
NAVFAC IGS-02630 (APRIL 2003)

Preparing Activity: LANTNAVFACENGCOM Based on UFGS-02630N

ITALIAN GUIDE SPECIFICATIONS

Use for ITALIAN projects only

SECTION 02630

STORM DRAINAGE
04/03

NOTE: This guide specification is issued by the Atlantic Division, Naval Facilities Engineering Command for regional use in Italy.

NOTE: This guide specification covers the requirements for piping and appurtenant structures for a storm drainage 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.

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.

NOTE: On the project drawing, show:

1. Plan and location of all 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. Provide shape requirements if different shapes available.
7. Design details for pertinent manholes, catch basins, curb inlets, and head walls.
8. Store drainage lines and culverts required to be watertight.
9. Bedding conditions, where different from those specified in the appropriate NAVFAC specifications and location of cradle(s), when cradle is required if not covered under the appropriate NAVFACENGCOCM specifications.

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|-------------|---|
| ASTM C 506M | (1995; Rev. A) Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe (Metric) |
| ASTM C 507M | (1995; Rev. A) Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe (Metric) |
| ASTM F 949 | (1996; Rev. A) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings |

ITALIAN INSTITUTE OF PLASTICS (IIP)

- | | |
|------------------------|---|
| IIP, Pub.n.3; Nov.1984 | Installation of PVC Sewer Systems. Calculations and Installation of PVC Underground Sewers and Industrial Drains. |
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ITALIAN LAWS AND NORMS (D.M.)(LAW)(CIRC.)

NOTE: Italian laws and normatives are the

legislative regulations and decrees issued by the Italian government in the form of laws, norms, decrees, circulars, and letters. These Laws and Decrees concur together with Norms and Standards in forming the governing directives for construction.

- D.M. 23 February 1971 Technical norms for crossings and for parallelism of sewer, drain and gas lines with railroads and other transportation routes.

- D.M. 12 December 1985 Technical norms pertaining to piping.

- D.M. 20 November 1987 Technical norms for the design, execution and testing of masonry buildings and for their consolidation

- D.M. 9 January 1996 Criteria for the design, execution and test of reinforced concrete, prestressed concrete and steel structures.

- D.L. 494 (14/8/96) Implementation of the instruction CEE 92/57 concerning the minimum safety and health requirements to be accomplished in temporary or mobile work sites

ITALIAN NATIONAL ASSOCIATION FOR UNIFICATION OF STANDARDS (UNI)

NOTE: A UNI Norm is a technical normative recognized as Italian Law, submitted by a private organization "Ente Nazionale Italiano di Unificazione" for Italy and is available only in the Italian language. It is the National Standard.

- UNI 8403 (1982) Paints and varnishes - Determination of stability for protection of anticorrosive painting cycle on steel after exposure to atmosphere

- UNI 8942-1 (1986) Clay bricks and blocks. Terminology and classification system.

- UNI 9534 (1989) Concrete non-reinforced sewer circular pipe without laying basis

- UNI E07.04.064.0 (1993) Concrete reinforced sewer circular pipe without laying basis.

ITALIAN/EUROPEAN HARMONIZATION STANDARDS (UNI EN)(UNI ENV)(CEI EN)

NOTE: A UNI EN, UNI ENV, CEI EN, UNI EN ISO or UNI ISO is a European Standard with a coincident Italian National Standard or International Standard. The two standards are identical, with most (but not all) EN's available in the English language and the UNI available only in the Italian language.

- UNI EN 124 (1995) Gully tops and manhole tops for vehicular and pedestrian areas - Design requirements, type testing, marking, quality control
- UNI EN 197-1 (2001) Cement - Part 1: Composition, specifications and conformity criteria for common cements
- UNI EN 288-1/A1 (1993/99) Specification and qualification of welding procedures for metallic materials - Part 1: General rules for fusion welding
- UNI EN 288-2 (1993) Specification and qualification of welding procedures for metallic materials Part 2: Welding procedure specification for arc welding
- UNI EN 295-1/A1/A2/A3 (1992/99/99) Vitrified clay pipes and fittings and pipe joints for drains and sewers Part 1: Requirements
- UNI EN 295-5/A1 (1995/00) Vitrified clay pipes and fittings and pipe joints for drains and sewers Part 5: Requirements for perforated vitrified clay pipes and fittings
- UNI EN 545 (1995) Ductile iron pipes, fittings, accessories and their joints for water pipelines - Requirements and test methods
- UNI EN 598 (1995) Ductile iron pipes, fittings accessories and their joints for sewerage application - Requirements and tests methods
- UNI EN 681-1/A1 (1997/00) Elastomeric seals - Materials requirements for pipe joint seals used in water and drainage applications - Vulcanized rubber

