

**ALBEMARLE COUNTY SERVICE AUTHORITY (ACSA)
CONSTRUCTION SPECIFICATIONS**

Regulating the Construction and Expansion of the
Water and Sewer Systems within the County
of Albemarle, Virginia

TABLE OF CONTENTS

<u>PART I</u>	<u>PAGE</u>
<u>GENERAL INFORMATION</u>	
A. Purpose.....	GI-1
B. Definitions	GI-1
C. Responsibility	GI-3
D. Underground Utility Damage Prevention Act	GI-4
E. Regulations of Other Agencies	GI-4
 <u>PART II</u>	
<u>ADMINISTRATIVE POLICIES</u>	
A. General	AP-1
B. Utility Master Plan	AP-1
C. Plans & Specifications	AP-1
1. Submittal.....	AP-1
2. Plan Review Fees.....	AP-2
3. Review	AP-2
4. Approval.....	AP-3
5. Preconstruction Conference.....	AP-3
D. Dedication	AP-3
E. Easements	AP-3
F. As-Built Plans.....	AP-4
G. Liability	AP-4
H. Regulations & Ordinances of Other Agencies	AP-4
I. Inspection.....	AP-5

PART III

PAGE

GENERAL CONDITIONS

A.	General Information	GC-1
B.	Safety of Public	GC-1
C.	Protection of Existing Facilities	GC-1
D.	Separation of Water & Sewer Systems	GC-2
	1. General.....	GC-2
	2. Parallel Installations.....	GC-2
	3. Crossing Installations	GC-2
E.	Pipeline Installation Under Existing Public Highways	GC-3
	1. General.....	GC-3
	2. Pipeline Installation.....	GC-3
	3. Pavement & Shoulder Replacement.....	GC-4
F.	Pipeline Installation Under Existing Railroads.....	GC-4
G.	Blasting.....	GC-4
H.	Restoration.....	GC-5
I.	Erosion Control	GC-5
J.	Utilities Within Streets of Planned Developments	GC-5

PART IV

WORK ASSOCIATED WITH WATER SYSTEM CONSTRUCTION

A.	General Information	W-1
B.	Design Criteria	W-1
	1. Pipe Size.....	W-1
	2. Flow Requirements.....	W-1
	3. Depth of Cover	W-1
	4. Gate Valve Locations	W-2
	5. Crossing Water Courses	W-2
	6. Constructing Under Culverts and Storm Drains	W-2

	<u>PAGE</u>
C. Water System Construction	W-3
1. Handling of Materials.....	W-3
2. Pipe Laying - General Comments	W-3
3. Tapping Water Mains	W-3
a. Tapping PVC, Transite or DI Pipe.....	W-3
b. General Requirements for Tapping PVC and Transite Pipe (AC Pipe)	W-4
c. Special Requirements for Tapping PVC Pipe	W-4
d. Special Requirements for Tapping Transite Pipe (AC Pipe).....	W-5
4. Excavation and Laying of Pipe	W-5
a. Excavation	W-5
b. Construction in Fill Areas.....	W-6
c. Trench Width	W-6
d. Rock Excavation.....	W-6
e. Over Excavation	W-7
f. Pipe Installation (General).....	W-7
g. Condition of Pipe	W-7
h. Special Precautions.....	W-7
5. Pipe Installation	W-7
a. Cutting of Pipe	W-7
b. Pipe Deflection.....	W-8
6. Hydrants, Valves, and Fittings Construction	W-8
a. Bracing of Fittings.....	W-8
b. Fitting Installations.....	W-8
c. Cross Anchor Restraints	W-9
7. Pipe Foundation	W-9
a. General.....	W-9
b. Foundation in Good Soil.....	W-9
c. Foundation in Poor Soil.....	W-9
8. Backfilling and Compaction	W-10
a. General.....	W-10
b. Materials	W-10
c. Backfilling.....	W-10
d. Compaction	W-10
e. Protection of Pipe & Appurtenances	W-11

	<u>PAGE</u>
D. Water Pipe Material & Jointing	W-11
1. General Requirements	W-11
a. Ductile Iron Pipe and Fittings	W-11
b. Galvanized Steel Pipe and Fittings	W-12
c. Copper Pipe and Fittings.....	W-12
2. Jointing	W-12
E. Valves & Accessories	W-13
1. Gate Valves	W-13
2. Butterfly Valves.....	W-13
3. Tapping Valves.....	W-15
4. Tapping Sleeves.....	W-15
5. Check Valves.....	W-15
6. Detector Check Valves (Private Fire Protection Line).....	W-15
7. Valve Boxes.....	W-16
8. Corporation Stops.....	W-16
9. Copper Meter Yokes & Coppersetters	W-16
10. Service Laterals.....	W-17
11. Concrete Thrust Blocks	W-17
12. Marking Tape.....	W-17
13. Conductive Wire	W-17
F. Meter Boxes & Meter Vaults	W-17
1. Meter Boxes	W-17
2. Meter Vaults	W-18
a. General.....	W-18
b. 1-1/2" & 2" Meters	W-18
c. Meters 3" and Larger.....	W-18
G. Water Service Laterals.....	W-19
H. Blow-Off Assemblies.....	W-19
I. Air Relief Valve Assemblies	W-20
J. Fire Hydrant Specifications	W-20
K. Acceptable Tests	W-22
1. Pressure Test	W-22
a. Test Pressure Restrictions	W-22
b. Pressurization.....	W-22

	<u>PAGE</u>
c. Air Removal	W-22
d. Examination	W-22
2. Leakage Test.....	W-23
a. Leakage Defined	W-23
b. Allowable Leakage	W-23
c. Acceptance of Installation	W-23
L. Disinfection.....	W-23
1. Continuous Feed Method.....	W-24
2. Tablet Method.....	W-24

