
USACE / NAVFAC / AFCEC UFGS-33 30 00 (May 2018)

Preparing Activity: USACE

Superseding
UFGS-33 30 00 (April 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated April 2025

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DIVISION 33 - UTILITIES

SECTION 33 30 00

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SECTION 33 30 00

SANITARY SEWERAGE
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NOTE: This guide specification covers the requirements for piping and appurtenant structures for an exterior sanitary sewer system.

Adhere to [UFC 1-300-02](#) Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a [Criteria Change Request \(CCR\)](#).

For corrosive soils select materials, coatings or cathodic protection systems in accordance with UFC 3-230-01. When cathodic protection is used include Section [26 42 13](#) GALVANIC (SACRIFICIAL) ANODE CATHODIC PROTECTION (GACP) SYSTEM.

NOTE: For Army and Air Force, impress current cathodic protection (ICCP) may be used. When ICCP is used include Section [26 42 17](#) IMPRESSED CURRENT CATHODIC PROTECTION (ICCP) SYSTEM.

PART 1 GENERAL

NOTE: In areas where problems with root penetration

are anticipated, specify pipe which has the kind of joint which will successfully resist root penetration. Generally speaking, the more watertight the joint, the greater the resistance to root penetration will be. Rubber-gasketed and compression-type joints are considered to give the best performance for this application.

When using plastic pipe in areas with contaminated soil or groundwater, consult with the manufacturer regarding permeation of pipe walls. When pipe is installed in contaminated soil or groundwater consult with the manufacturer regarding selection of appropriate gasket material based on type and concentration of contaminants and refer to AWWA C605.

Plastic pipe is subject to temperature limitations which must be observed.

Use caution if considering concrete pipe for septic flows. Depending on septicity, these pipes may not be satisfactory.

Give special attention in the design stage of project to plastic pipe materials, particularly with respect to superimposed external loads which could cause excessive deflection of the pipe. The degree of sidefill compaction should be considered realistically, particularly in marginal cases.

Where different classes, strengths, etc., of pipe are required for different sections of long pipelines due to significant differences in external loading, expand or modify the applicable paragraphs of this specification accordingly. Show the limits for each class, strength, etc., either on the project drawings or appropriately describe them in the applicable paragraph of the project specification.

Pipe joints: When more than one type of joint is applicable for the specified piping, permit each as a Contractor's option except where watertight joints are necessary or in areas where root penetration problems are anticipated. In these cases, rubber-gasketed or compression-type, or solvent-cemented joints are preferred. Use fuel resistant joint gaskets when required.

It may be necessary to modify chemical requirements for cement under certain conditions. Sulfate resistance is required for concrete pipe when pipe is carrying sulfate-bearing waters, or when pipe is buried in soil containing sulfates. Specify Type II (moderate sulfate resisting) cement when water-soluble sulfates (as S04) in the soil are in the range of 0.1 to 0.2 percent and, for water, are in the range of 150 to 1000 parts per million. Specify Type V (sulfate resisting) cement when soils

contain in excess of 0.2 percent water-soluble sulfate and water samples contain in excess of 1000 parts per million. In areas where reactive aggregates are known to occur, specify low alkali cement.

1.1 REFERENCES

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

ACPA 01-102	(2000) Concrete Pipe Handbook
ACPA 01-103	(2000) Concrete Pipe Installation Manual

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA Eng Man	(2023) Manual for Railway Engineering
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AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2022) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105/A21.5	(2018) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C111/A21.11	(2023) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C600	(2023) Installation of Ductile-Iron Mains and Their Appurtenances

ASTM INTERNATIONAL (ASTM)

ASTM A48/A48M	(2022) Standard Specification for Gray Iron Castings
ASTM A123/A123M	(2024) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A536	(2024) Standard Specification for Ductile Iron Castings
ASTM A746	(2018; R 2022) Standard Specification for Ductile Iron Gravity Sewer Pipe
ASTM C12	(2024) Standard Practice for Installing Vitrified Clay Pipe Lines
ASTM C14M	(2020; R 2025) Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe (Metric)
ASTM C76M	(2022a) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C94/C94M	(2025) Standard Specification for Ready-Mixed Concrete
ASTM C150/C150M	(2024) Standard Specification for Portland Cement
ASTM C260/C260M	(2024) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C270	(2025) Standard Specification for Mortar for Unit Masonry
ASTM C443M	(2021) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric)
ASTM C478	(2018) Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
ASTM C478M	(2018) Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric)
ASTM C828	(2023) Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C923M	(2008b; R 2013) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals (Metric)