UNI EN 804	(1995) Plastics piping systems - Injection-moulded socket fittings for solvent-cemented joints for pressure piping - Test method for resistance to a short-term internal hydrostatic pressure
UNI EN 1401-1	(1998) Plastics piping systems for non-pressure underground drainage and sewerage - Unplasticized poly(vinyl chloride) (PVC-U) - Specifications for pipes, fittings and the system
UNI EN ISO 1461	(1999) Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods
UNI ISO 6594	(1987) Cast iron drainage pipes and fittings - Spigot series
UNI EN 29519	(1995) Shipbuilding and marine structures - Rungs for dog-step ladders

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-C-490	(Rev. D; Int Am. 1) Cleaning Methods for Ferrous Surfaces and Pretreatments for Organic Coatings
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1.2 SUBMITTALS

NOTE: Where a "G" in submittal tags follows a submittal item, it indicates Government approval for that item. Add "G" in submittal tags following any added or existing submittal items deemed sufficiently critical, complex, or aesthetically significant to merit approval by the Government. Submittal items not designated with a "G" will be approved by the QC organization.

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Precast concrete structures

Metal items

SD-03 Product Data

Cast-iron soil piping including fittings and jointing materials

Clay piping including fittings and jointing materials

Concrete piping including fittings and jointing materials

Polyvinyl chloride (PVC) plastic piping including fittings and jointing materials

Subsurface drainage piping including fittings and jointing materials

SD-07 Certificates

Cast-iron frames, covers, and gratings

Submit certificates attesting that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and that production control tests have been performed at the frequency or intervals specified in the publication. Other tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

1.3.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. 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.

1.3.1.2 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.

1.3.1.3 Cement, Aggregates, and Reinforcement

NOTE: Delete this paragraph if not used or insert applicable concrete requirements here.

Store as specified in Section 03300, "Cast-In-Place Concrete."

1.3.2 Handling

Handle pipe, fittings, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. [Take special care not to

damage [coating] [and] [lining] on pipe and fittings; if damaged, make repairs.] Carry, do not drag pipe to trench.

PART 2 PRODUCTS

NOTE: Allowable Piping Materials:

1. The project specification should allow the use of all piping materials for each application which are suitable for the project, each to be permitted as a Contractor's option.
2. Refer to the appropriate NAVFAC Design Manual on storm drainage for general information on piping materials suitable for use on the applications covered by this specification. Additional information may be obtained from the "Life Cycle Cost for Drainage Structures," Technical Report GL-882-2 by the U.S. Army Corps of Engineers.
3. 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.
4. 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.
5. 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.
6. Give special attention in the design stage of the 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. See also the appendices to ASTM D 2321.

2.1 SOURCE MANUFACTURERS

2.1.1 Cast Iron Soil Piping

The following manufacturers provide cast iron soil piping materials that generally comply with these specifications:

OPPO Gesuino
Via Amerigo Vespucci, 1
09074 Ghilarza (OR)
Tel: 0785-54642
www.oppo.it

JANNONE S.p.A.
Via Nicaragua, 4
00040 Pomezia
Tel: 691-602200
Fax: 691-22140

HYDROMAT ITALIA S.r.l.
Via Plinio, 56
80058 - Torre Annunziata Napoli (NA)
Tel: 081-8624005
Fax: 081-8611097
e-mail: hydro.it@globalink.it

TUBI GHISA S.p.A.
Via Allegro, 1
16016 Cogoleto Genova (GE)
Tel: 010-91711
Fax: 010-9171401

2.1.2 Clay Piping

The following manufacturers provide clay piping materials that generally comply with these specifications:

Società del Gres
Italcementi Group
Via G. Marconi, 1
24010 Petosino (BG)
Tel: 035/579111
Fax: 035/579384

GREENPIPE
Via Modena, 48b
42015 Correggio (RE)
Tel. 0522/633123
Fax: 0522/633124
www.greenpipe.it

