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USACE / NAVFAC / AFCESA / NASA | **NASA-02531S (December 2005)**

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Superseding
UFGS-02531 (July 2003)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are NOT in agreement with UMRL
References will be in agreement at next scheduled update of UMRL
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SECTION TABLE OF CONTENTS

DIVISION 02 - SITE CONSTRUCTION

SECTION 02531S

SANITARY SEWERS

12/05

-- End of Section Table of Contents --

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SECTION 02531S

SANITARY SEWERS
12/05

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

Comments and suggestion on this specification are welcome and should be directed to the technical proponent of the specification. A listing of the technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.
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NOTE: On the project drawings, show:

1. Plan and location of new pipelines, including type of service and size of pipe

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

3. Paved areas and railroads which pass over new pipelines

4. Profile, where necessary to show unusual conditions

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

6. Class or strength of pipe and limits for same where class or strength will be different for different sections of pipeline

7. Design details for pertinent manholes, septic tank(s), and sewage absorption trench

8. Bedding conditions, where different from those specified in the appropriate specification and location of cradle(s), when cradle is required, if not covered

9. Maximum working pressure for pressure sewers

10. Location and size of thrust blocks on pressure lines

11. Location of flanged joints on pressure sewers

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

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NOTE: The following is applicable to USACE project designs.

All pipe materials specified will be retained except under conditions where they would not be suitable; see TM 5-814-1. Where it is determined that a pipe material would be altogether unsuitable, every mention of the unsuitable material and referenced publications that pertain only to the unsuitable material will be deleted. If a material would be suitable in a part of the system and unsuitable in other parts, the locations where the material may and may not be used will be shown on the contract drawings and stated in the contract specifications. A study of the conditions will be made to determine the suitability of the materials. If doubt remains after the study, because of exceptional conditions, a report should be submitted to HQUSACE (CECW-EW).

NOTE: Consider the following in NAVFAC project designs.

1. Allowable piping materials:

a. The project specification should allow the use of piping materials for each application which are suitable for the project, each to be permitted as a Contractor's option.

b. Refer to the appropriate NAVFACENGCOM Design Manual/Military Handbook for general information on piping materials suitable for use on the applications covered by this specification.

c. Pipe materials which are known to be unsuitable

for local conditions (i.e., corrosion, root penetration, etc.) should not be permitted for the project. However, consideration should be given to use of more effective protective coatings and jointing methods where economically feasible.

d. 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 will be the resistance to root penetration. Rubber-gasketed and compression-type joints are considered to give the best performance for this application.

e. It is assumed that corrosive fluids (acids, alkalies, toluene, etc.) will not be reaching the exterior sewer system in relatively undiluted condition. If such will not be the case, investigate the materials specified herein for resistance to the particular chemical involved. If necessary, corrosion-resistant materials other than those specified herein may be used.

f. Further information on clay pipe may be found in the Clay Pipe Engineering Manual (1985 Edition) of the National Clay Pipe Institute.

g. For further information on the selection of concrete sewer pipe and jointing materials, see the Concrete Pipe Design Manual (1980 Edition) and the Concrete Pipe Handbook (1980 Edition), both published by the American Concrete Pipe Association.

h. Where required for special applications, reinforced concrete arch pipe conforming to ASTM C 506 or reinforced concrete elliptical pipe conforming to ASTM C 507 may be specified.

i. Plastic pipe is subject to temperature limitations which must be observed when specifying plastic pipe for service from laundries, kitchens, and other facilities discharging large quantities of water at elevated temperatures (the temperature limit given is for short-time, nonpressure use only; lower temperature limit is required for long-time use or for pressure use):

ABS ..... 82 degrees C 180 degrees F
PVC ..... 71.degrees C 160 degrees F

j. Do not use ABS pipe for applications where high chemical resistance is desired, such as in lines from laboratories or hospitals.

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

2. Pipe design:

a. Specify equivalent pipe design for the project conditions (using the applicable criteria for each pipe material) for each pipe material insofar as is practicable. American Society of Civil Engineers (ASCE Manual No. 37, "Design and Construction of Sanitary and Storm Sewers," contains methods of calculation for structural requirements of pipe; from these, the required strengths for pipe of various materials may be determined. Investigate external loads, including earth loads, truck loads, seismic loads, and impact, in the design stage of the project.

b. 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.

c. 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.

3. 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 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.

4. 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.

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PART 1 GENERAL

1.1 REFERENCES

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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 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.

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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	(1999) Concrete Pipe Installation Manual

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

AREMA 1-5	(2001; R 2002) Pipelines

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2002) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 307	(2004) Standard Specification for Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength
ASTM A 47/A 47M	(1999) Standard Specification for Ferritic Malleable Iron Castings
ASTM A 48/A 48M	(2003) Standard Specification for Gray Iron Castings
ASTM A 536	(1984; R 2004) Standard Specification for Ductile Iron Castings

ASTM A 563	(2004) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 563M	(2003) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A 74	(2004) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A 746	(2003) Standard Specification for Ductile Iron Gravity Sewer Pipe
ASTM C 12	(2003) Standard Practice for Installing Vitrified Clay Pipe Lines
ASTM C 14	(2003) Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 14M	(2003) Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe (Metric)
ASTM C 150	(2005) Standard Specification for Portland Cement
ASTM C 260	(2001) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 270	(2005a) Standard Specification for Mortar for Unit Masonry
ASTM C 33	(2003) Standard Specification for Concrete Aggregates
ASTM C 361	(2003a) Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
ASTM C 361M	(2003a) Standard Specification for Reinforced Concrete Low-Head Pressure Pipe (Metric)
ASTM C 425	(2002) Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443	(2003) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 443M	(2003) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric)
ASTM C 478	(2003a) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(2003a) Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric)

ASTM C 564	(2003a) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 700	(2002) Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM C 76	(2003) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 76M	(2003) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C 828	(2001) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C 923	(2002) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C 923M	(2002) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals (Metric)
ASTM C 924	(2002) Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C 924M	(2002) Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method (Metric)
ASTM C 94/C 94M	(2003a) Standard Specification for Ready-Mixed Concrete
ASTM C 969	(2002) Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C 969M	(2003) Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric)
ASTM C 972	(2000) Compression-Recovery of Tape Sealant
ASTM C 990	(2001a) Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealers
ASTM C 990M	(2001a) Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants (Metric)
ASTM D 1784	(2003) Standard Specification for Rigid

	Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(2005) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2235	(2004) Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2241	(2005) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2321	(2000) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2412	(2002) Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D 2464	(1999e1) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(2002) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(2004e1) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2680	(2001) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2751	(1996a) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 2996	(2001) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 2997	(2001) Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 3034	(2000) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3139	(1998) Standard Specification for Joints for Plastic Pressure Pipes Using Flexible

	Elastomeric Seals
ASTM D 3212	(1996a; R 2003) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3262	(2001) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
ASTM D 3350	(2002a) Polyethylene Plastics Pipe and Fittings Materials
ASTM D 3753	(1999) Glass-Fiber-Reinforced Polyester Manholes and Wet Wells
ASTM D 3840	(2001) "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Fittings for Nonpressure Applications
ASTM D 4101	(2005a) Standard Specification for Polypropylene Injection And Extrusion Materials
ASTM D 412	(1998a; R 2002e1) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D 4161	(2001) Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
ASTM D 624	(2000e2) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM F 402	(1993; R 1999) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 405	(1997) Corrugated Polyethylene (PE) Tubing and Fittings
ASTM F 477	(2002e1) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 714	(2003) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F 758	(1995; R 2000) Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage
ASTM F 794	(2003) Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on

	Controlled Inside Diameter
ASTM F 894	(1998a) Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F 949	(2001a) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA C104	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	(1999) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	(2003) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	(1999) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151	(2002) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C153	(2000) Ductile-Iron Compact Fittings for Water Service
AWWA C302	(1995) Reinforced Concrete Pressure Pipe, Noncylinder Type
AWWA C600	(1999) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	(2004) Grooved and Shouldered Joints
AWWA C900	(1997) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution
AWWA M23	(2002) Manual: PVC Pipe - Design and Installation
AWWA M9	(1995) Manual: Concrete Pressure Pipe

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 2003) Pipe Threads, General Purpose (Inch)
ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B18.2.2	(1987; R 1999) Square and Hex Nuts

ASME B18.5.2.1M	(1981; R 1995) Metric Round Head Short Square Neck Bolts
ASME B18.5.2.2M	(1982; R 2000) Metric Round Head Square Neck Bolts

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	(2000) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(1997) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-3	(1992) Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe (Nominal Diameters 4-36 Inch)
UBPPA UNI-B-6	(1998) Recommended Practice for the Low-Pressure Air Testing of Installed Sewer Pipe

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-60005	(Basic) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.27	Fixed Ladders

1.2 SYSTEM DESCRIPTION

1.2.1 Sanitary Sewer Gravity Pipeline

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NOTE: Choose one of the following options for NAVFAC projects. Choose the second option for LANTNAVFACENGCOM projects.

****

[Provide [mains and laterals] [[_____] mm inch lines] of [clay pipe] [concrete pipe] [ductile-iron pipe] [acrylonitrile-butadiene-styrene (ABS) composite plastic pipe] [or] [polyvinyl chloride (PVC) plastic pipe] [at the Contractor's option]. Provide building connections [[_____] mm inch lines] of [cast iron soil pipe] [clay pipe] [concrete pipe] [acrylonitrile-butadiene-styrene (ABS) solid-wall plastic pipe] [or] [polyvinyl chloride (PVC) plastic pipe] at the Contractor's option.]

[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 5 feet

outside of building walls.]

1.2.2 Sanitary Sewer Pressure Lines

Provide pressure lines of [ductile iron pressure pipe] [concrete pressure pipe] [or] [polyvinyl chloride (PVC) plastic pressure pipe] [at the Contractor's option].

1.3 GENERAL REQUIREMENTS

****
NOTE: Use this paragraph for USACE projects.
****

The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 1.5 m 5 feet outside the building to which the sewer system is to be connected. The Contractor shall replace damaged material and redo unacceptable work at no additional cost to the Government. Backfilling shall be accomplished after inspection by the Contracting Officer. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.4 SUBMITTALS

****
NOTE: Review Submittal Description (SD) definitions in Section 01330 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation 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, Air Force, and NASA projects.

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

****

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Existing Conditions

SD-02 Shop Drawings

Precast concrete manhole

Metal items

Frames, covers, and gratings

Installation Drawings

As-Built Drawings

SD-03 Product Data

Pipeline materials

Submit manufacturer's standard drawings or catalog cuts.

SD-06 Test Reports

Inspection Reports

SD-07 Certificates

Portland Cement

Certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes.

Gaskets

Certificates of compliance stating that the fittings or gaskets used for waste drains or lines designated on the plans as [_____] are [oil] [_____] resistant.

1.5 DRAWINGS

Submit Installation Drawings showing complete detail, both plan and side view details with proper layout and elevations.

Submit As-Built Drawings for the complete sanitary sewer system showing complete detail with all dimensions, both above and below grade, including invert elevation.

****
NOTE: Include the following paragraph on NASA projects.
****

[Sign and seal As-Built Drawings by a Professional Surveyor and Mapper. Include the following statement, "All potable water lines crossed by sanitary hazard mains is in accordance with the permitted utility separation requirements."]

1.6 EXISTING CONDITIONS

Existing Conditions shall be submitted after a thorough inspection of the area by the Contractor in the presence of the Contracting Officer. Details shall include the condition in the presence of the Contracting Officer. Details should include the condition of environment and other areas adjacent to site work. Submit copies of the record and state the existing conditions before starting work shall be verified.

1.7 DELIVERY, STORAGE, AND HANDLING

1.7.1 Delivery and Storage

1.7.1.1 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.

1.7.1.2 Metal Items

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.

1.7.1.3 Cement, Aggregate, and Reinforcement

****
NOTE: Delete these paragraphs if not used or insert applicable concrete requirements here.
****

As specified in Section 03300S CAST-IN-PLACE CONCRETE.

1.7.2 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.

1.8 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. Installing Contractor's License shall be current and be state certified or state registered.