ASTM C969M	(2019) Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric)
ASTM C972	(2024) Standard Test Method for Compression-Recovery of Tape Sealant
ASTM C990M	(2009; R 2019) Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants (Metric)
ASTM C1214M	(2013) Standard Test Method for Concrete Pipe Sewerlines by Negative Air Pressure (Vacuum) Test Method (Metric)
ASTM C1244M	(2020) Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill (Metric)
ASTM D412	(2016; R 2021) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D624	(2000; R 2020) Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D2321	(2020) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2412	(2021) Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D3034	(2016) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3212	(2020) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3753	(2019) Glass-Fiber-Reinforced Polyester Manholes and Wetwells
ASTM F477	(2014; R 2021) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F667/F667M	(2016; R 2021) Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings
ASTM F794	(2021) Standard Specification for

Poly(Vinyl Chloride) (PVC) Profile Gravity
Sewer Pipe and Fittings Based on
Controlled Inside Diameter

ASTM F949

(2025) Standard Specification for
Poly(Vinyl Chloride) (PVC) Corrugated
Sewer Pipe with a Smooth Interior and
Fittings

ASTM F1417

(2025) Standard Practice for Installation
Acceptance of Plastic Non-pressure Sewer
Lines Using Low-Pressure Air

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS
(IAPMO)

IAPMO Z1000

(2013) Prefabricated Septic Tanks

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6

(1998) Recommended Practice for
Low-Pressure Air Testing of Installed
Sewer Pipe

KOREAN INDUSTRIAL STANDARDS (KS)

KS D 4308

(2022) Ductile Iron Fittings

KS D 4311

(2015; R 2020) Ductile Iron Pipes

KS D 4316

(2012; R 2022) Mortar Lining of Ductile
Iron Pipes & Fittings

KS F 2560

(2019; R 2024) Chemical Admixtures for
Concrete

KS F 4009

(2024) Ready-Mixed Concrete

KS F 4403

(2019; R 2024) Reinforced Spun Concrete
Pipes

KS L 5201

(2021) Portland Cement

KS L 5219

(2024) Masonry Cement

KS M 3404

(2021) Unplasticized Poly(Vinyl
Chloride)(PVC-U) Pipes for General Service

KS M 3410

(2021) Unplasticized Poly(Vinyl
Chloride)(PVC-U) Pipe Fittings for Drain

KS M 6613

(2022) Rubber Goods for Water Works Service

KS M ISO 34-1

(2020) Rubber, Vulcanized of Thermoplastic
- Determination of Tear Strength - Part 1 :
Trouser, Angle and Crescent Test Pieces

KS M ISO 37

(2022) Rubber, Vulcanized or Thermoplastic
- Determination of Tensile Stress-Strain

Properties

1.2 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy and Air Force projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy and Air Force projects, or choose the second bracketed item for Army projects.

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Contractor's License; G

SD-02 Shop Drawings

Installation Drawings; G

SD-03 Product Data

Precast Concrete Manholes

Frames, Covers, and Gratings

Gravity Pipe

PVC Gravity Pipe and Fittings; G

Precast Concrete Septic Tanks; G

SD-06 Test Reports

Precast Concrete Sewer Manhole Test; G

Infiltration Tests And Exfiltration Tests; G

Negative Air Pressure Test; G

Low-Pressure Air Tests; G

Deflection Testing

Concrete Pipe Test; G

SD-07 Certificates

Portland Cement

Gaskets

1.3 QUALITY CONTROL

1.3.1 Installer Qualifications

Install specified materials by a licensed underground utility Contractor licensed for such work in the state where the work is to be performed. Verify installing [Contractor's License](#) is current and state certified or state registered.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.4.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.4.1.2 Cement, Aggregate, and Reinforcement

NOTE: Delete this paragraphs if cast-in-place

concrete is not used.

Select 03 30 00 for projects with large amounts of
cast-in-place concrete work.

Select 03 30 53 for projects with small amounts of
cast-in-place concrete work.