2.1.3 Concrete Piping

The following manufacturers provide concrete piping materials that generally comply with these specifications:

OPPO Gesuino
Via Amerigo Vespucci, 1
09074 Ghilarza (OR)
Tel: 0785-54642
www.oppo.it

MUSILLI Prefabbricati
Sede Amministrazione: 03043 Cassino (FR)
Via Casilina Sud, 49
Uffici Commerciali: Tel. 0776/312431
Uffici Amministrativi: Tel.0776/312436
Ufficio Acquisti: Tel.0776/312439
Ufficio Tecnico: Tel. 0776/312440
Telefax: 0776/310420

IPIEMME
Quadrivio Pioppettaa, 1
81011 Alife Caserta (CE)
Tel: 0823-918322
Fax: 0823-918406
e-mail: ipiemme@tin.it

2.1.4 Polyvinyl Chloride (PVC) Plastic Piping

The following manufacturers provide plastic piping materials that generally comply with these specifications:

ATE Alta Tecnologia Estrusione S.p.A.
38066 RIVA DEL GARDA (TN) Loc. Ceole, 3/c
Tel: (0464) 520520
Fax: (0464) 521752 - 556820

DALMINE Resine
Ufficio Vendita Nord-Estero
24040 Levate (BG)
Tel: 035/594848
Fax: 035/594832

UNIPLAST TUBI
Via s. Lazzaro, 1
42021 Ghiardo di Bibbiano (RE)
Tel: 0522-2512
Fax: 0522-883411
e-mail: contact@uniplast-tubi.it

2.1.5 Metal Frames, Covers, and Gratings

The following manufacturers provide metal frames, covers, and grating components that generally comply with these specifications:

MARIO CIRINO POMICINO

Strada Provinciale - Arzano
80022 Arzano - Napoli (NA)
Tel: 081-573-4740
Fax: 081-573-1418
e-mail: mcp@synapsis.it
www.mcpomicino.it

2.2 PIPELINE [AND CULVERT] MATERIALS

2.2.1 Cast-Iron Soil Piping

2.2.1.1 Cast-Iron Soil Pipe and Fittings

UNI EN 545 or UNI ISO 6594.

2.2.1.2 Jointing Materials for Cast-Iron Soil Piping

Gaskets shall be compression-type rubber gaskets conforming to UNI EN 681-1/A1.

2.2.2 Clay Piping

NOTE: Information on clay pipe may be found in the
Clay Pipe Engineering Manual (1982 Edition) of the
National Clay Pipe Institute.

2.2.2.1 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 (1985
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. Refer
to Table 5 of UNI EN 295-1 to select the Class of
clay pipe.

NOTE: 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.

UNI EN 295-1/A1/A2/A3, Class Number [L] [95] [120] [160] [200]. Pipe joints shall be [socket] [or] [spigot] controlled jointing systems.

2.2.2.2 Jointing Materials for Clay Piping

UNI EN 681-1/A1.

2.2.3 Concrete Piping

NOTE: For information on the selection of concrete 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. For special applications, reinforced concrete arch pipe conforming to ASTM C 506M or reinforced concrete elliptical pipe conforming to ASTM C 507M may be specified.

2.2.3.1 Concrete Pipe and Fittings

NOTE: The D-load (load per meter of diameter) must be calculated on the basis of project conditions to determine the applicable 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 strength of pipe can be determined when depth of trench is known. Designer shall refer to Tables 1 and 2 in UNI 9534 to select Class of nonreinforced sewer circular pipe.

- Class 1 - 60 kN/sq.m
- Class 2 - 100 kN/sq.m
- Class 3 - 150 kN/sq.m

Refer to Table 1 in UNI E07.04.064.0 to select Class of reinforced sewer circular pipe.

- Class 1 - 60/90 kN/sq.m
- Class 2 - 100/140 kN/sq.m
- Class 3 - 150/190 kN/sq.m

The U.S. designer shall coordinate with the in-country designer on the selection of pipe material and classes.

NOTE: For pipe culverts, nonreinforced pipe may be used in sizes 300 to 600 mm in diameter, inclusive, provided that the pipe meets all applicable requirements specified for reinforced concrete pipe of equal diameter and under the same conditions of loading.