PART V

WORK ASSOCIATED WITH SEWER CONSTRUCTION

A. General Information	S-1
B. Design Criteria	S-1
1. Slope	S-1
2. Drop Manhole Requirements	S-2
3. Sewers Exceeding 20% Slope	S-2
4. Sewer Junctions	S-2
5. Minimum Size	S-2
6. Manhole Requirements	S-3
7. Ventilation	S-3
8. Depth of Cover	S-3
9. Design.....	S-4
10. Industrial Waste.....	S-4
11. Storm and Sanitary Sewer Crossings	S-4
C. Sewer Locations.....	S-4
1. General.....	S-4
2. Stream Crossings.....	S-4
D. Sewer Service Laterals	S-5
1. General.....	S-5
2. Pipe Installation	S-5
3. Marking.....	S-6
4. Inspection	S-6

	<u>PAGE</u>
E. Sanitary Sewer Construction	S-6
1. Pipe Laying-General Requirements	S-6
2. Excavation & Laying of Pipe.....	S-7
a. Excavation	S-7
b. Construction in Fill Areas.....	S-8
c. Trench Width	S-8
d. Rock Excavation	S-8
e. Over Excavation	S-8
f. Pipe Installation (General).....	S-9
g. Condition of Ductile Iron Pipe.....	S-9
h. Special Precautions.....	S-9
3. Pipe Foundation	S-9
a. Foundation in Good Soil.....	S-9
b. Foundation in Poor Soil	S-10
c. Pressure Sewer	S-10
4. Backfilling & Tamping.....	S-10
a. General	S-10
b. Materials	S-10
c. Backfilling.....	S-11
d. Compaction	S-11
e. Protection of Pipe and Appurtenances	S-11
F. Sanitary Sewer Pipe, Jointing & Accessories	S-12
1. General Requirements	S-12
a. Ductile Iron Pipe & Fittings	S-12
b. Concrete Pipe.....	S-12
c. Polyvinyl Chloride Pipe	S-12
d. Marking Tape.....	S-13
2. Joints	S-13
a. Ductile Iron & Cast Iron Pipe	S-13
b. Concrete Pipe.....	S-13
c. Polyvinyl Chloride Pipe	S-14
d. Gaskets	S-14
G. Manholes.....	S-14
1. General Requirements	S-14
2. Frames & Covers.....	S-14

	<u>PAGE</u>
a. Materials	S-14
b. Frame & Cover Installations	S-15
3. Precast Concrete Manholes	S-15
a. General Information.....	S-15
b. Concrete	S-16
c. Joints	S-16
d. Steps.....	S-16
e. Inverts	S-17
4. Connection to Existing Manholes.....	S-17
5. Doghouse Manholes.	S-17
H. Acceptable Tests	S-17
1. General Requirements	S-17
2. Gravity Sewers	S-18
a. Alignment.....	S-18
b. Deflection.....	S-18
c. Testing.....	S-18
I. Infiltration	S-18
II. Exfiltration	S-19
III. Low Pressure Air Test	S-20
3. Manhole Testing.....	S-21
a. General.....	S-21
b. Exfiltration	S-22
c. Vacuum Testing	S-22
4. Pressure Sewer	S-23
5. Acceptance.....	S-24

PART VI

SUPPLEMENTAL SPECIFICATIONS

A. Concrete.....	SUP-1
1. General Requirements	SUP-1

	<u>PAGE</u>
2. Materials	SUP-1
a. Concrete	SUP-1
b. Steel Reinforcement.....	SUP-1
c. Wire Reinforcement	SUP-1
d. Curing Compound	SUP-1
e. Joint Filler	SUP-1
3. Slump	SUP-2
4. Testing.....	SUP-2
5. Forms.....	SUP-2
6. Placing Reinforcement	SUP-2
7. Placing of Concrete	SUP-3
8. Vibration.....	SUP-3
9. Construction Joints	SUP-3
10. Placing Concrete in Cold Weather	SUP-4
11. Repair of Surface Defects	SUP-4
12. Surface Finish.....	SUP-4
13. Protection & Curing	SUP-4
14. Concrete Walks	SUP-5

PART VII

TYPICAL DETAILS & SKETCHES

WATER

Fig. W-1	Utility Locations & Easements Widths.....	TD-1
Fig. W-2	Ductile Iron Water Pipe Installation & Bedding.....	TD-2
Fig. W-3	Concrete Thrust Blocks	TD-3
Fig. W-3A	Concrete Blocking for Upper Vertical Bends	TD-4
Fig. W-3B	Typical Thrust Block in Fill Area.....	TD-5

	<u>PAGE</u>
Fig. W-3C	Cross Anchor Restraints for Valves..... TD-6
Fig. W-4	Typical Fire Hydrant Assembly TD-7
Fig. W-5	Typical Gate Valve..... TD-8
Fig. W-6	Typical Service Lateral Installation TD-9
Fig. W-7	Typical Meter Boxes (5/8" & 1")..... TD-10
Fig. W-7A	Typical Meter Vault (Outer Dimensions for 1-1/2" & Larger)..... TD-11
Fig. W-7B	Typical Meter Vault (1-1/2") TD-12
Fig. W-7C	Typical Meter Vault (2")..... TD-13
Fig. W-7D	Typical Meter Vault (3")..... TD-14
Fig. W-7E	Typical Meter Vault (4")..... TD-15
Fig. W-8	Typical Blow-Off Assembly TD-16
Fig. W-9	Air Release Valve TD-17
Fig. W-10	Typical Steel Sleeve Installation Under Roadways – Water TD-18
Fig. W-11	Typical Steel Sleeve Installation Under Railroads – Water TD-19
Fig. W-12	Typical Stream Crossing – Water..... TD-20

SEWER

Fig. S-1-A	Typical Manhole Section Showing Branch Tie-In..... TD-21
Fig. S-1-A1	Typical Manhole Base Showing “Doghouse” Installation TD-22
Fig. S-1-B	Typical Manhole Plan Showing Branch Tie-In..... TD-23
Fig. S-1-C	Typical Manhole with Drop Connection TD-24
Fig. S-1-D	Typical Manhole Frame & Cover TD-25
Fig. S-1-E	Typical Watertight MH Frame & Cover..... TD-26
Fig. S-2	Typical Sewer Service Lateral Connection..... TD-27
Fig. S-3	Typical Sewer Pipe Installation in Trench..... TD-28
Fig. S-4	Typical Anchor Detail for Sewers on Grades Greater 20%..... TD-29