For Army, Use 03 30 00.

As specified in Section [03 30 00 CAST-IN-PLACE CONCRETE][03 30 53
MISCELLANEOUS CAST-IN-PLACE CONCRETE].

1.4.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Take special care not to damage linings of pipe and fittings; if lining is damaged, make satisfactory repairs. Carry, do not drag, pipe to trench. Store solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe in accordance with the manufacturer's recommendation and discard those materials if the storage period exceeds the recommended shelf life. Discard solvents in use when the recommended pot life is exceeded.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Sanitary Sewer Gravity Pipeline

Provide [mains and laterals] of [concrete pipe] [ductile-iron pipe] [polypropylene pipe] [or] [polyvinyl chloride (PVC) plastic pipe]. Provide building connections of [concrete pipe] [or] [polyvinyl chloride (PVC) plastic pipe]. Provide new and modify existing exterior sanitary gravity sewer piping and appurtenances. Provide each system complete and ready for operation. The exterior sanitary gravity sewer system includes equipment, materials, installation, and workmanship as specified herein more than 1.5 m outside of building walls.

2.2 MATERIALS

NOTE: Show the following information on the project drawings:

Location of all new pipelines, diameter of pipe, fittings and appurtenances including but not limited to valves, fire hydrants, yard hydrants, thrust blocks, restrained joints and details where necessary;

Location, size, and type of service of existing connecting, intersecting, or adjacent pipelines and other utilities;

Paved areas and railroads which pass over new

pipelines;

Profile, where necessary to show unusual conditions

Invert elevations at beginning and end of pipelines
and at manholes or similar structures;

Where different materials are required, show the
material, class or thickness of pipe and limits
where class or thickness must be different for
different sections of pipeline;

Details for manholes, septic tank(s), and sewage
absorption trench;

Bedding conditions, where different from those
specified in the appropriate specification ;

Location and size of thrust blocks on pressure lines

Location of flanged joints on pressure sewers;

Location of mechanical joints on ductile-iron piping
(when used on only part of the system).

Provide materials conforming to the respective specifications and other
requirements specified below. Submit manufacturer's product
specification, standard drawings or catalog cuts.

2.2.1 Gravity Pipe

2.2.1.1 Concrete Gravity Sewer Piping

2.2.1.1.1 Concrete Gravity Pipe and Fittings

NOTE: The D-load (load per linear meter of
diameter) must be calculated on the basis of project
conditions to determine the applicable Class or
strength of pipe. The Concrete Pipe Design Manual
(2011 edition) of the American Concrete Pipe
Association contains design information and methods
by which the applicable Class or strength of pipe
can be determined when depth of trench is known.

It may be necessary to modify chemical requirements
for cement under certain conditions. Sulfate
resistance is required for concrete pipe when pipe
is carrying sulfate-bearing waters, or when pipe is
buried in soil containing sulfates. Specify Type II
(moderate sulfate resisting) cement when
water-soluble sulfates (as SO₄) in the soil are in
the range of 0.1 to 0.2 percent and, for water, are
in the range of 150 to 1000 parts per million.
Specify Type V (sulfate resisting) cement when soils
contain in excess of 0.2 percent water-soluble
sulfate and water samples contain in excess of 1000
parts per million. In areas where reactive

aggregates are known to occur, specify low alkali cement.

Delete requirement for tongue-and-groove pipe (concrete pipe) when not allowed for the project.

Provide [nonreinforced concrete pipe conforming to ASTM C14M, Class 1 or 2][reinforced concrete pipe conforming to ASTM C76M or KS F 4403]. Provide circular pipe with elliptical reinforcement having a readily visible line at least 300 mm long painted or otherwise applied on the inside and outside of the pipe at each end so that when the pipe is laid in the proper position, the line will be at the center of the top of the pipe. Provide fittings and specials conforming to the applicable requirements specified for the pipe including the strength of the pipe. Use pipe and fittings containing Type II or Type V low alkali cement cement conforming to ASTM C150/C150M or KS L 5201.

2.2.1.1.2 Jointing Materials for Concrete Gravity Piping

Provide gaskets and pipe ends for rubber gasket joint conforming to ASTM C443M. Use gaskets suitable for use with sewage.

Submit certificates of compliance stating that the fittings or gaskets used for waste drains or lines designated on the plans.