NOTE: Sulfate resistance is required for concrete pipe when pipe is carrying sulfate-bearing waters, or when pipe is buried in soil containing sulfates. Specify CEM II/A-S or CEM II/B-S (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 1,000 parts per million. Specify CEM III/A (sulfate resisting) cement when soils contain in excess of 0.2 percent water-soluble sulfate and water samples contain in excess of 1,000 parts per million. In areas where reactive aggregates are known to occur, specify low alkali cement.

NOTE: The following are requirements for LANTNAVFACENCOM projects: Pipe sizes under 300 mm diameter shall be nonreinforced concrete pipe. Pipe sizes 300 mm diameter through 600 mm diameter may be either reinforced or nonreinforced concrete pipe. Pipe sizes larger than 600 mm diameter shall be reinforced concrete pipe.

NOTE: UNI 9534 and UNI E07.04.064.0 do not include pipe sizes less than 300 mm. However, pipe sizes less than 300 mm are available. Designer shall edit this paragraph accordingly to include performance requirements for pipe sizes less than 300 mm when required.

Storm drainage pipe shall be [nonreinforced concrete pipe conforming to UNI 9534, Class [1] [2] [3]] [reinforced concrete pipe conforming to UNI E07.04.064.0, Class [1] [2] [3]]. [Culvert pipe shall be [nonreinforced pipe conforming to UNI 9534, Class [1] [2] [3]] [reinforced pipe conforming to UNI E07.04.064.0, Class [1] [2] [3]] [reinforced concrete arch culverts conforming to ASTM C 506M, Class [___]] [reinforced concrete elliptical culverts conforming to ASTM C 507M, Class [___]].] [Circular pipe with elliptical reinforcement shall have a readily visible line no less than 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. 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 [CEM II/A-S] [CEM II/B-S] [CEM III/A] [low alkali cement] conforming to UNI EN 197-1.]]

[2.2.3.2 Jointing Materials for Concrete Piping

NOTE: Choose the paragraph below or the paragraph entitled "Joint Sealants."

Gaskets and pipe ends for rubber gasket joint shall conform to UNI EN 681-1/A1. Gaskets shall be suitable for use with sewage.

]2.2.3.3 Joint Sealants

NOTE: Use only ASTM C 443M rubber O-ring gaskets for airfield pavement areas. Delete other options.

Provide primers and lubricants as recommended by the manufacturer. Concrete pipe joints shall be suitable for use with the joint sealants specified.

- a. Butyl gaskets.
- b. UNI EN 681-1/A1, rubber O-ring gaskets.
- c. Preformed plastic gaskets.

]2.2.4 Polyvinyl Chloride (PVC) Plastic Piping

NOTE: Give special attention in the design stage of the 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.

[Polyvinyl Chloride (PVC) Pipe and Fittings, SDR [51] [41] [34], conforming to UNI EN 1401-1, with ends suitable for elastomeric gasket joints. ASTM F 949 with solvent cement joints or elastomeric gasket joints. UNI EN 681-1/A1 elastomeric gasket joints, UNI EN 804 solvent cement joints and UNI EN 681-1/A1 gaskets.]

2.2.5 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 D.M. 23 February 1971, unless otherwise specified. For casing pipe provide ductile-iron pipe in lieu of cast-iron pipe. Ductile-iron pipe shall conform to and have strength computed in accordance with UNI EN 598.

2.2.6 Subsurface Drainage Piping Materials

2.2.6.1 Clay Drain Tile

NOTE: Refer to Table 5 of UNI EN 295-1 to select
the Class of clay pipe for drain tile.

UNI EN 295-1/A1/A2/A3, Class Number [L] [95] [120] [160] [200].

2.2.6.2 Concrete Drain Tile

NOTE: Refer to Tables 1 and 2 in UNI 9534 to select
Class of nonreinforced circular pipe for concrete
drain tile.

UNI 9534, Class [1] [2] [3].

2.2.6.3 Perforated Clay Pipe

NOTE: Refer to Table 4 of UNI EN 295-5 to select
the Class of clay pipe for drain tile.

UNI EN 295-5/A1, Class Number [L] [95] [120] [160].

2.2.6.4 Perforated Concrete Piping

NOTE: There are no Italian references for
perforated concrete pipe. Designer shall edit
paragraph below to suit project requirements and
verify availability of type required.

Provide unreinforced type pipe meeting applicable requirements of UNI 9534,
Class [1] [2] [3] fabricated with holes approximately 10 mm to 15 mm[____ mm
] diameter arranged in [3] [4] [5] rows parallel to the axis of the pipe.
Perforations shall be spaced approximately 30 mm apart.