	<u>PAGE</u>
Fig. S-5 Typical Steel Sleeve Installation Under Roadways – Sewer	TD-30
Fig. S-6 Typical Steel Sleeve Installation Under Railroads – Sewer	TD-31
Fig. S-7 Typical Stream Crossing – Sewer	TD-32

APPENDIX

1. Water Data Sheet.....	A-1
2. Sewer Data Sheet	A-2
3. Letter of Dedication	A-3
4. Memo of Understanding, Virginia Department of Health	
5. Memo of Understanding, Department of Environmental Quality	

PART I

GENERAL INFORMATION

A. PURPOSE

These construction specifications of the Albemarle County Service Authority (ACSA) cover general conditions, technical specifications, and details for water and sewer utilities to be incorporated into the ACSA's infrastructure.

Requests for additional information or clarification shall be submitted to the Director of Engineering, Albemarle County Service Authority, 168 Spotnap Road, Charlottesville, Virginia 22911.

If any part of these specifications is held to be invalid, it shall not affect the validity of any other part of these specifications.

These specifications are intended as a guide to be supplemented by the Waterworks and Sewage Collection and Treatment Regulations of the Virginia Department of Health (VDH) or the Virginia Department of Environmental Quality (DEQ), which are included herein by reference.

In the event of any discrepancy between these specifications and applicable rules and regulations of the VDH or the DEQ, it shall be understood that the more stringent requirement will govern.

B. DEFINITIONS

Unless the context specifically indicates otherwise, the meaning of terms used herein shall be as follows:

AASHTO - American Association of State Highway Transportation Officials.

ANSI - American National Standards Institute.

ASCE - American Society of Civil Engineers.

AWWA - American Water Works Association.

ACSA - The Albemarle County Service Authority, including its governing and operating bodies and designated agents. Any office referred to solely by title (e.g., Executive Director, Director of Engineering) shall be the person retained in this position by the ACSA.

As-Built - Construction plans and details that have been edited after

construction to reflect accurate locations and features of all appurtenant utilities.

Board - The Board of Directors of the Albemarle County Service Authority.

Building Sewer - The extension from the building sewage drain to the public sewer.

Construction Approval - A letter issued by the ACSA to a developer which authorizes him to construct facilities for which the design plans and specifications have been approved by the ACSA.

Contractor - Any person(s), firm, group or affiliates responsible for constructing the facilities described in the ACSA's General Water and Sewer Construction Specifications.

County - The County of Albemarle, Virginia, its governing and operating bodies and designated agents.

DCR – Virginia Department of Conservation and Recreation.

DEQ - Department of Environmental Quality.

Developer - Any person, firm, corporation or association having an interest in constructing improvements to alter the use of land. Of particular interest to these specifications are developers constructing facilities to be dedicated to public use within the jurisdictional area of the ACSA.

EPA – United States Environmental Protection Agency.

Normal Domestic Sewage - Is that in which the concentration of Suspended Solids (SS) and Biological Oxygen Demand (B.O.D.) is established at 240 parts per million each, on the basis of the normal daily domestic sewage concentration.

OSHA – U.S. Department of Labor Occupational Safety & Health Administration, administered by the Virginia Department of Labor & Industry.

Public Sewer - A sewer in which all owners of abutting properties have equal rights, and which is controlled by the Service Authority.

RWSA - The Rivanna Water & Sewer Authority, its representatives and designated agents.

Sanitary Sewage - That water-carried waste which derives principally from dwellings, business buildings, institutions, industrial establishments and

the like, exclusive of any storm and surface waters.

Sanitary Sewer - A sewer that has its use limited to sanitary sewage and to which storm, surface and ground waters are not intentionally admitted.

Sewage Works - All facilities for collecting, pumping, treating and disposing of sewage.

Shall or Will - Are mandatory; may is permissive.

VDH - Virginia Department of Health - Office of Drinking Water. Division of Water Supply Engineering.

VDOT - Virginia Department of Transportation.

VMRC - Virginia Marine Resources Commission.

C. RESPONSIBILITY

The ACSA has entered into a Memorandum of Understanding with the Virginia Department of Health (VDH) and the Virginia Department of Environmental Quality (DEQ) authorizing local review of utility designs. The ACSA is responsible to enforce these regulations and standards to ensure development of utilities in accordance with these specifications as well as the regulations of the Virginia Department of Health (VDH) and of the Virginia Department of Environmental Quality (DEQ).

The developer is responsible to employ reliable contractors with sufficient skills and experience to perform all work in an acceptable manner relative to the facilities herein described. Failure to do so may result in work stoppage and/or refusal by the ACSA to accept the project as part of its system. It is recommended on large projects that the developer and/or consultant hold a preliminary conference with the Authority regarding the project prior to its design phase.

The contractor is responsible to ensure the safe and proper construction of the facilities herein mentioned. If any person is in doubt as to the true meaning of any part of these specifications, a written request shall be submitted to the ACSA for interpretation. Any questions concerning the standards shall be governed by the final decision of the ACSA.

The consultant is responsible for design and submission of the proper number of plans and specifications for the proposed work.

The ACSA reserves the right to make adjustments in types of materials and methods of construction required, should field inspections reveal

unforeseen and/or unfavorable conditions for installation of the utilities, as designed.

All work relative to connecting the systems shall be performed by the contractor or ACSA work forces. All related costs shall be the responsibility of the contractor and/or developer, unless specifically preempted by a formal contractual arrangement.

D. UNDERGROUND UTILITY DAMAGE PREVENTION ACT

In accordance with the Underground Utility Damage Prevention Act and specifically Section 56-265.17 of the Virginia Code, no person shall begin excavation or demolition without making required notification.

"Miss Utility" of Virginia is the notification control center and can be reached at 1-800-552-7001 for most utilities. 48 hours notice is required.