2.2.1.2 Ductile Iron Gravity Sewer Pipe and Associated Fittings

2.2.1.2.1 Ductile Iron Gravity Pipe and Fittings

NOTE: ASTM A746 also contains design information and methods by which the required Thickness Class of Pipe can be determined when depth of trench is known.

Delete requirements for and references to push-on joints for ductile-iron gravity sewer pipe and associated fittings when the greater deflection afforded by the mechanical joint is considered necessary throughout.

Provide ductile iron pipe conforming to ASTM A746 or KS D 4311 with cement-mortar lining in conforming to AWWA C104/A21.4 or KS D 4316, standard thickness. Provide push-on joints conforming to AWWA C111/A21.11 or KS D 4308.

2.2.1.3 PVC Gravity Sewer Piping

2.2.1.3.1 PVC Gravity Pipe and Fittings

ASTM D3034, SDR 35, ASTM F949, KS M 3404, or KS M 3410, with ends suitable for elastomeric gasket joints. ASTM F794, Series 46, for ribbed sewer pipe with smooth interior, size 200 mm through 1200 mm diameters.

2.2.1.3.2 PVC Gravity Joints and Jointing Material

Provide joints conforming to ASTM D3212. Gaskets are to conform to ASTM F477.

2.2.2 Piping Beneath Railroad Right-of-Way

Where pipeline passes under the right-of-way of a commercial railroad, piping is to conform to the specifications for pipelines conveying nonflammable substances in AREMA Eng Man, except as otherwise specified in this paragraph. For casing pipe provide ductile-iron pipe in lieu of cast-iron soil pipe. Ductile-iron pipe is to conform to and have strength computed in accordance with ASTM A746 or KS D 4311.

2.2.3 Cement Mortar

Provide cement mortar conforming to ASTM C270, Type M with Type II cement, or KS L 5219, Type II.

2.2.4 Portland Cement

NOTE: Type II cement normally will be specified, but Type V cement will be specified when the soils contain in excess of 0.2 percent water-soluble sulfate as SO(4), or the waste water contains in excess of 1000 parts per million sulfates. Type I cement may be permitted when it can be assured that the water soluble sulfates in the soil will be less than 0.1 percent and the waste water will contain less than 150 parts per million sulfates over the design life of the project.

Submit certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings, septic tanks, and precast manholes. Provide portland cement conforming to ASTM C150/C150M or KS L 5201, Type II or V for concrete used in concrete pipe, concrete pipe fittings, septic tanks, and manholes and type optional for cement used in concrete cradle, concrete encasement, and thrust blocking. Use air-entraining admixture conforming to ASTM C260/C260M or KS F 2560 with Type V cement.

2.2.5 Portland Cement Concrete

NOTE: When ready-mix concrete conforming to ASTM C94/C94M is not economically available, rewrite this paragraph to permit use of concrete mixed onsite. Specify concrete aggregates conforming to ASTM C33/C33M and concrete consisting of 1 part portland cement, 2-1/2 parts sand, and 5 parts gravel, with just enough water for workable consistency

Provide portland cement concrete conforming to ASTM C94/C94M or KS F 4009, compressive strength of 27 MPa at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement is to have a compressive strength of 17 MPa minimum at 28 days. Protect concrete in place from freezing and moisture loss for 7 days.

2.2.6 Precast Concrete Manholes

Provide precast concrete manholes, risers, base sections, and tops conforming to ASTM C478M; base and first riser are to be monolithic.

2.2.7 Glass-Fiber-Reinforced Polyester Manholes

Glass-Fiber-Reinforced Polyester Manholes are to conform to ASTM D3753.

2.2.8 Gaskets and Connectors

Provide gaskets for joints between manhole sections conforming to ASTM C443M or KS M 6613. Resilient connectors for making joints between manhole and pipes entering manhole are to conform to ASTM C923M or ASTM C990M.