PART 2 PRODUCTS

2.1 PIPELINE MATERIALS

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Cast-Iron Soil Piping

2.1.1.1 Cast-Iron Hub and Spigot Soil Pipe and Fittings

ASTM A 74, [service] [extra heavy], with ASTM C 564 compression-type rubber gaskets.

2.1.1.2 Cast-Iron Hubless Soil Pipe and Fittings

****
NOTE: Delete this paragraph for areas where hubless fittings are considered inappropriate due to failure of coupling by corrosion.
****

CISPI 301 with CISPI 310 coupling joints.

2.1.2 Clay Piping

2.1.2.1 Clay Pipe and Fittings

****
NOTE: Tables of trench loadings, trench backfill loads, and supporting strengths of clay pipe are included in the Clay Pipe Engineering Manual (1982 edition) of the National Clay Pipe Institute. The required strength of clay pipe can be derived from these tables when depth of trench is known.

Specify "bell-and-spigot piping only" in areas where corrosion problems may be anticipated with the stainless steel parts of the couplings used for plain-end piping.
****

ASTM C 700, [standard strength] [extra strength] [bell-and-spigot piping only].

2.1.2.2 Clay Piping Jointing Materials

ASTM C 425.

2.1.3 Concrete Gravity Sewer Piping

****

NOTE: Not allowed for LANTNAVFACENGCOM projects.

Not normally allowed on NASA projects.

****

2.1.3.1 Concrete Gravity Pipe and Fittings

****

NOTE: The D-load (load per linear [meter] [foot] 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 (1980 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 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.

****

Pipe shall be [nonreinforced concrete pipe conforming to ASTM C 14M ASTM C 14, Class [_____]] [reinforced concrete pipe conforming to ASTM C 76MASTM C 76, Class [_____]]. Circular pipe with elliptical reinforcement shall have a readily visible line at least 300 mm 12 inches 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. Fittings and specials shall conform to the applicable requirements specified for the pipe and shall be of the same strength as the pipe. [Cement used in manufacturing pipe and fittings shall be [Type II] [Type V] [low alkali cement] conforming to ASTM C 150.]

2.1.3.2 Jointing Materials for Concrete Gravity Piping

Gaskets and pipe ends for rubber gasket joint shall conform to ASTM C 443M ASTM C 443. Gaskets shall be suitable for use with sewage.

2.1.4 Concrete Pressure Piping

****

NOTE: Not allowed for LANTNAVFACENGCOM projects.

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2.1.4.1 Concrete Pressure Pipe and Fittings

****

NOTE: Delete reference to AWWA C302 within brackets when pressure rating greater than 310 kPa 45 psi is 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.

For concrete pressure piping, ASTM C 361MASTM C 361 covers pipe for up to 37.5 m 125 feet of hydrostatic head, approximately 379 kPa 55 psi; AWWA C302 covers pipe and fittings for 310 kPa 45 psi pressure rating, 30 m 100 feet of hydro-static head) only. ASTM C 361MASTM C 361 contains tables giving design requirements for pipe in all combinations of 30 and 37.5 m 100 and 125 feet of hydrostatic head with 1.5, 3.0, 4.5, 6.0 m 5, 10, 15, and 20 feet of earth cover. Where higher pressure ratings are necessary, piping conforming to AWWA C300, C301, or C303 should be specified.

****

Pipe shall conform to [AWWA C302 or to] ASTM C 361MASTM C 361. Pipe shall be designed for hydrostatic head of [30] [38] m [100] [125] feet and external loading of [1.5] [3.0] [4.5] [6.0] m [5] [10] [15] [20] feet of earth cover. Circular pipe with elliptical reinforcement shall have a readily visible line at least 300 mm 12 inches 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. [Cement used in manufacturing pipe and fittings shall be [Type II] [Type V] [low alkali cement] conforming to ASTM C 150.] Fittings shall conform to AWWA C302.

2.1.4.2 Jointing Materials for Concrete Pressure Piping

****

NOTE: Use first bracketed wording when pressure rating greater than 310 kPa 45 psi is not required. Use second bracketed wording when pressure rating greater than 310 kPa 45 psi is required.

****

Gaskets shall be as specified in [the referenced specification for the pipe] [ASTM C 361MASTM C 361] and shall be suitable for use with sewage.

2.1.5 Ductile Iron Gravity Sewer Pipe and Associated Fittings

2.1.5.1 Ductile Iron Gravity Pipe and Fittings

****
NOTE: ASTM A 746 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.
****

Ductile iron pipe shall conform to ASTM A 746, Thickness Class [_____]. Fittings shall conform to AWWA C110 or AWWA C153. [Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, [except that the bell design shall be modified, as approved by the Contracting Officer, for push-on joint].] Fittings shall have strength at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the joints specified hereinafter. Pipe and fittings shall have cement-mortar lining conforming to AWWA C104, standard thickness.

2.1.5.2 Ductile Iron Gravity Joints and Jointing Materials

****
NOTE: 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.
****

Pipe and fittings shall have [push-on joints] [or] [mechanical joints], except as otherwise specified in this paragraph. [Mechanical joints only shall be used where indicated.] [Push-on joint pipe ends and fitting ends, gaskets, and lubricant for joint assembly shall conform to AWWA C111.] [Mechanical joint requirements for pipe ends, glands, bolts and nuts, and gaskets shall conform to AWWA C111.]

2.1.6 Ductile Iron Pressure Piping

****
NOTE: Ductile iron pipe is used for sizes 75 mm 3 inches to 1600 mm 64 inches.
****

2.1.6.1 Ductile Iron Pressure Pipe and Fittings

****
NOTE: Use Thickness Class 52 for LANTNAVFACENGCOM projects.
****

Ductile-iron pipe shall conform to AWWA C151, Thickness Class [_____]. [Flanged pipe shall conform to AWWA C115.] Fittings shall conform to AWWA

C110 or AWWA C153. [Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved, for push-on joint.] Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the joints specified hereinafter. Pipe and fittings shall have cement-mortar lining conforming to AWWA C104, standard thickness.