2.2.6.5 Perforated Polyvinyl Chloride (PVC) Piping

UNI EN 1401-1.

2.2.6.6 Requirements Governing Piping

NOTE: Sulfate resistance is required for concrete
pipe when pipe is carrying sulfate-bearing waters,
or when pipe is buried in soil containing sulfates.
Specify CEM II/A-S or CEM II/B-S (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

1,000 parts per million. Specify CEM III/A (sulfate resisting) cement when soils contain in excess of 0.2 percent water-soluble sulfate and water samples contain in excess of 1,000 parts per million. In areas where reactive aggregates are known to occur, specify low alkali cement.

[Cement for concrete pipe shall be [CEM II/A-S] [CEM II/B-S] [CEM III/A] [low alkali cement] conforming to UNI EN 197-1.] Use nonperforated fittings of the same material and strength where necessary, that conform to the applicable specifications specified for fittings.

2.2.6.7 Jointing Materials

Tar paper, reinforced building paper, roofing paper, glass fiber fabric, or other approved materials shall be used for covering open joints in drain tile.

2.3 CONCRETE MATERIALS

NOTE: Delete this paragraph if not used or insert applicable concrete requirements here.

Provide as specified in Section 03300, "Cast-In-Place Concrete."

2.4 MISCELLANEOUS MATERIALS

2.4.1 Drainage Structures

Construct of clay brick or concrete, except that airfield catch basins, headwalls, gutters, top of curb inlets, and bases shall be concrete. Precast structures may be provided in lieu of cast-in-place concrete except for airfield catch basins, headwalls, and gutters. Pipe-to-wall connections shall be mortared to produce smooth transitions and watertight joints or provided with resilient connectors. Bases shall have smooth inverts accurately shaped to a semicircular bottom conforming to the inside contour of the adjacent sewer sections. Changes in direction of the sewer and entering branches into the manhole shall have a circular curve in the manhole invert of as large a radius as the size of the manhole will permit.

2.4.1.1 Precast Concrete Structures

D.M. 9 January 1996, except as specified herein. Provide [an air content of 6 percent, plus or minus 2 percent and] a minimum wall thickness of 125 mm. D.M. 9 January 1996 reinforcing bars. D.M. 9 January 1996 welded wire fabric. UNI EN 681-1/A1 gaskets for joint connections. Provide a 100 mm layer of clean gravel bedding with a maximum size of 50 mm.

2.4.2 Masonry Materials

Shall conform to the following specifications and other requirements

specified hereunder.

2.4.2.1 Brick

UNI 8942-1, except that the absorption test will be waived.

2.4.2.3 Mortar

D.M. 20 November 1987.

2.4.2.4 Water

Water for masonry mortar shall be fresh, clean, potable.

2.4.2.5 Grout

D.M. 20 November 1987.

2.4.3 Metal Items

2.4.3.1 Frames, Covers, and Gratings

NOTE: Include frame, cover, and grating design requirements on the drawings. Provide ductile iron option if available and meets load requirements. Designer shall check grate capacity of detailed grate to verify it is adequate to meet design.

Shall be cast iron conforming to UNI EN 124, with dimensions and shapes as shown on the drawings. Fabricate frames, covers, and gratings for airfield use of standard commercial grade steel [or ductile iron], welded by qualified welders in accordance with UNI EN 288-1/A1 and UNI EN 288-2. Covers shall be of rolled steel floor plate [or ductile iron] having an approved anti-slip surface. Steel gratings shall be of commercial grade steel [or ductile iron] and be of welded construction. Solid covers shall have the word "STORM" cast on the top.

- a. Traffic manhole frames, grates, and covers: Class [D400] [E600] [F900] minimum. Provide in paved areas.
- b. Non-traffic manhole frames, grates, and covers: Class [A15] [B125] [C250] minimum.

2.4.3.2 Drainage Structure Steps

[Zinc-coated steel] [as indicated] conforming to UNI EN 29519. [As an option, plastic or rubber coating pressure-molded to the steel may be used. Plastic coating shall be copolymer polypropylene as recommended by manufacturer of steps. Rubber shall conform to UNI EN 681-1/A1.] [For curb inlets, steel sump ladder rungs as indicated may be used in lieu of cast-iron steps; rungs shall be zinc-coated after fabrication.] Aluminum steps or rungs will not be permitted. Steps are not required in manholes

[, curb inlets,] or catch basins less than 1.2 m deep.