E. REGULATIONS OF OTHER AGENCIES

In addition to the regulations herein, utility designs shall comply with the following:

1. The Commonwealth of Virginia, Department of Health Waterworks Regulations, 12 VAC 5-590 as revised June 14, 2006 or latest revision.
2. The Commonwealth of Virginia, Department of Environmental Quality, Office of Wastewater Engineering, Sewage Collection and Treatment Regulations 9 VAC 25-790, effective February 12, 2004 or latest revision.
3. Local and State Building Codes and Ordinances.
4. Any utility crossing navigable streams must meet the requirements of the U.S. Army Corp of Engineers, DEQ, and Virginia Marine Resources Commission (VMRC). A joint permit application should be made to VMRC for review by these agencies.
5. The Commonwealth of Virginia Department of Conservation and Recreation Storm Water Management Regulations.

PART II

ADMINISTRATIVE POLICIES

A. GENERAL

This section outlines the procedural requirements for submission of utility plans and specifications to the Authority. Requirements of other regulating agencies are included by reference.

B. UTILITY MASTER PLAN

Early in the planning process, the developer shall provide a Site Utility Master Plan to the ACSA for review. This Master Plan shall include the general location and size of water mains and sewers, estimated build-out flow requirements for the project and the proposed phasing of site construction. If the site build-out needs exceed 40,000 gal/day, a capacity certification from RWSA will be required. This certificate shall address capacity in the existing water mains and sewers, as well as serving water and wastewater treatment plants.

If the existing infrastructure is not adequate to serve the project at “build-out”, the Master Plan shall also address off-site utility improvements and a construction phasing plan. Only phases for which there exists available capacity will be accepted for review.

If the entire project serves 400 people or fewer, or estimates a demand of 40,000 gal/day or less, no Master Plan will be required. Utility Plans may be submitted directly to the ACSA for review.

C. PLANS AND SPECIFICATIONS

1. Submittal

Once the Master Plan and/or subsequent phasing plan has been approved, the developer shall submit technical plans and specifications for review.

Drawings, specifications, and engineer's reports submitted for approval shall be prepared by or under the supervision of a registered professional engineer or others legally qualified to practice in Virginia in accordance with Sections 54.1-400 to 54.1-411 of the Code of Virginia inclusive. The front sheet of each set of drawings shall bear the original imprint of the P.E. seal, signature, and date of the responsible registered professional and all following sheets shall bear at least a legible facsimile of that seal, signature, and date. A cover letter shall be submitted with each set of plans and specifications giving a description

of the work.

The Virginia Department of Health (VDH) and Department of Environmental Quality (DEQ) have delegated certain rights to the ACSA to review local water and sewer projects. Any projects that include pump stations, pretreatment or storage facilities, must also be submitted to VDH and/or DEQ for review. VDH and/or DEQ reserve the right to require any project regardless of size, and scope, to be submitted for their review.

The following number of sets of plans and specifications must be submitted to the respective agency for review (contact the Charlottesville Residency of the Department of Transportation for their submittal requirements):

<u>Project</u>	<u>ACSA</u>	<u>VDH</u>	<u>DEQ</u>
Water only	3	3	
Sewer only	3	4	3
Water and sewer	3	5	3

Plan sheets shall not exceed 30" x 42" -2

Each set of plans shall be provided with a cover letter and review data sheet (Appendix, Pages A-1 & A-2) which will be stamped on the date received. Any supplemental specifications shall be attached to or shown on plans to govern work not covered by ACSA specifications. Each set of plans shall reference the approved General Water and Sewer Construction Specifications of the Albemarle County Service Authority.

2. Plan Review Fees

Plan review fees are billed based on the staff time required to adequately review all submittals. Review fees will vary depending on the complexity of the project. The fee is reviewed annually and adjusted when appropriate. Current fees are posted on the Albemarle County Service Authority (ACSA) website www.serviceauthority.org or may be obtained directly from the office of the ACSA.

3. Review

The ACSA's goal will be to review plans within forty-five (45) days after receipt. Comments shall be returned to the consultant. If the consultant does not respond within sixty (60) days, the plan shall be considered inactive. In such case a new submission shall be made. All plans will be stamped upon receipt and reviewed in order of receipt. Fees shall be charged for all plan review time on an hourly basis at the rate in effect at the time of submittal.

4. Approval

Following review and approval, plans and specifications shall be stamped "approved" and returned to the consultant with a letter of approval. Approval is for basic compliance with these Construction Specifications. "Approval" does not relieve the owner, developer, contractor or owner's consultant from responsibility for their work.

Approvals are valid for a period of eighteen (18) months from date of issue. If construction is not in progress at the end of that period, or if construction becomes inactive for a period of twelve (12) months, ACSA approval shall be void. By letter of request from the owner, an approval may be reinstated. Plans and specifications may have to be submitted as a new project, if deemed necessary by the ACSA to conform to the most current specifications.

5. Preconstruction Conference

Prior to beginning construction on the project the owner and contractor must hold a preconstruction conference with ACSA personnel. To schedule a conference contact the ACSA engineer who returned the approval letter.

D. DEDICATION

Upon completion of construction of the utilities the developer must dedicate the utilities to the ACSA. A letter of dedication (Appendix Page A-3) stating the terms of dedication must be submitted. Upon final inspection and approval of the facilities and satisfaction of all dedication requirements the ACSA will accept the facilities in writing.

The developer will be responsible for any maintenance as a result of construction or defects of said facilities for one (1) year from the date of acceptance.

E. EASEMENTS

Easements shall be required for all water, sewer lines, and appurtenances except where installed within a public right-of-way of the Virginia Department of Transportation (VDOT). If the utility is placed within the outer ten (10) feet of VDOT right-of-way, additional private easements shall be provided to allow ten (10) feet from the center of any utility. Such easements shall not be less than twenty (20) feet in width centered on the main. Combined sewer and water easements shall not be less than thirty (30) feet in width with both mains ten (10) feet from the edges of the easement. The ACSA reserves the right to require additional easement width if construction and maintenance activities require it. All easements shall have the right of ingress and egress fully

provided for in the recorded deed. Where deemed necessary by the ACSA, easements shall extend to adjacent property for orderly extensions of service.