2.1.6.2 Ductile Iron Pressure Joints and Jointing Materials

a. Joints, general: Joints for pipe and fittings shall be [push-on joints] [or] [mechanical joints] except as otherwise specified in this paragraph. [Joints shall be mechanical-joints where indicated.] [Joints shall be flanged joints where indicated.] [Joints made with sleeve-type mechanical coupling may be used in lieu of push-on joint.] [[Grooved] [or] [shouldered] type joints may be used in lieu of push-on joint [or flanged joint], except where joint is buried.]

b. Push-on joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly shall conform to AWWA C111.

c. Mechanical joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets shall conform to AWWA C111.

d. Flanged joints: Bolts, nuts, and gaskets for flanged connections shall be as recommended in the Appendix to AWWA C115. Flange for setscrewed flanges shall be of ductile iron, ASTM A 536, Grade 65-45-12, and shall conform to the applicable requirements of ASME B16.1, Class 250. Setscrews for setscrewed flanges shall be 1310 MPa 190,000 psi tensile strength, heat treated, and zinc-coated steel. Gasket for setscrewed flanges shall conform to the applicable requirements for mechanical-joint gaskets specified in AWWA C111. Design of setscrewed gasket shall provide for confinement and compression of gasket when joint to adjoining flange is made.

****

NOTE: At the text below, delete "or steel" when middle ring of cast iron only is considered necessary due to anticipated corrosion problems. Delete requirement for strength of steel when steel is not allowed as a material for middle ring.

At the text below, minimum numbers of bolts for each pipe size should be as follows: 75 mm 3 inch, 3; 100 mm 4 inch, 4; 150 mm 6 inch, 5; 200 mm 8 inch, 6; 250 mm 10 inch, 7; 300 and 350 mm 12 and 14 inch, 8; 400 mm 16 inch; 9; 450 mm 18 inch, 10; 500 mm 20 inch, 12; 550 mm 22 inch, 13; 600 mm 24 inch, 14.

****

e. Joints made with sleeve-type mechanical couplings: Couplings shall be designed to couple plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling shall consist of one middle ring flared or beveled at each end to provide a gasket seat, two follower rings, two resilient tapered rubber gaskets, and bolts and nuts to draw the

follower rings toward each other to compress the gaskets. The middle ring and the follower rings shall be true circular sections free from irregularities, flat spots, and surface defects; the design shall provide for confinement and compression of the gaskets. Middle ring shall be of cast-iron [or steel], and the follower rings shall be of malleable iron or ductile iron. Cast iron shall conform to ASTM A 48/A 48M and shall be not less than Class 25. Malleable iron shall conform to ASTM A 47/A 47M. Ductile iron shall conform to ASTM A 536. [Steel shall have a strength not less than that of the pipe.] Gaskets shall be designed for long life and resistance to set after installation and shall meet the applicable requirements specified for gaskets for mechanical joint in AWWA C111. Bolts shall be track-head type; bolts and nuts shall be either of the following: bolts conforming to the tensile requirements of ASTM A 307, Grade A, with nuts conforming to the tensile requirements of ASTM A 563M ASTM A 563, Grade A; or round-head square-neck type bolts conforming to ASME B18.5.2.1M and ASME B18.5.2.2M with hex nuts conforming to ASME B18.2.2. Bolts shall be 16 mm 5/8 inch in diameter; minimum number of bolts for each coupling shall be [_____] [for [_____] mm inch pipe [,[_____] for [_____] mm inch pipe,] and [_____] for [_____] mm inch pipe]. Bolt holes in follower rings shall be of a shape to hold fast the necks of the bolts used. Sleeve-type mechanical couplings shall not be used as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint.

f. [Grooved] [and] [Shouldered] Type Joints: [Grooved pipe ends] [Shouldered pipe ends] and couplings shall conform to AWWA C606. Joint dimensions shall be as specified in AWWA C606 for rigid joints.

2.1.7 ABS Composite Plastic Piping

2.1.7.1 ABS Composite Plastic Pipe and Fittings

ASTM D 2680.

2.1.7.2 Jointing Materials for ABS Composite Plastic Piping

Solvent cement and primer shall conform to ASTM D 2680.

2.1.8 ABS Solid-Wall Plastic Piping

2.1.8.1 ABS Solid-Wall Plastic Pipe and Fittings

ASTM D 2751, SDR 35, with ends suitable for either solvent cement joints or elastomer joints.

2.1.8.2 ABS Solid-Wall Plastic Joints and Jointing Materials

Solvent cement for solvent cement joints shall conform to ASTM D 2235. Elastomeric joints shall conform to ASTM D 3212. Gaskets for elastomeric joints shall conform to ASTM F 477.

2.1.9 PVC Plastic Gravity Sewer Piping

2.1.9.1 PVC Plastic Gravity Pipe and Fittings

[ASTM D 3034, SDR 35, or ASTM F 949 with ends suitable for elastomeric gasket joints.] [ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior, size 200 mm 8 inch through 1200 mm 48 inch diameters.]

2.1.9.2 PVC Plastic Gravity Joints and Jointing Material

Joints shall conform to ASTM D 3212. Gaskets shall conform to ASTM F 477.

2.1.10 PVC Plastic Pressure Pipe and Associated Fittings

2.1.10.1 PVC Plastic Pressure Pipe and Fittings

a. Pipe and Fittings Less Than 100 mm 4 inch Diameter: Pipe, couplings and fittings shall be manufactured of materials conforming to ASTM D 1784, Class 12454B.

(1) Screw-Joint: Pipe shall conform to dimensional requirements of ASTM D 1785, Schedule 80, with joints meeting requirements of 1.03 Mpa 150 psi working pressure, 1.38 Mpa 200 psihydrostatic test pressure, unless otherwise shown or specified. Fittings for threaded pipe shall conform to requirements of ASTM D 2464, threaded to conform to the requirements of ASME B1.20.1 for use with Schedule 80 pipe and fittings. Pipe couplings when used, shall be tested as required by ASTM D 2464.

(2) Push-On Joint: ASTM D 3139, with ASTM F 477 gaskets. Fittings for push-on joints shall be iron conforming to AWWA C110 or AWWA C111. Iron fittings and specials shall shall be cement-mortar lined (standard thickness) in accordance with AWWA C104.