2.5 FLARED ENDS

Flared end sections shall be same material as pipe material except that only reinforced concrete flared ends shall be provided for concrete pipe. [Flared ends are included in the lengths of pipe indicated.]

2.6 EROSION CONTROL RIPRAP

Provide nonerrodible rock not exceeding 375 mm in its greatest dimension and choked with sufficient small rocks to provide a dense mass with a minimum thickness of [200 mm] [as indicated].

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

3.1.1 General Requirements for Installation of Pipelines

Installation shall conform to D.L. 494 and D.M. 12 December 1985, except where specific exception is made under paragraph entitled "Special Requirements."

3.1.1.1 Location

The work covered by this section shall terminate at a point approximately 1.5 m from the building[, unless otherwise indicated on the drawings].

3.1.1.2 Earthwork

NOTE: Earthwork requirements for pipe trenches are covered in Section 02302, "Excavation, Backfilling, and Compacting for Utilities." The applicable requirements which are set forth in Section 02302 must be incorporated into the project specification, whether in Section 02302 or in an all-inclusive earthwork section. The above referenced section number and title is subject to change. The specifier should verify the current appropriate specification and revise as necessary if different.

Perform earthwork operations in accordance with Section 02315, "Excavation and Fill."

3.1.1.3 Pipe Laying and Jointing

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

Inspect each pipe and fitting before and after installation; remove those found defective from site and replace with new. Provide proper facilities for lowering sections of pipe into trenches. Lay pipe with the bell [or groove] ends in the upgrade direction. Adjust spigots in bells [and tongues in grooves] to produce a uniform space. Blocking or wedging between bells and spigots [or tongues and grooves] will not be permitted. Replace by one of the proper dimensions any pipe or fitting that does not allow sufficient space for proper calking or 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 7.5 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.

3.1.1.4 Connections to Existing Lines

Notify Contracting Officer in writing at least 10 days prior to date that connections are to be made. Obtain approval of the Contracting Officer before interrupting service. 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

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations and written instructions of the pipe manufacturer. Make joints with the rubber gaskets specified for joints with this piping; 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 manufacturer written instructions and recommendations for pipe laying. Make joints with a compression joint material specified for joints with this piping and assemble in accordance with the recommendations of the manufacturer of the pipe.

3.1.2.3 Installation of Concrete 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 the manufacturer written instructions and recommendations. Make joints with the gaskets previously specified for joints with this piping. 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.

3.1.2.4 Installation of PVC Plastic Piping

Install pipe and fittings in accordance with the "General Requirements for Installation of Pipelines" and with the requirements of IIP, Pub.n.3; Nov.1984 for laying and joining pipe and fittings. Make joints with the gaskets specified for joints with this piping; assemble in accordance with the requirements of IIP, Pub.n.3; Nov.1984 for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.1.2.5 Installation Beneath Railroad Right-Of-Way

Where pipeline passes under the right-of-way of a commercial railroad, install piping [by the boring and jacking method] in accordance with the specifications for pipelines conveying nonflammable substances in D.M. 23 February 1971.

3.1.2.6 Installation of Subsurface Drainage Piping

Laying and jointing shall be in accordance with paragraph entitled "General Requirements for Installation of Piping" of this section, except as specified hereinafter, and with the additional requirements specified hereinafter.

- a. Laying and jointing: The laying of pipe and tile shall proceed upgrade from the lower end of the line, and shall have a uniform pitch to the outlets. Lay drain tile with 3 to 6 mm open joints. Joints between the tile shall be covered with one thickness of the jointing material specified; material shall overlap the joint not less than 100 mm on each side and shall cover the tile for not less than the upper half or more than the upper two-thirds of the circumference of the tile. [[Lay perforated clay pipe] [and] [perforated concrete pipe] without filling the pipe joints, but with positive provision for centering each section of pipe in the bell [or groove] of the placed section.] Provide vertical pipe at the high points in each drain run, for testing purposes. Connect the vertical pipe sections into the drains by means of tees, and extend to the height indicated. Fit the upper hub ends with screwed plugs. Make joints in cast-iron sections with fiber gaskets and 1 to 2 portland cement mortar.