All appurtenances (blow-off, hydrants, etc.) shall be provided with an easement twenty (20) feet in width centered on the interconnecting piping and ten (10) feet from the center of the appurtenance. Easements shall be corrected to reflect the as-built conditions and shall be submitted with the final dedication package.

No building or permanent structure shall be constructed within the easement. No trees, shrubs, structures, fences or obstacles shall be placed within an easement which would render the easement inaccessible by equipment. Any person who constructs a structure within the utility easement shall be liable for the cost of removal and any damage to the utility.

F. AS-BUILT PLANS

As-Built construction plans shall be maintained by the contractor in the field. These shall be provided to the developer or his representative to serve as the basis for the final "As-Built" plans.

Where available, control shall be based on the Virginia State Plane Coordinate System South Zone NAD 1983. Vertical reference shall be based on NAVD 1988.

A set of reproducible mylar "As-Built" plans and one blue-line copy shall be provided to the ACSA's Engineering Department by the developer. The "As-Built" plans shall be made available for use within thirty (30) days after final inspection. "As-Built" plans shall be defined as substantially in compliance with approved plans and shall indicate actual physical construction. All plan preparation, printing and duplicating cost shall be borne by the owner.

G. LIABILITY

The ACSA shall have no liability resulting from any reason whatsoever in connection with the construction, installation, or testing of any utility lines or systems.

H. REGULATIONS & ORDINANCES OF OTHER AGENCIES

All developers and builders should be familiar with all policies and laws that involve the VDH, DEQ, VDOT, VMRC, and any State Building and Fire Codes. Specifically noted are rules governing cross connections and backflow prevention.

All developers and builders should be familiar with and shall comply with the Ordinances of Albemarle County including the Building and Zoning requirements.

I. INSPECTION

An inspector from the ACSA will be assigned to each project to ensure that all work is completed and materials are installed in compliance with these specifications. During the course of construction the inspector will report to the project engineer on progress of the work. Any deviation from the approved drawing must be approved by the ACSA before incorporation into the work. ACSA shall be permitted access to the construction work at any time for inspection of work and construction methods.

PAGE LEFT BLANK INTENTIONALLY

PART III

GENERAL CONDITIONS

A. GENERAL INFORMATION

This section outlines miscellaneous conditions for water and sewer construction.

B. SAFETY OF PUBLIC

Construction operations shall be scheduled so as to interfere as little as possible with public travel, whether vehicular or pedestrian. Whenever it is necessary to cross or interfere with roads, driveways, and walks, whether public or private, suitable and safe bridges, detours, or other temporary provisions for the accommodation of public and private travel shall be provided and maintained. Reasonable notice shall be given to owners of private driveways before disturbing the driveway. The contractor shall designate a safety officer from his staff to be responsible for his operation.

C. PROTECTION OF EXISTING FACILITIES

All construction operations in the vicinity of other existing facilities shall be performed with great care to prevent damage to these utilities. Prior to construction operations all utility companies shall be requested to verify location of their utilities in the field. Any damaged utility shall be repaired with new materials and restored to its original condition.

In accordance with the Underground Utility Damage Prevention Act and specifically Section 56-265.17 of the Virginia Code, no person shall begin or make excavation or demolition without making required notification.

"Miss Utility" of Virginia is the notification control center and can be reached at 1-800-552-7001 for most utilities. Forty-eight (48) hours notice is required.

Existing Utilities: It shall be the Contractor's responsibility to conduct the work in such a manner as to avoid damage to or interference with utilities. If damage or interruption of service occurs as a result of his work, it is the Contractor's responsibility to promptly notify the inspector and the utility and to repair or correct it immediately at the Contractor's expense and to the satisfaction of the ACSA and owner of the utility.

D. SEPARATION OF WATER AND SEWER SYSTEMS

1. General

There shall be no physical connection between drinking water supplies and sewers or appurtenances. No sewer shall pass within one hundred (100) feet of a potable water supply well or other potable water supply source or structure unless special construction and/or pipe materials are used to obtain adequate protection. No water pipe shall pass through or come in contact with any part of a sewer manhole.

2. Parallel Installations

Water lines shall be laid at least ten (10) feet horizontally from a sewer or sewer manhole whenever possible; the distance shall be measured edge-to-edge. When local conditions prevent a horizontal separation of ten (10) feet, the water line may be laid closer to a sewer or sewer manhole provided that:

- a. The bottom (invert) of the water main shall be at least eighteen (18) inches above the top (crown) of the sewer.
- b. Where this vertical separation cannot be obtained, the sewer 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.

3. Crossing Installations

Water lines crossing sewers shall be laid to provide a separation of at least eighteen (18) inches between the bottom of the water line and the top of the sewer whenever possible. When local conditions prevent this vertical separation, the following construction shall be used:

- a. Sewers passing over or under water lines shall be constructed of AWWA approved Ductile Iron water pipe and pressure tested in place without leakage prior to backfilling.
- b. Water lines passing under sewers shall, in addition, be protected by providing:
 - i. A vertical separation of at least eighteen (18) inches between the bottom of the sewer and the top of the water line;

- ii. Adequate structural support for the sewers to prevent excessive deflection of the joints and the settling on and breaking of the water line;
- iii. That the length of the water line be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer. The length of sewer pipe shall also be centered at the point of crossing, so that joints shall be equidistant and as far as possible from the water line.

E. PIPELINE INSTALLATION UNDER EXISTING PUBLIC HIGHWAYS

1. General

Work in public highway rights-of-way shall be subject to VDOT approval. A Land Use Permit must be obtained from the Virginia Department of Transportation before beginning the work. Permit requirements are outlined in the "Land Use Permit Manual, Virginia Department of Transportation, Richmond, Virginia," current revision. No work will be authorized by the Authority that has not been approved by VDOT. Specifications of VDOT governing work within public highway rights-of-way shall govern this work. Where there is a conflict between the VDOT specifications and these specifications, the more stringent requirement shall apply.

