connection to each piece of equipment.
- 3) Install dielectric fittings at connections of dissimilar metal pipes.

Install equipment level and plumb, unless otherwise indicated. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location. Install equipment to allow right of way to piping systems installed at required slope.

**Concrete Bases:**

Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of base. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded. Install anchor bolts to elevations required for proper attachment to supported equipment. Install anchor bolts according to anchor-bolt manufacturer's written instructions. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section 033000 Cast-in-Place Concrete.

**Metal Supports and Anchorage:**

Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor piped utility materials and equipment. Comply with AWS D1.1/D1.1M for field welding.

**Grouting:**

Mix and install grout for equipment base bearing surfaces, pumps, and other equipment base plates, and anchors. Clean surfaces that will come into contact with grout. Provide forms as

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required for placement of grout. Avoid air entrapment during placement of grout. Place grout, completely filling equipment bases. Place grout on concrete bases and provide smooth bearing surface for equipment. Place grout around anchors. Cure placed grout.

**33 41 00 Storm Utility Drainage Piping**

This Section includes design and construction guidelines for localized stormwater drainage system inclusive of pipe and fittings, non-pressure transition couplings, pressure pipe couplings, expansion joints and deflection fittings, cleanouts, drains, encasement for piping, manholes, channel drainage systems, catch basins, stormwater inlets, stormwater detention structures, and pipe outlets.

Use detectable warning tape over ferrous piping. Use detectable warning tape over nonferrous piping and over edges of underground structures.

Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects. Do not enclose, cover, or put into service before inspection and approval. Test completed piping systems according to requirements of TTUS FP&C. Schedule tests and inspections with at least 72 hours' advance notice. Submit a separate report for each test.

Gravity-Flow Storm Drainage Piping: Test according to requirements of specifications, UNI-B-6, and in accordance with ASTM F 1417 for plastic piping and ASTM C 924 (ASTM C 924M) for concrete piping.

Force-Main Storm Drainage Piping: Perform hydrostatic testing 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. For ductile-iron piping, test according to AWWA C600, "Hydraulic Testing". For PVC piping, test according to AWWA M23, "Testing and Maintenance" Chapter. Leaks and loss in test pressure constitute defects that must be repaired. Replace leaking piping using new materials and repeat testing until leakage is within allowances specified.

Clean interior of piping of dirt and superfluous materials. Flush with water.

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Do not interrupt stormwater drainage service to facilities occupied by Owner or others unless permitted only after arranging to provide temporary service. Notify Owner no fewer than two days in advance of proposed interruption of service. Do not proceed with interruption of service without Owner's permission.

Do not store plastic manholes, pipe, and fittings in direct sunlight. Protect pipe, pipe fittings, and seals from dirt and damage. Handle manholes according to manufacturer's written rigging instructions. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

Cast Iron Pipe and Fittings (hub and spigot): ASTM A 74, Service and Extra-Heavy classes. Gaskets, ASTM C 564, rubber. Caulking Materials, ASTM B 29, pure lead and oakum or hemp fiber. Pipe and Fittings (hub-less): ASTM A 888 or CISPI 301.

Culvert Pipe and Fittings: ASTM A 716, pipe for push-on joints. AWWA C110, ductile or gray iron, fittings for push-on joints and AWWA C153, for compact push-on joints. AWWA C111, rubber for gaskets.

Steel Pipe and Fittings: ASTM A 760/A 760M, Type I with fittings of similar form and construction as pipe.

Acrylonitrile Butadiene Styrene (ABS) Pipe and Fittings: ASTM D 2751, with bell-and-spigot ends for gasketed joints. For nominal pipe size 3" - 6" use SDR 35. For nominal pipe size 8" - 12" use SDR 42. Gaskets, ASTM F 477, elastomeric seals.

Polyethylene (PE) Pipe and Fittings: For nominal pipe size 3" – 10", AASHTO M 252M, Type S, with smooth waterway for coupling joints. Sleeve with ASTM D 1056 Type 2, Class A, Grade 2 gasket material that mates with tube and fittings or AASHTO M 252M (corrugated) matching pipe and fittings. For nominal pipe size 12" – 60", AASHTO M 294M, Type S, with smooth waterway for coupling joints. Sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings or AASHTO M 294M, corrugated, matching pipe and fittings.