3.1.3 Concrete Work

NOTE: Delete this paragraph if not used or insert applicable concrete requirements here.

Perform cast-in-place concrete work in accordance with Section 03300, "Cast-In-Place Concrete."

3.1.4 Manhole[, Curb Inlet,] and Catch Basin 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 drainage sections. For changes in direction of drains 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. For precast concrete construction, make joints between sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete piping. Give a smooth finish to inside joints of precast concrete manholes[, curb inlets,] and catch basins. Parging will not be required for precast concrete manholes. Cast-in-place concrete work shall be in accordance with the paragraph entitled, "Concrete Work." Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose or mortared to produce a watertight joint; install in accordance with the recommendations of the connector manufacturer. Where a new manhole is constructed on an existing line, remove existing pipe as required to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding beyond into the manhole.

3.1.5 Metal Work

3.1.5.1 Workmanship and Finish

NOTE: Provide paint system acceptable in project's locality. See Section 09900, "Paints and Coatings" for guidance.

Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron [and steel] 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 rabbets, lugs, and brackets wherever necessary for fitting and support. [Apply zinc coating to steel gratings after fabrication in accordance with UNI EN ISO 1461.] [Clean surfaces of steel frames and covers to bare metal by a blasting process. Where surfaces cannot be cleaned satisfactorily by blasting, clean to bare metal by wire brushing or other mechanical means. For surfaces contaminated with rust, dirt, oil, grease, or other contaminants, wash with solvents until thoroughly clean. Immediately after cleaning, coat surfaces with a coat of pretreatment coating, UNI 8403, applied to a dry film thickness of 0.008 to 0.013 mm; or apply a crystalline phosphate coating, FS TT-C-490, Method I, Type II. As soon as practicable after the pretreatment coating has dried, prime treated surfaces with a coat of [_____] applied to a minimum dry film thickness of [_____] mm. If primed

surfaces are damaged before removal from the shop, retouch with primer.]

3.1.5.2 Field Painting

NOTE: Provide paint system acceptable in project's locality. See Section 09900, "Paints and Coatings" for guidance.

[After installation, clean cast-iron frames, covers, gratings, and steps not buried in masonry or concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint.] [After installation, clean steel covers and steel or concrete frames not buried in masonry or concrete to bare metal of mortar, dirt, grease, and other deleterious materials. Apply a coat of primer, [____], to a minimum dry film thickness of [____] mm; and apply a top coat, [____] to a minimum dry film thickness of [____] mm, color optional.] Do not paint surfaces subject to abrasion.

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 [____, "____."]] Be able to produce evidence, when required, that each item of work has been constructed properly in accordance with the drawings and specifications.

3.2.2 Pipeline Testing

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.

3.2.2.1 Leakage Tests

NOTE: Delete the paragraph when watertight joints are not required.

NOTE: In the 5th sentence, use 1st optional wording in connection with exfiltration test requirements except where the line or any test portion thereof is of such slope that the testing water will cause an excessively high pressure on the lower part of the line. In this case, for the entire line or the applicable portion, the test requirements should be modified accordingly for the project conditions.

NOTE: In the 8th sentence, use 1st optional wording if it meets project requirements. For other cases, leakage rates may be determined for infiltration and exfiltration tests as specified in Section 02530, "Sanitary Sewerage."

NOTE: Delete for projects that do not have bell-and-spigot joint piping.

Test lines for leakage by either infiltration tests or exfiltration tests. Prior to testing for leakage, backfill trench up to at least the 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 the water table is 600 mm or more above top of pipe at upper end of pipeline section to be tested, measure infiltration using a suitable weir or other acceptable device. When the water table is less than 600 mm above top of pipe at upper end of pipeline section to be tested, make exfiltration test by filling the line to be tested with water so that the head will be [at least 1.2 m above top of pipe at upper end of pipeline section being tested] [_____]. Allow filled pipeline to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, re-establish the head and measure amount of water needed to maintain this water level during a 2 hour test period. Amount of leakage, as measured by either infiltration or exfiltration test shall not exceed [47] [_____] liters per millimeter of diameter per day per kilometer of pipeline. When leakage exceeds the amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

3.2.3 Field Tests for Concrete

NOTE: Delete this paragraph if not used or insert applicable concrete requirements here.

Field testing requirements are covered in Section 03300, "Cast-In-Place Concrete."

-- End of Section --