Construction operations in public streets, roads, or alleys shall be confined to as small a working space as practical so as not to cause undue inconvenience to the public or to adjacent properties. At the time of undertaking the work, the contractor shall notify VDOT and the project engineer twenty-four (24) hours in advance of construction.

2. Pipeline Installation

Main water distribution lines and sanitary sewer lines under existing public highways shall be installed by open cutting if approved by VDOT. If not approved, they shall be installed by bore and jacking inside with a spiral-welded steel casing pipe with a minimum thickness of one-quarter (1/4) inch. The casing pipe shall extend from back of curb to back of curb, or beyond concrete or paved ditches, or a minimum of five (5) feet beyond the edge of pavement, whichever is greater.

The steel casing pipe shall be no less than twice the diameter of the carrier pipe for water installations and no less than three times the diameter of the carrier pipe for sewer installations. All carrier pipe installed in steel casings shall be ductile iron and shall be supported with steel casing spacers. For steel sleeves under roadways see Part VII, Figure W-10, and Figure S-5.

Bore and jacking of pipe or tunneling under pavement shall be done only upon prior written approval by the ACSA. If any pipe is installed in this manner, the contractor shall submit a detailed schedule of operation and shall show the equipment and the exact method to be used.

3. Pavement & Shoulder Replacement

The work includes the replacement of all pavement and shoulders removed or damaged by the contractor during the course of construction. All work replaced shall match the existing work as nearly as practicable. Materials to be replaced shall be as required in the "Land Use Permit", but no less than 1-1/2 times those removed and shall be in accordance with the Virginia Department of Transportation Road and Bridge Specifications, latest revision.

F. PIPELINE INSTALLATION UNDER EXISTING RAILROADS

Local railway companies require permits for any construction within the confines of their right-of-way limits or properties. All requirements relative to design and construction must be met prior to approval by the Authority. Notice or verification of meeting such requirements shall be submitted to the Authority with the construction plans. Main water and sewer distribution lines under railroads shall be installed and sleeved in accordance with the "AREA Manual for Railway Engineering - Part 5, Pipelines," current revision. Approvals by the railway company involved and the Authority are necessary prior to authorization of work to commence. For steel sleeves under railroads, see Part VII, Figure W-11, and Figure S-6.

G. BLASTING

Blasting, where required, shall be done with care in accordance with all applicable Federal, State, and local laws, ordinances, rules and regulations of the authorities having jurisdiction and by skilled and experienced blasters. A blasting permit must be obtained from the Albemarle County Department of Fire & Rescue prior to commencing the work. All Federal, State, and local regulations governing construction safety shall be adhered to and any violation of such regulations shall be deemed the sole responsibility of the contractor and/or developer. Proper notification shall be given to the ACSA and the public prior to the commencement of blasting operations. Blasting on Saturdays, Sundays, and holidays will be permitted only with special written permission from the ACSA.

Precautions shall be taken to prevent injury to persons and damage to property. No blasting shall be done within twenty-five (25) feet of any completed work or adjacent to any other structures unless proper precautions are taken. Ends of utility lines adjacent to the blasting area shall be covered to avoid debris and damage. Whenever blasting will be undertaken in the vicinity

of an existing utility, it shall only be done with direct "onsite" supervision of the ACSA. Any damage as a result of blasting operations shall be the sole responsibility of the contractor and/or developer.

H. RESTORATION

The Contractor shall restore all surfaces disturbed by his operations to a condition at least equal to that which existed prior to commencement of the work. Restoration work shall be commenced immediately following the completion of the work on any section of the project. All drainage structures shall be restored using like materials and details.

All ditches shall be restored to the prior existing grade and cross section. All pavement, walks, curbs, gutters, and entrances removed or damaged by the Contractor shall be replaced to equal or better condition.

All public streets, roads, and highways shall be restored as required by VDOT. All private streets shall be restored to VDOT standards with materials 1½ times the thickness of the surface disturbed.

Work performed on private property shall be confined to the easements obtained and the area shall be seeded or sodded. Landscaping, fences or other improvements shall be restored, where applicable, to their original condition.

The contractor shall be responsible for all restoration necessary as a result of his operations for the period of one (1) year following acceptance of the work by the ACSA.

I. EROSION CONTROL

Prior to beginning any land disturbing activity, equal to or greater than one acre, the Contractor shall obtain a Virginia Stormwater Management Program (VSMP) Permit from the Virginia Department of Conservation & Recreation. The Contractor shall also submit an Erosion Control Plan to the Albemarle County Department of Community Development for their review. Construction activity disturbing in excess of 10,000 sq. ft. shall require a Soil Erosion Control permit from the Albemarle County Department of Community Development. Special precaution shall be taken for activity occurring within the drainage basin of any water supply impoundment.

J. UTILITIES WITHIN STREETS OF PLANNED DEVELOPMENTS

Utilities to be installed in planned subdivisions may be installed within streets, subject to approval of VDOT, where such streets are to be dedicated to VDOT for public use. Guidelines have been developed to assist in planning

utility installations. The following guidelines are for proposed utility placement within the right-of-way in the Culpeper District for subdivision streets:

1. Waterlines will be allowed under the pavement five (5) feet from the outside edge of the pavement or seven (7) feet from the face of curb on undivided roadways. This guideline will be recognized unless, as determined by VDOT, there are compelling design or safety issues which would demand consideration of an alternate location.
2. Waterlines greater than twenty-four (24) inches in diameter under the pavement parallel with the roadway alignment will be reviewed on a case-by-case basis.
3. Sanitary manholes and surface structures should be located outside the roadway shoulder and ditch line or beyond the back of the roadway curb. Connecting lines between manholes will be allowed under the pavement around curves and at crossings. However, these scenarios will be minimized by the guidelines herein. Special situations beyond these guidelines will be reviewed on a case-by-case basis.