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Polyvinyl Chloride (PVC) Pipe and Fittings: Cellular Core, ASTM F 891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints. Fittings in compliance with ASTM D 3034, SDR 35, PVC socket-type fittings.

Profile Series Sewer Pipe: ASTM F 794, PVC profile, gravity sewer pipe with bell-and-spigot ends for gasketed joints. Fittings, ASTM D 3034, PVC with bell ends. Gaskets, ASTM F 477, elastomeric seals.

Gravity Sewer Piping: ASTM F 679, Schedule 40 wall thickness, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.

Pressure Piping: AWWA C900, PVC pipe with bell-and-spigot ends for gasketed joints. Fittings, AWWA C900, PVC pipe with bell ends. Gaskets, ASTM F 477, elastomeric seals.

Concrete Pipe and Fittings: Reinforced-Concrete Sewer Pipe and Fittings, ASTM C 76 (ASTM C 76M). Tongue-and-groove ends and gasketed joints with ASTM C 443 (ASTM C 443M), rubber gaskets, with ASTM C 990 (ASTM C 990M), bitumen or butyl-rubber sealant.

Manholes: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints; 48 inches minimum unless otherwise indicated. Base section 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor. Riser sections, 4-inch minimum thickness, and lengths to provide depth indicated. Top section, eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings. Joint Sealant, ASTM C 990 (ASTM C 990M), bitumen or butyl rubber. Grade rings, reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

Catch Basins: Polymer-concrete body, with outlets in quantities and sizes indicated. Gray-iron slotted grate. Frame, Include gray-iron or steel frame for grate.

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Oil Interceptors: Polymer-concrete body with interior baffle and four steel support channels and two 1/4-inch- thick, steel-plate covers. Steel-plate covers, capacity as specified.

Sediment Interceptors: Polymer-concrete body, with outlets in quantities and sizes indicated, square, gray-iron frame, and slotted grate.

Stormwater Inlets: Concrete curb, gutter, and combination inlets with heavy duty galvanized steel frames and cast-iron grates.

Pipe Outlets: Head Walls, cast-in-place reinforced concrete, with apron and tapered sides with riprap basins, broken, irregularly sized and shaped, graded filter stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."

### **33 46 00 Subdrainage**

This Section includes design and construction guidelines for perforated-wall pipe and fittings, drainage conduits, drainage panels, and geotextile filter fabrics.

All perforated polyethylene (PE) pipe is required to conform to the following requirements:

Nominal pipe 6 inches and smaller: ASTM F 405 or AASHTO M 252, Type CP; corrugated, for coupled joints.

Nominal pipe 8 inches and larger: ASTM F 667; AASHTO M 252, Type CP; or AASHTO M 294, Type CP; corrugated; for coupled joints.

Perforated PVC Sewer Pipe and Fittings: ASTM D 2729, bell-and-spigot ends, for loose joints.

Molded-Sheet Drainage Conduits: Prefabricated geocomposite with cusped, molded-plastic drainage core wrapped in geotextile filter fabric. Filter Fabric nonwoven, needle-punched geotextile. Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. when tested according to ASTM D 4491.

Waterproofing felts in compliance with ASTM D 226, Type I, asphalt or ASTM D 227, coal-tar-

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saturated organic felt.

If subdrainage is required for landscaping, locate and mark existing utilities, underground structures, and aboveground obstructions before beginning installation and avoid disruption and damage of services. Verify that drainage panels installed as part of foundation wall waterproofing is properly positioned to drain into subdrainage system. Proceed with installation only after unsatisfactory conditions have been corrected.

Install PE warning tape or detectable warning tape over ferrous piping. Install detectable warning tape over nonferrous piping and over edges of underground structures.

Tests and Inspections: After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling. Remove obstructions, replace damaged components, and repeat the test until results are satisfactory. Drain piping will be considered defective if it does not pass tests and inspections. Prepare test and inspection reports.

**33 63 13 Underground Steam and Condensate Distribution Piping**

To be developed.