(3) Solvent Cement Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 1.03 Mpa 150 psiworking pressure and 1.38 Mpa 200 psi hydrostatic test pressure. Fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467.

b. Pipe and Fittings 100 mm 4 inch Diameter to 300 mm 12 inch: Pipe shall conform to AWWA C900 and shall be plain end or gasket bell end, Pressure Class 150 (DR 18), with cast-iron-pipe-equivalent OD. Fittings shall be gray-iron or ductile-iron conforming to AWWA C110 or AWWA C153 and shall have cement-mortar lining conforming to AWWA C104, standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with the PVC plastic pressure pipe specified in this paragraph.

2.1.10.2 PVC Plastic Pressure Joints and Jointing Material

Joints for pipe, 100 mm 4 inch to 300 mm 12 inchdiameter, shall be push-on joints as specified in ASTM D 3139. Joints between pipe and fittings shall be push-on joints as specified in ASTM D 3139 or shall be compression-type joints/mechanical-joints as respectively specified in ASTM D 3139 and AWWA C111. Each joint connection shall be provided with an elastomeric gasket

suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe shall conform to ASTM F 477. Gaskets for push-on joints and compression-type joints/mechanical-joints for joint connections between pipe and fittings shall be as specified in AWWA C111, respectively, for push-on joints and mechanical-joints.

2.1.11 High Density Polyethylene Pipe

ASTM F 894, Class 63, size 450 mm 18 inch through 3000 mm. 120 inch. ASTM F 714, size 100 mm) 4 inch through 1200 mm . 48 inch. The polyethylene shall be certified by the resin producer as meeting the requirements of ASTM D 3350, cell Class 334433C. The pipe stiffness shall be greater than or equal to 1170/D for cohesionless material pipe trench backfills. Fittings for High Density Polyethylene Pipe: ASTM F 894. Joints for high density polyethylene pipe: Rubber gasket joints shall conform to ASTM C 443M ASTM C 443.

2.1.12 Reinforced Plastic Mortar Pipe (RPMP)

Reinforced plastic mortar pipe shall be produced by centrifugal casting and shall have an outside diameter equal to dectile iron pipe dimensions from 450 mm 18 inch to 1200 mm 48 inch. The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner. The minimum pipe stiffness shall be 248 kPa 36 psi. RPMP shall be in accordance with ASTM D 3262. Fittings for RPMP: ASTM D 3840. Joints for RPMP: Bell and spigot gasket coupling utilizing an elastomeric gasket in accordance with ASTM D 4161 and ASTM F 477.

2.1.13 Reinforced Thermosetting Resin Pipe (RTRP)

RTRP pipe: ASTM D 3262. Fittings for RTRP: ASTM D 3262. Joints for RTRP: Bell and spigot type utilizing an elastomeric gasket in accordance with ASTM F 477.

2.1.13.1 Filament Wound RTRP-I

RTRP-I shall conform to ASTM D 2996, except pipe shall have an outside diameter equal to cast iron outside diameter or standard weight steel pipe. The pipe shall be suitable for a normal working pressure of 1.03 MPa (150 psi) 150 psi at 22.8 degrees C. 73 degrees F.The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner conforming to ASTM D 2996.

2.1.13.2 Centrifugally Cast RTRP-II

RTRP-II shall conform to ASTM D 2997. Pipe shall have an outside diameter equal to standard weight steel pipe.

2.1.14 Piping Beneath Railroad Right-of-Way

Where pipeline passes under the right-of-way of a commercial railroad, piping shall conform to the specifications for pipelines conveying nonflammable substances in AREMA 1-5, except as otherwise specified in this paragraph. For casing pipe provide ductile-iron pipe in lieu of cast-iron soil pipe. Ductile-iron pipe shall conform to and have strength computed in accordance with ASTM A 746.

2.2 CONCRETE MATERIALS

2.2.1 Cement Mortar

Cement mortar shall conform to ASTM C 270, Type M with Type II cement.

2.2.2 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.
****

Portland cement shall conform to ASTM C 150, Type [II] [V] for concrete used in concrete pipe, concrete pipe fittings, and manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking. [Air-entraining admixture conforming to ASTM C 260 shall be used with Type V cement.] [Where aggregates are alkali reactive, as determined by Appendix XI of ASTM C 33, a cement containing less than 0.60 percent alkalies shall be used.]

2.2.3 Portland Cement Concrete

****
NOTE: When ready-mix concrete conforming to ASTM C 94/C 94M is not economically available, rewrite this paragraph to permit use of concrete mixed onsite. Specify concrete aggregates conforming to ASTM C 33 and concrete consisting of 1 part portland cement, 2-1/2 parts sand, and 5 parts gravel, with just enough water for workable consistency
****

Portland cement concrete shall conform to ASTM C 94/C 94M, compressive strength of 28 MPa 4000 psi at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement shall have a compressive strength of 17 MPa 2500 psiminimum at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Precast Concrete Manholes and Glass-Fiber-Reinforced Polyester Manholes.

Precast concrete manhole risers, base sections, and tops shall conform to ASTM C 478M ASTM C 478; base and first riser shall be monolithic. Glass-Fiber-Reinforced Polyester Manholes shall conform to ASTM D 3753.

2.3.2 Gaskets and Connectors

Gaskets for joints between manhole sections shall conform to ASTM C 443M ASTM C 443. Resilient connectors for making joints between manhole and pipes entering manhole shall conform to ASTM C 923M ASTM C 923 or ASTM C 990M ASTM C 990.