PART IV

WORK ASSOCIATED WITH WATER SYSTEM CONSTRUCTION

A. GENERAL INFORMATION

Any new water system to be connected to the public supply shall not be constructed until final plans are approved by the ACSA. The ACSA shall be furnished for review three (3) sets of plans and specifications prepared by a Registered Engineer certified to do business in the State of Virginia. Plans shall be in sufficient detail to accurately indicate all pertinent design and construction details for a comprehensive interpretation of the work to be performed. Plans shall be reviewed for compliance with the following standards as have been adopted by the ACSA.

B. DESIGN CRITERIA

1. Pipe Size

All main distribution pipe lines shall be of a size to adequately serve all the needs of the proposed subdivision or water system, but in any event shall not be less than six (6) inches (nominal size) in diameter except as may otherwise be permitted herein.

The minimum size of the pipe where fire protection is to be provided or required shall be six (6) inches in diameter. If more than one (1) fire hydrant is required, then the minimum line size shall be eight (8) inches or the system shall be reinforced using a grid system layout. Dead-ends shall be minimized by looping all mains. Where dead-ends are necessary they shall be provided with a fire hydrant, or blow-off assembly. The nominal pipe diameter of water mains without fire hydrants shall not be less than four (4) inches. The consultant shall be responsible to properly design the water system for fire protection under all conditions. Hydraulic calculations for sizing the water system must be submitted to the ACSA for review.

2. Flow Requirements

All distribution systems shall be capable of providing a flow of three (3) gallons per minute per connection at a minimum working pressure of 20 psi at each service connection, plus the required fire flow as determined by the Albemarle County Department of Fire & Rescue.

3. Depth of Cover

Water pipe shall be laid with a cover of three (3) feet measured from established finished grade to the top of the pipe. The contractor shall establish

adequate elevation control to ensure that upon final grading a minimum of three (3) feet of cover over waterlines has been maintained. It shall be the contractor's responsibility and expense to verify the cover at any location questioned by the ACSA. Any potential changes in alignment or grade of roadways shall be considered in the original utility design. Loss of adequate cover will necessitate relocation or lowering of the water line. Every effort shall be made to maintain the finished grade so as to not exceed a trench depth of five (5) feet.

4. Gate Valve Locations

Approved gate valves shall be installed at all pipe junctions and street intersections in such a manner as to control and cut off flows in all segments of the system. Three (3) valves are required at crosses on systems, two (2) valves at tees; the valves are to be placed on the smaller lines at each cross and tee location, unless otherwise approved by the ACSA. In other areas gate valves will be required every 1000 feet, except as may otherwise be approved by the ACSA. No gate valve shall be located under a concrete storm gutter or sidewalk. Additional valves may be required under certain circumstances, such as in looped systems, where it is necessary to isolate limited areas.

5. Crossing Water Courses

Waterlines intended to cross streams, rivers, or other surface waters, either continuous or intermittent flows, present special problems and should be discussed with the ACSA and the Virginia Department of Health before final plans are prepared. The waterline is to be installed a minimum of three (3) feet under the stream or riverbed and be of special construction having flexible watertight joints. Valves shall be provided at both ends of the water crossing so that the section can be isolated for tests or repairs; the valves shall be easily accessible and not subject to flooding. Permanent one-inch (1") taps shall be made for testing and locating leaks at each end of the water crossing. Ductile iron water pipe, Class 52, shall be used (See Part VII, Figure W-12.)

The developer is reminded that specific requirements of the U.S. Army Corp of Engineers, DEQ, and/or VMRC may apply to any perennial stream crossing with a drainage area greater than five (5) sq. miles. A joint permit application may be filed with VMRC for review of these agencies.

6. Constructing Under Culverts & Storm Drains

The Authority shall require a minimum separation from open-ended culverts of twelve (12) inches with insulation to prevent freezing or three (3) feet without insulation. The type of insulation and the method of application shall conform to the manufacturer's published recommendation.

The minimum distance between waterlines and storm drainage appurtenances where crossing shall be twelve (12) inches.

C. WATER SYSTEM CONSTRUCTION

Construction of water lines and appurtenances shall be in accordance with the approved plans and specifications. The ACSA shall insist that good workmanship and standard waterline construction principles apply in the work in order that the finished project may qualify on final inspection for acceptance into the ACSA water system.

1. Handling of Materials

Pipe, fittings, valves, hydrants, and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall they be dropped. Pipe shall not be skidded or rolled against pipe already on the ground. Pipe shall be handled so that the coating and lining shall not be damaged.

2. Pipe Laying - General Comments

The water mains shall be installed and maintained to the required lines and grades with fittings, valves, hydrants, and accessories set at the required locations as indicated on the approved plans. All valves and hydrant stems shall be set plumb. Blue marking tape shall be placed in the trench two (2) feet above the top of all water mains, service lines and appurtenant items during backfill operations. Wherever obstructions not shown on plans are encountered during progress of the work, the ACSA or its representative shall be advised. If any deviation is contemplated from that shown on the plans approved by the ACSA, details shall be submitted for review and approval before construction. Verbal approval may be granted for minor alterations. Major alterations will require written approval. No water main shall terminate under a curb, gutter, ditch or storm drainage structure.

3. Tapping Water Mains

All tapping on existing mains shall be accomplished with ACSA forces unless otherwise approved. Tap sizes and location shall be as shown on the typical details, appended herein.

a. Tapping PVC, Transite or DI Pipe

The following procedures are required when tapping existing PVC, transite or ductile iron water mains:

- I. Taps shall be located at least eighteen (18) inches from the joint.