2.2.9 External Preformed Rubber Joint Seals

An external preformed rubber joint seal is an accepted method of sealing cast iron covers to precast concrete sections to prevent ground water infiltration into sewer systems. All finished and sealed manholes constructed in accordance with paragraph entitled "Manhole Construction" are to be tested for leakage in the same manner as pipelines as described in paragraph entitled "Leakage Tests." The seal is to be multi-section with a neoprene rubber top section and all lower sections made of Ethylene Propylene Diene Monomer (EPDM) rubber with a minimum thickness of 1.5 mm. Each unit is to consist of a top and bottom section and have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic is to be a non-hardening butyl rubber sealant and seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections are to cover up to two more adjusting rings. Properties and values are listed in the following table:

Properties, Test Methods and Minimum Values for Rubber used in Preformed Joint Seals				
Physical Properties	Test Methods	EPDM	Neoprene	Butyl Mastic
Tensile, kPa	ASTM D412 or KS M ISO 37	12,684	15,132	--
Elongation, percent	ASTM D412 or KS M ISO 37	553	295	350
Tear Resistance, N/mm	ASTM D624 (Die B) or KS M ISO 34-1	49	29	--
Rebound, percent, 5 minutes	ASTM C972 (mod.)	--	--	11
Rebound, percent, 2 hours	ASTM C972	--	--	12

2.2.10 Precast Concrete Septic Tanks

Provide precast concrete septic tanks risers, base sections, and tops conforming to ASTM C478M; base and first riser are to be monolithic.

2.2.11 Glass-Fiber-Reinforced Polyester Septic Tanks

Glass-Fiber-Reinforced Polyester Septic Tanks are to conform to [IAPMO Z1000](#).

2.2.12 Septic Tank Piping

PVC pipe and fittings.

2.2.13 Siphon for Septic Tank

PVC or Polyethylene, of an approved standard design, and prompt and positive in action.

2.2.14 Sewage Absorption Field Materials

Pipe is to be perforated corrugated polyethylene tubing conforming to [ASTM F667/F667M](#).

2.2.15 [Frames, Covers, and Gratings](#) for Manholes

Frame and cover are to be cast gray iron, [ASTM A48/A48M](#), Class 35B, cast ductile iron, [ASTM A536](#), Grade 65-45-12, or reinforced concrete, [ASTM C478](#) [ASTM C478M](#). Frames and covers are to be circular without vent holes. Size are to be as indicated on the plans. Stamp or cast the words "Sanitary Sewer" into covers so that it is plainly visible.

2.2.16 Manhole Ladders

Provide a steel ladder where the depth of a manhole exceeds 1.2 m. The ladder is not to be less than 406 mm in width, with 19 mm diameter rungs spaced 305 mm apart. The two stringers are to be a minimum 10 mm thick and 51 mm wide. Galvanize ladders and inserts after fabrication in conformance with [ASTM A123/A123M](#).

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Installation Drawings

Submit [Installation Drawings](#) showing complete detail, both plan and side view details with proper layout and elevations.

3.2 INSTALLATION

Backfill after inspection by the Contracting Officer. Before, during, and after installation, protect plastic pipe and fittings from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Contracting Officer.

3.2.1 Connections to Existing Lines

NOTE: For Navy, Use BMS B-5.2.19 to determine Installation requirements for connecting to existing sanitary sewer lines and incorporate into this paragraph. In accordance with BMS B-5.2.19 a Utility

Connection Permit must be submitted during design.

Obtain approval from the Contracting Officer before making connection to existing line. Conduct work so that there is minimum interruption of service on existing line.

3.2.2 General Requirements for Installation of Pipelines

These general requirements apply except where specific exception is made in the following paragraphs entitled "Special Requirements."

3.2.2.1 Location

NOTE: Horizontal and vertical separation distances must be in accordance with the Recommended Standards for Wastewater Facilities, State or local requirements.

Terminate the work covered by this section at a point approximately 1.5 m from the building, unless otherwise indicated.

3.2.2.1.1 Sanitary Piping Installation Parallel with Water Line

3.2.2.1.1.1 Normal Conditions

Install sanitary piping or manholes at least 3 m horizontally from a water line whenever possible. Measure the distance from edge-to-edge.

3.2.2.1.1.2 Unusual Conditions

When local conditions prevent a horizontal separation of 3 m, the sanitary piping or manhole may be laid closer to a water line provided that:

- a. The top (crown) of the sanitary piping is to be at least 450 mm below the bottom (invert) of the water main.
- b. Where this vertical separation cannot be obtained, construct the sanitary piping with AWWA-approved water pipe pressure and conduct a hydrostatic sewer test without leakage prior to backfilling.
- c. The sewer manhole is to be of watertight construction and tested in place.