2.3.3 External Preformed Rubber Joint Seals

An external preformed rubber joint seal shall be 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" shall be tested for leakage in the same manner as pipelines as described in paragraph entitled "Leakage Tests." The seal shall be multi-section with a neoprene rubber top section and all lower sections made of Ethylene Proplene Di Monomer (EPDM) rubber with a minimum thickness of 1.5 mm 60 mils. Each unit shall consist of a top and bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be a non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections shall cover up to two more adjusting rings. Properties and values are listed in the following tables:

[Properties, Test Methods and Minimum Values for Rubber used in Preformed Joint Seals

Physical Properties	Test Methods	EPDM	Neoprene	Butyl mastic
Tensile, kPa	ASTM D 412	12,684	15,132	-
Elogation percent	ASTM D 412	553	295	350
Tear Resistance, N/mm	ASTM D 624 (Die B)	49	28	-
Rebound, percent, 5 minutes	ASTM C 972 (mod.)	-	-	11
Rebound, percent, 2 hours	ASTM C 972	-	-	12]

[Properties, Test Methods and Minimum Values for Rubber used in Preformed Joint Seals

Physical Properties	Test Methods	EPDM	Neoprene	Butyl mastic
Tensile, psi	ASTM D 412	1840	2195	-
Elogation percent	ASTM D 412	553	295	350
Tear Resistance, ppi	ASTM D 624 (Die B)	280	160	-
Rebound, percent, 5 minutes	ASTM C 972 (mod.)	-	-	11
Rebound, percent, 2 hours	ASTM C 972	-	-	12]

[Properties, Test Methods and Minimum Values for
Rubber used in Preformed Joint Seals

Physical Properties	Test Methods	EPDM	Neoprene	Butyl mastic

2.3.4 Metal Items

2.3.4.1 Frames, Covers, and Gratings for Manholes

FS A-A-60005, cast iron; figure numbers shall be [as follows] [as indicated]:

a. Traffic manhole: Provide in paved areas.

Frame: Figure 1, Size 22A
Cover: Figure 8, Size 22A
Steps: Figure 19

b. Non-traffic manhole:

Frame: Figure 4, Size 22
Cover: Figure 12, Size 22
Steps: Figure 19

Frames and covers shall be cast iron, ductile iron or reinforced concrete. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 181.4 kg. 400 pounds. Reinforced concrete frames and covers shall be as indicated or shall conform to ASTM C 478 or ASTM C 478M. The word "Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.3.4.2 Manhole Steps

[Zinc-coated steel] [as indicated] conforming to 29 CFR 1910.27. [As an option, plastic or rubber coating pressure-molded to the steel may be used. Plastic coating shall conform to ASTM D 4101, copolymer polypropylene. Rubber shall conform to ASTM C 443M ASTM C 443, except shore A durometer hardness shall be 70 plus or minus 5.] Aluminum steps or rungs will not be permitted. Steps are not required in manholes less than 1.2 m 4 feet deep.

2.3.4.3 Manhole Ladders

A steel ladder shall be provided where the depth of a manhole exceeds 3.6 m . 12 feet. The ladder shall not be less than 406 mm 16 inches in width, with 19 mm 3/4 inch diameter rungs spaced 305 mm) 12 inches apart. The two stringers shall be a minimum 10 mm (3/8 inch) 3/8 inch thick and 51 mm 2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123/A 123M.

2.3.4.4 Septic Tank Piping

Cast iron soil pipe and fittings.

2.3.4.5 Siphon for Septic Tank

Welded steel or close-grained cast iron free from flaws, of an approved standard design, and prompt and positive in action.

2.3.5 Sewage Absorption Field Materials

****
NOTE: Choose one of the following options. Choose the second option for LANTNAVFACENGCOM projects.
****

[Pipe shall be perforated bell-and-spigot clay pipe conforming to ASTM C 700, clay drain tile, perforated corrugated polyethylene tubing conforming to ASTM F 405. Covering for open joints in drain tile lines shall be asphalt-treated paper or asphalt-covered fibrous glass cloth. Wire for fastening covering to tile shall be 1.2 mm No. 18 American Wire Gage, nonferrous metal composition.]

[Pipe shall be perforated bell-and-spigot clay pipe conforming to ASTM C 700, clay drain tile or PVC plastic pipe conforming to ASTM F 758. Covering for open joints in drain tile lines shall be asphalt-treated paper or asphalt-covered fibrous glass cloth. Wire for fastening covering to tile shall be 1.2 mm No. 18 American Wire Gage, nonferrous metal composition.]

2.4 REPORTS

Inspection Reports for daily activities during the installation of the sanitary system shall be submitted. Information in the report shall be detailed enough to describe location of work and amount pipe laid in place measured in liner feet or meters.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

3.1.1 General Requirements for Installation of Pipelines

Apply except where specific exception is made in the following paragraphs entitled "Special Requirements."

****
NOTE: Select the applicable paragraph from the following:
****

3.1.1.1 Location

****
NOTE: Choose one of the following options.
****

The work covered by this section shall terminate at a point approximately 1.5 m 5 feet from the building [, unless otherwise indicated]. [Where the location of the sewer is not clearly defined by dimensions on the drawings, do not lay sewer line closer horizontally than 3 m 10 feet to a water main or service line.] [Install pressure sewer lines beneath water lines only, with the top of the sewer line being at least 0.60 m 2 feet below bottom of water line.] [Where sanitary sewer lines pass above water lines, encase sewer in concrete for a distance of 3 m 10 feet on each side of the crossing, or substitute rubber-gasketed pressure pipe for the pipe being used for the same distance.] [Where sanitary sewer lines pass below water lines, lay pipe so that no joint in the sewer line will be closer than 0.9 m

3 feet, horizontal distance, to the water line.]

****
NOTE: Include the option "a" through "c" below for LANTNAVFACENGCOM projects.
****

[a. Sanitary piping installation parallel with water line:

(1) Normal conditions: Sanitary piping or manholes shall be laid at least 3 m 10 feet horizontally from a water line whenever possible. The distance shall be measured edge-to-edge.

(2) Unusual conditions: When local conditions prevent a horizontal separation of 3 m 10 feet, the sanitary piping or manhole may be laid closer to a water line provided that:

(a) The top (crown) of the sanitary piping shall be at least 450 mm 18 inches below the bottom (invert) of the water main.

(b) Where this vertical separation cannot be obtained, the sanitary piping shall be constructed of AWWA-approved ductile iron water pipe pressure tested in place without leakage prior to backfilling.

(c) The sewer manhole shall be of watertight construction and tested in place.]

[b. Installation of sanitary piping crossing a water line:

(1) Normal conditions: Lay sanitary sewer piping by crossing under water lines to provide a separation of at least 450 mm 18 inches between the top of the sanitary piping and the bottom of the water line whenever possible.