3.2.2.1.2 Installation of Sanitary Piping Crossing a Water Line

3.2.2.1.2.1 Normal Conditions

Lay sanitary sewer piping by crossing under water lines to provide a separation of at least 450 mm between the top of the sanitary piping and the bottom of the water line whenever possible.

3.2.2.1.2.2 Unusual Conditions

When local conditions prevent a vertical separation described above, use the following construction:

- a. Construct sanitary piping passing over or under water lines with AWWA-approved ductile pressure piping and conduct a hydrostatic sewer test without leakage prior to backfilling.
- b. Protect sanitary piping passing over water lines by providing:
 - (1) A vertical separation of at least 450 mm between the bottom of the sanitary piping and the top of the water line.
 - (2) Adequate structural support for the sanitary piping to prevent excessive deflection of the joints and the settling on and breaking of the water line.
 - (3) That the length, minimum 6.1 m, of the sanitary piping be centered at the point of the crossing so that joints are equidistant and as far as possible from the water line.

3.2.2.1.3 Sanitary Sewer Manholes

No water piping must pass through or come in contact with any part of a sanitary sewer manhole.

3.2.2.2 Earthwork

NOTE: Earthwork requirements, including bedding,
for pipe trenches and utility structures are covered
in Section 31 00 00 EARTHWORK.

NOTE: For Navy, earthwork requirements or pipe
trenches, including bedding, are covered in Section
31 00 00 EARTHWORK. The applicable requirements
which are set forth in Section 31 00 00 EARTHWORK
must be incorporated into the project
specification. The specifier should verify the
current appropriate specification and revise as
necessary.

Perform earthwork operations in accordance with Section 31 00 00 EARTHWORK.

3.2.2.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Lay nonpressure pipe with the bell or groove ends in the upgrade direction. Adjust spigots in bells to give a uniform space all around. Blocking or wedging between bells and spigots will not be permitted. Replace by one of the proper dimensions, pipe or fittings that do not allow sufficient space for installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 7.50 m apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose. Construct branch connections by use of regular fittings or solvent cemented saddles as approved. Provide saddles for PVC pipe conforming to Table 4 of ASTM D3034.

3.2.3 Special Requirements

3.2.3.1 Installation of Clay Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of **ASTM C12** for pipe laying. Make joints with a compression joint material specified for clay pipe joints and assemble in accordance with the recommendations of the manufacturer of the pipe.

3.2.3.2 Installation of Concrete Gravity Sewer Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the provisions for rubber gasket jointing and jointing procedures of **ACPA 01-103** or of **ACPA 01-102**, Chapter 9, "Installation, Inspection and Construction Testing." Make joints with the gaskets specified for concrete gravity sewer pipe joints. Clean and dry surfaces receiving lubricants, cements, or adhesives. Affix gaskets to pipe not more than 24 hours prior to the installation of the pipe. Protect gaskets from sun, blowing dust, and other deleterious agents at all times. Before installation of the pipe, inspect gaskets and remove and replace loose or improperly affixed gaskets. Align each pipe section with the previously installed pipe section, and pull the joint together. If, while pulling the joint, the gasket becomes loose and can be seen through the exterior joint recess when the pipe is pulled up to within **25 mm** of closure, remove the pipe and remake the joint.

3.2.3.3 Installation of Ductile Iron Gravity Sewer Pipe

Unless otherwise specified, install pipe and associated fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of **AWWA C600** for pipe installation and joint assembly.

NOTE: At the text below, delete requirements for and references to push-on joints for ductile-iron gravity sewer pipe and associated fittings when the greater deflection afforded by the mechanical joint is considered necessary throughout.

- a. Make push-on joints with the gaskets and lubricant specified for this type joint and assemble in accordance with the applicable requirements of **AWWA C600** for joint assembly. Make mechanical-joints with the gaskets, glands, bolts, and nuts specified for this type joint and assemble in accordance with the applicable requirements of **AWWA C600** for joint assembly and the recommendations of Appendix A to **AWWA C111/A21.11** or **KS D 4308**.

NOTE: At the text below, delete the paragraph except when required. See AWWA C105/A21.5 for guidance on selecting Class of polyethylene film.