(2) Unusual conditions: When local conditions prevent a vertical separation described above, use the following construction:

(a) Sanitary piping passing over or under water lines shall be constructed of AWWA-approved ductile iron water pipe, pressure tested in place without leakage prior to backfilling.

(b) Sanitary piping passing over water lines shall, in addition, be protected by providing:

1. A vertical separation of at least 450 mm 18 inches 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 20 feet, of the sanitary piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the water line.]

[c. Sanitary sewer manholes: No water piping shall pass through or come in contact with any part of a sanitary sewer manhole.]

3.1.1.2 Earthwork

****
NOTE: Earthwork requirements, including bedding, for pipe trenches and utility structures are covered in Section 02315N EXCAVATION AND FILL. The above referenced section number and title are subject to change. The specifier should verify the current specification and revise if different.
****

Perform earthwork operations in accordance with Section 02300S EARTHWORK.

3.1.1.3 Pipe Laying and Jointing

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

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 [and tongues in grooves] to give a uniform space all around. Blocking or wedging between bells and spigots [or tongues and grooves] 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 25 feet 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.

Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for ABS and PVC composite pipe shall conform to Figure 2 of ASTM D 2680; saddles for ABS pipe shall comply with Table 3 of ASTM D 2751; and saddles for PVC pipe shall conform to Table 4 of ASTM D 3034.

3.1.1.4 Connections to Existing Lines

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.

3.1.2 Special Requirements

3.1.2.1 Installation of Cast Iron Soil Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the pipe manufacturer. Make joints with the rubber gaskets specified for cast iron soil pipe joints and assemble in accordance with the recommendations of the pipe manufacturer.

3.1.2.2 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 C 12 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.

3.1.2.3 Installation of Concrete Gravity Sewer Piping

****
NOTE: Not allowed for LANTNAVFACENGCOM projects.
****

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 one inch of closure, remove the pipe and remake the joint.

3.1.2.4 Installation of Concrete Pressure Lines

****
NOTE: Not allowed for LANTNAVFACENGCOM projects.
****

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the laying and joining requirements specified in the guide specifications for installation of pipe given in AWWA M9, Chapter 14, "Guide Specifications for Installation of Pipe."

a. Joints: Make joints with the gaskets specified for concrete pressure pipe joints, using an approved lubricant recommended by the pipe manufacturer. Assemble these joints in accordance with the joining requirements specified in the guide specifications for installation of pipe given in AWWA M9, Chapter 14, "Guide Specifications for Installation of Pipe," and with the recommendations given for laying the pipe in AWWA M9, Chapter 6, "Installation by Trenching or Tunneling -- Methods and Equipment."

b. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated. Use concrete conforming to ASTM C 94/C 94M having a minimum compressive strength of 13.80 MPa 2,000 psi at 28 days; or use concrete of a mix not leaner than one part cement 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.1.2.5 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.

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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.

****
NOTE: At the text below, delete the paragraph except when required. See the NAVFACENGCOM Design Manual on Water Supply Systems for guidance. See Foreword to AWWA C105 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, using [Class A] [Class C] polyethylene film.

3.1.2.6 Installation of Ductile-Iron Pressure Lines

Unless otherwise specified, install pipe and 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, joint assembly, and valve-and-fitting installation.

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; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111. [Make flanged joints with gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight, taking care to avoid undue strain on flanges, fittings, and other accessories. Align bolt holes for each flanged joint. Use full size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. When flanged pipe or fittings have dimensions that do not allow the making of a proper flanged joint as specified, replace it by one of proper dimensions.] [Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer, as approved.] [Make

[grooved] [and] [shouldered] type joints with the couplings previously specified for this type joint connecting pipe with the [grooved] [or] [shouldered] ends specified for this type joint and assemble in accordance with the recommendations of the coupling manufacturer, as approved. [Groove pipe in the field only with approved groove cutting equipment designed especially for the purpose and produced by a manufacturer of grooved joint couplings; secure approval for field-cut grooves before assembling the joint.]]

****
NOTE: Delete the text below except when required. See the NAVFACENGCOM Design Manual on Water Supply Systems for guidance. See Foreword to AWWA C105 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, using [Class A] [Class C] polyethylene film.

c. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated. Use concrete conforming to ASTM C 94/C 94M having a minimum compressive strength of 13.80 MPa 2,000 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.1.2.7 Installation of ABS Composite Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the plastic pipe manufacturer. Make joints with the primer and solvent cement specified for this joint and assemble in accordance with the recommendations of the pipe manufacturer. Handle solvent cement in accordance with ASTM F 402.

3.1.2.8 Installation of ABS Solid-Wall Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the plastic pipe manufacturer. Make solvent cement joints with the solvent cement previously specified for this type joint. Make elastomeric joints with the gaskets specified for this type joint and assemble in accordance with the recommendations of the pipe manufacturer. Handle solvent cement in accordance with ASTM F 402.

3.1.2.9 Installation of PVC Plastic 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 D 2321 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 D 2321 for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.1.2.10 Installation of PVC Plastic Pressure Pipe and Fittings

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section; with the requirements of UBPPA UNI-B-3 for laying of pipe, joining PVC pipe to fittings and accessories, and setting of hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, "Installation."

a. Pipe Less Than 100 mm 4 Inch Diameter:

(1) Threaded joints shall be made by wrapping the male threads with joint tape or by applying an approved thread lubricant, then threading the joining members together. The joints shall be tightened with strap wrenches which will not damage the pipe and fittings. The joint shall be tightened no more than 2 threads past hand-tight.

(2) Push-On Joints: The ends of pipe for push-on joints shall be beveled to facilitate assembly. Pipe shall be marked to indicate when the pipe is fully seated. The gasket shall be lubricated to prevent displacement. Care shall be exercised to ensure that the gasket remains in proper position in the bell or coupling while making the joint.

(3) Solvent-weld joints shall comply with the manufacturer's instructions.

b. Pipe 100 mm 4 Inch Diameter Joints: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to fittings, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of UBPPA UNI-B-3 for laying the pipe and the recommendations in AWWA M23, Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings in accordance with the requirements of UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly. Make compression-type joints/mechanical-joints with the gaskets, glands, bolts, nuts, and internal stiffeners specified for this type joint and assemble in accordance with the requirements of UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories, with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111. Cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel.

c. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated. Use concrete conforming to ASTM C 94/C 94M having a minimum compressive strength of 13.80 MPa 2,000 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive

strength.