- b. Exterior protection: Completely encase buried ductile iron pipelines

with polyethylene tube or sheet in accordance with [AWWA C105/A21.5](#), using Class A or Class C polyethylene film.

3.2.3.4 Installation of PVC Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of [ASTM D2321](#) for laying and joining pipe and fittings. Make joints with the gaskets specified for joints with this piping and assemble in accordance with the requirements of [ASTM D2321](#) for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.2.3.5 Installation of Dual Wall and Triple Wall Polypropylene

Install pipe in accordance with "General Requirements for installation of Pipelines" of this section, with the polypropylene pipe manufacturer's recommendations, and with the requirements of [ASTM D2321](#) for laying and joining pipe and fittings. Place a minimum of 150 mm of Class 1 or Class 2 backfill over the crown of the pipe with minimum 90 percent compaction.

3.2.3.6 Pipeline Installation Beneath Railroad Right-of-Way

Where pipeline passes under the right-of-way of a commercial railroad, install piping in accordance with the specifications for pipelines conveying nonflammable substances in [AREMA Eng Man](#).

3.2.4 Concrete Work

NOTE: Delete this paragraphs if cast-in-place concrete is not used.

Select 03 30 00 for projects with large amounts of cast-in-place concrete work.

Select 03 30 53 for projects with small amounts of cast-in-place concrete work.

For Army, Use 03 30 00.

Cast-in-place concrete is included in Section [03 30 00 CAST-IN-PLACE CONCRETE][03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE]. Support the pipe on a concrete cradle, or encased in concrete where indicated or directed.

3.2.5 Manhole Construction

Construct base slab of cast-in-place concrete or use precast concrete base sections. Make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent sewer sections. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab. No parging will be permitted on interior manhole walls. For precast concrete construction, make joints between manhole sections with the gaskets specified for this

purpose; install in the manner specified for installing joints in concrete piping. Parging will not be required for precast concrete manholes. Perform cast-in-place concrete work in accordance with the requirements specified under paragraph entitled "Concrete Work" of this section. Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer. Where a new manhole is constructed on an existing line, remove existing pipe as necessary to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Use resilient connectors as previously specified for pipe connectors to concrete manholes.

3.2.6 Miscellaneous Construction and Installation

3.2.6.1 Connecting to Existing Manholes

Connect pipe to existing manholes such that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. Center the connection on the manhole. Holes for the new pipe are to be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cut the manhole in a manner that will cause the least damage to the walls.

3.2.6.2 Metal Work

3.2.6.2.1 Workmanship and Finish

Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide necessary rabbets, lugs, and brackets wherever necessary for fitting and support.

3.2.6.2.2 Field Painting

After installation, clean cast-iron frames, covers, gratings, and steps not buried in concrete to bare metal, remove mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

3.2.7 Sewage Absorption Trench Construction

Grade trenches uniformly with no slope. Lay perforated pipe with the perforations downward. Comply with the chamber manufacturer's instructions.

3.2.8 Installations of Wye Branches

Install wye branches in an existing sewer using a method which does not damage the integrity of the existing sewer. Do not cut into piping for connections except when approved by the Contracting Officer. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, support on a concrete cradle as directed by the Contracting Officer. Provide and install concrete required because of

conditions resulting from faulty construction methods or negligence without any additional cost to the Government. Do not damage the existing sewer when installing wye branches in an existing sewer.

3.3 FIELD QUALITY CONTROL

The Contracting Officer will conduct field inspections and witness field tests specified in this section. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

3.3.1 Tests

NOTE: Select the tests that are applicable to the work being performed and the desired testing standard. Delete the testing paragraphs that are not required or not applicable to the type of work being performed.

Perform field tests and provide labor, equipment, and incidentals required for testing.

3.3.1.1 Leakage Tests for Nonpressure Lines

Test lines for leakage by either infiltration tests and exfiltration tests, negative air pressure tests or by low-pressure air tests. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

3.3.1.1.1 Infiltration Tests and Exfiltration Tests

3.3.1.1.1.1 Precast Concrete Pipe Sewer Lines

Test leakage of precast concrete pipe in accordance with [ASTM C969M](#). The allowable leakage limit is located in [ASTM C969M](#). Make calculations in accordance with the Appendix to [ASTM C969M](#).