3.1.2.11 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 1-5.

3.1.3 Concrete Work

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NOTE: Delete these paragraphs if not used or insert applicable concrete requirements here.

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Cast-in-place concrete is included in Section 03300S CAST-IN-PLACE CONCRETE [Section 03305S CAST-IN PLACE CONCRETE (SHORT SECTION)].

The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

3.1.4 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. Cast-in-place concrete work shall be 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.

3.1.5 Miscellaneous Construction and Installation

3.1.5.1 Connecting to Existing Manholes

Pipe connections to existing manholes shall be made so 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. The connection shall be centered on the manhole. Holes for the new pipe shall 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. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.1.5.2 Metal Work

a. 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.

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NOTE: Delete the text below when painting of cast iron items is not in accordance with local station practice.
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b. Field painting: After installation, clean cast-iron frames, covers, gratings, and steps not buried in concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

3.1.6 Sewage Absorption Trench Construction

Grade pipe lines uniformly downward to the outlet. Lay perforated pipe with the perforations downward. Lay drain tile with 6 mm 1/4 inch open joints. Cover open joints of drain tile with the cover material specified so that it extends not less than 1.75 rad 100 degrees on each side of the vertical center line of the tile. Wire covering in place.

3.1.7 Installations of Wye Branches

Cutting into piping for connections shall not be done except in special approved cases. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete backfill or supported on a concrete cradle as directed. Concrete required because of conditions resulting from faulty construction methods or negligence by the Contractor shall be installed at no additional cost to the Government. The installation of wye branches in an existing sewer shall be made by a method which does not damage the integrity of the existing sewer. One acceptable method consists of removing one pipe section, breaking off the upper half of the bell of the next lower section and half of the running bell of wye section. After placing the new section, it shall be rotated so that the broken half of the bell will be at the bottom. The two joints shall then be made with joint packing and cement mortar.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The Contracting Officer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests and provide labor, equipment, and incidentals required for testing[, except that water and electric power needed for field tests will be furnished as set forth in Section 02300S EARTHWORK]. Be able to produce evidence, when required, that each item of work has been constructed in accordance with

the drawings and specifications.

3.2.2 Tests for Nonpressure Lines

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line. When pressure piping is used in a nonpressure line for nonpressure use, test this piping as specified for nonpressure pipe.

3.2.2.1 Leakage Tests

Test lines for leakage by either infiltration tests or exfiltration tests, or by low-pressure air tests. Prior to testing for leakage, backfill trench up to at least lower half of pipe. 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.

a. Infiltration tests and exfiltration tests: Perform these tests for sewer lines made of the specified materials, not only concrete, in accordance with ASTM C 969M ASTM C 969. Make calculations in accordance with the Appendix to ASTM C 969M ASTM C 969.

b. Low-pressure air tests: Perform tests as follows:

(1) Clay pipelines: Test in accordance with ASTM C 828. Allowable pressure drop shall be as given in ASTM C 828. Make calculations in accordance with the Appendix to ASTM C 828.

(2) Concrete pipelines: Test in accordance with ASTM C 924M ASTM C 924. Allowable pressure drop shall be as given in ASTM C 924M ASTM C 924. Make calculations in accordance with the Appendix to ASTM C 924M ASTM C 924.

(3) Ductile-iron pipelines: Test in accordance with the applicable requirements of ASTM C 924M ASTM C 924. Allowable pressure drop shall be as given in ASTM C 924M ASTM C 924. Make calculations in accordance with the Appendix to ASTM C 924M ASTM C 924.

(4) ABS composite plastic pipelines: Test in accordance with the applicable requirements of UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

(5) PVC plastic pipelines: Test in accordance with UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

3.2.2.2 Deflection Testing

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NOTE: Specify deflection testing only when warranted by scope or size of project.
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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 D 2412. Deflection of pipe in the installed pipeline under external loads shall not 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.

a. Pull-through device: This device shall be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Circular sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed 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 shall conform to the following:

   (1) 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.

   (2) Homogeneous material throughout, shall have a density greater than 1.0 as related to water at 4 degrees C 39.2 degrees F, and shall have a surface Brinell hardness of not less than 150.

   (3) Center bored and through-bolted with a 6 mm 1/4 inch minimum diameter steel shaft having a yield strength of not less than 483 MPa 70,000 pounds per square inch, with eyes or loops at each end for attaching pulling cables.

   (4) Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

b. Deflection measuring device: Sensitive to 1.0 percent of the diameter of the pipe being tested and shall be accurate to 1.0 percent of the indicated dimension. Deflection measuring device shall be approved prior to use.

c. 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.

d. 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.

3.2.3 Tests for Pressure Lines

Test pressure lines in accordance with the applicable standard specified in this paragraph, except for test pressures. For hydrostatic pressure test, use a hydrostatic pressure 345 kPa 50 psi in excess of the maximum working pressure of the system, but not less than 690 kPa 100 psi, holding the pressure for a period of not less than one hour. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test. [Test ductile-iron pressure lines in accordance with the requirements of AWWA C600 for hydrostatic testing. Leakage on ductile-iron pipelines with mechanical-joints [or push-on joints] shall not exceed the amounts given in AWWA C600; allow no leakage at joints made by other methods.] [Test concrete pressure lines in accordance with the recommendations in AWWA M9, Chapter 10, "Hydrostatic Testing and Disinfection of Mains." Leakage on concrete pipelines shall not exceed 1.88 liters per 24 hours per mm of pipe diameter per kilometer 20 gallons per 24 hours per inch of pipe diameter per mile of pipeline.] [Test PVC plastic pressure lines in accordance with the requirements of UBPPA UNI-B-3 for pressure and leakage tests, using the allowable leakage given therein.]

3.2.4 Field Tests for Concrete

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NOTE: Delete these paragraphs if not used or insert applicable concrete requirements here.
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Field testing requirements are covered in Section 03300S CAST-IN-PLACE CONCRETE

-- End of Section --