3.3.1.1.2 Negative Air Pressure Test

3.3.1.1.2.1 Concrete Pipe

NOTE: This test method covers testing of 4 to 36-in. diameter circular concrete pipe sewerlines utilizing gasketed joints.

Test [concrete pipe test](#) in accordance with [ASTM C1214M](#). The allowable vacuum loss is located in [ASTM C1214M](#). Make calculations in accordance with the Appendix to [ASTM C1214M](#).

3.3.1.1.2.2 Precast Concrete Manholes

NOTE: This test method is used for testing concrete manhole sections utilizing mortar, mastic, or gasketed joints.

This test method is intended to be used as a preliminary test to enable the installer to demonstrate the condition of the concrete manholes prior to backfill.

Misuse of the test criteria in ASTM C1244 or ASTM C1244M may cause permanent damage to the system being tested.

Test [precast concrete sewer manhole test](#) in accordance with [ASTM C1244M](#). The allowable vacuum drop is located in [ASTM C1244M](#) Make calculations in accordance with the Appendix to [ASTM C1244M](#).

3.3.1.1.3 Low-Pressure Air Tests

3.3.1.1.3.1 Clay Pipelines

Test clay pipe in accordance with [ASTM C828](#). The allowable pressure drop is located in [ASTM C828](#). Make calculations in accordance with the Appendix to [ASTM C828](#).

3.3.1.1.3.2 PVC Pipelines

Test PVC pipe in accordance with [UBPPA UNI-B-6](#). The allowable pressure drop is located in [UBPPA UNI-B-6](#). Make calculations in accordance with the Appendix to [UBPPA UNI-B-6](#).

3.3.1.1.3.3 Dual Wall and Triple Wall Polypropylene

Test polypropylene pipe in accordance with [ASTM F1417](#) or [UBPPA UNI-B-6](#). The allowable pressure drop is located in [ASTM F1417](#) or [UBPPA UNI-B-6](#) depending on the chosen test procedure. Make calculations in accordance with the Appendix to [ASTM F1417](#) or [UBPPA UNI-B-6](#) depending on the chosen test procedure.

3.3.1.2 Deflection Testing

NOTE: Specify deflection testing only when warranted by scope or size of project.

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads determined in accordance with [ASTM D2412](#). Deflection of pipe in the installed pipeline under external loads is not to exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.

3.3.1.2.1 Pull-Through Device

This device is to be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Space circular sections on the shaft so that the distance from external faces of front and back sections will equal or exceed the diameter of the circular section. Pull-through device may also be of a design promulgated by the Uni-Bell Plastic Pipe Association, provided the device meets the applicable requirements specified in this paragraph, including those for diameter of the device, and that the mandrel has a minimum of 9 arms. Ball, cylinder, or circular sections are to conform to the following:

- a. A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.
- b. Homogeneous material throughout, is to have a density greater than 1.0 as related to water at 4 degrees C, and a surface Brinell hardness of not less than 150.
- c. Center bored and through-bolted with a 6 mm minimum diameter steel shaft having a yield strength of not less than 483 MPa, with eyes or loops at each end for attaching pulling cables.
- d. Suitably Back each eye or loop with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

3.3.1.2.2 Deflection Measuring Device

Sensitive to 1.0 percent of the diameter of the pipe being tested and be accurate to 1.0 percent of the indicated dimension. Prior approval is required for the deflection measuring device.

3.3.1.2.3 Pull-Through Device Procedure

Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions.

3.3.1.2.4 Deflection measuring device procedure

Measure deflections through each run of installed pipe. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, replace pipe which has excessive deflection and completely retest in same manner and under same conditions.

3.3.2 Field Tests for Cast-In-Place Concrete

NOTE: Delete this paragraphs if cast-in-place concrete is not used.

Select 03 30 00 for projects with large amounts of cast-in-place concrete work.

Select 03 30 53 for projects with small amounts of
cast-in-place concrete work.

For Army, Use 03 30 00.

Field testing requirements are covered in Section [03 30 00 CAST-IN-PLACE
CONCRETE][03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE]

3.3.3 Inspection

Check each straight run of pipeline for gross deficiencies by holding a
light in a manhole; the light must show a practically full circle of light
through the pipeline when viewed from the adjoining end of line.

-- End of Section --