- II. Tapping procedures shall be in accordance with the manufacturer's published recommendations.
- III. Tapping sleeves and valves shall be used on four (4) inch or larger taps.
- IV. Tapping sleeves shall be subjected to an air test at 35 psi for a duration of five minutes, prior to making a tap. The test pressure shall not exceed 40 psi in any case.
- V. All two (2) inch taps shall be made using saddles.

b. *General Requirements for Tapping PVC & Transite Pipe (AC Pipe)*

The following procedures are required when tapping existing PVC or transite pipe water mains:

- I. Only one tap shall be located in a common line parallel to the longitudinal axis.
- II. When multiple taps are necessary on the same length of pipe they shall be located on slightly different planes and separated by at least three (3) feet.
- III. Saddles shall be used on all taps.
- IV. Tapping sleeves on PVC or transite waterlines shall be supported by a concrete pad, cast in-place, prior to the tap being made. A concrete thrust block shall also be provided behind the tapping sleeve.

c. *Special Requirements for Tapping PVC Pipe*

The pipe shall be tapped only when the temperatures fall within the following range limits:

Temperature Limits for Tapping PVC Pipe

<u>Connection</u>	<u>Minimum</u>	<u>Maximum</u>
Dry Taps	0° F (-18° C)	100° F (38° C)
Wet Taps	32° F (0° C)	90° F (32° C)

No taps shall be made where the pipe is discolored.

d. Special Requirements for Tapping Transite Pipe

Special precautions shall be taken preparing and tapping transite (asbestos cement) pipe. The EPA has recognized asbestos as presenting a cancer or lung disease health hazard. The EPA in conjunction with the US OSHA have established regulations to address asbestos exposure. 29 CFR 1926.1101 addresses asbestos in the construction industry and 29 CFR 1910.134 addresses the use of respirators approved for use working with asbestos products. Any Contractor working with or around asbestos cement pipe shall be familiar with these regulations.

Any employee working on or around asbestos cement pipe shall have had at a minimum EPA's sixteen hour maintenance and custodial training. Any employee performing the tapping operation shall have completed EPA's 4 day Asbestos Abatement Worker training. All tapping work shall be supervised by an EPA certified "Competent Person."

4. Excavation and Laying of Pipe

a. Excavation

Pipe line construction shall be made by open cut unless otherwise specified or required. During the excavation operations, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins.

All open trenches shall be adequately shored and braced to provide a safe working environment. Trench boxes shall be made available onsite and utilized in accordance with appropriate OSHA standards. It is the contractor's responsibility to comply with the requirements of OSHA as pertaining to men working in an open trench.

All excavated material not suitable for backfill shall be removed and disposed of in an acceptable manner. Grading shall be done as may be necessary to prevent water from flowing into trenches or other excavations, and any water accumulating therein shall be removed by approved methods.

The trenches in which the pipe is to be laid shall be opened in accordance with the approved plans so pipe can be laid to the alignment and depth required. The exposed end of all pipes shall be fully closed by means of an approved stopper to prevent earth or other substances from entering the pipe which may interfere with the disinfection process. All waterlines shall be laid true to line and grade. The pipe and trench shall be kept free of water during the laying operation. Not more than one

hundred (100) feet of trench shall be opened in advance of the completed waterline when located along streets or highways, and not more than two hundred (200) feet at other locations.

b. Construction in Fill Areas

Where pipelines are to be installed in fill areas, the fill shall be compacted to 95% of the optimum density as determined by AASHTO T-99 before excavation begins for the pipe trench. Certification shall be required of all compaction in fill areas, at intervals as directed by the Authority. This certification shall be signed by a professional geologist and shall state the exact area the certification applies to. Every effort shall be made to prevent hydrants, valves and other appurtenances from being located in fill areas.

c. Trench Width

Whenever the trench depth is less than five (5) feet, the trench width shall be as narrow as is practicable to permit the pipe to be laid and joined properly, and to permit the backfill to be placed and compacted properly. In general, the clear width of the trench at an elevation of one (1) foot above the top of the pipe shall be approximately equal to the external diameter of the pipe plus sixteen (16) inches, or in accordance with the trench widths specified for various types and sizes of pipe. The provisions of this section shall not relieve the contractor from responsibility to ensure all trenching methods are in accordance with the appropriate safety requirements of the applicable OSHA regulations. Whenever the trench depth exceeds five (5) feet, approved shoring or trench boxes shall be used.

d. Rock Excavation

Where rock is encountered in trench excavation, whether solid or in the form of loose rock, shale, or large boulders, it shall be removed by blasting or other approved methods to the extent that no projection of rock shall be nearer than six (6) inches to any part of the water pipe, valves and fittings when laid, nor project beyond the lines and grades of structures. No blasting shall be done within twenty-five (25) feet of any completed work or adjacent to any other structure unless proper precautions are taken. Ends of water line adjacent to blasting shall be covered to avoid receiving debris. No rock or asphalt over six (6) inches in any dimension shall be placed in the trench and in no case shall rock or asphalt be placed closer than two (2) feet vertically to the installed pipe.

e. Over Excavation

Where the excavation has been carried too deep, the Contractor shall refill the over-excavated trench with No. 68 or 21A Virginia Department of Transportation stone in order to ensure the stability of the various structures.

f. Pipe Installation (General)

When installing pipe in the trench, proper implements, tools, and facilities satisfactory to the Authority and as recommended by the material manufacturer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, valves, fittings, hydrants, and accessories shall be carefully lowered into the trench piece by piece by means of a derrick, ropes, slings, or other suitable tools or equipment in such a manner as to prevent damage to the water main materials and any protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench.

g. Condition of Pipe

All lumps, blisters and excess coal tar coating shall be removed from the ends of each pipe. The outside of the spigot and the inside of the bell shall be thoroughly cleaned and dried, and be free from oil and grease before the pipe is joined.

h. Special Precautions

The contractor shall visually examine each joint of pipe to prevent foreign material from entering the pipe while it is being placed in the trench. During the laying operations, no debris, tools, clothing or other materials shall be placed in the pipe. Water lines shall be plugged at the end of each construction day to prevent foreign matter from entering them.

5. Pipe Installation

Ductile iron pipe shall be installed in accordance with ANSI/AWWA C600-05 or current revision. Specifically, ductile iron pipe shall be installed in accordance with Figure W-2, of these specifications with bedding requirements similar to Figure 58 Class C in ASCE Manual #37 for shaped bottom.

a. Cutting of Pipe

The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe.

When machine cutting is not available for cutting pipe twenty (20) inches in diameter or larger, the electric-arc cutting method will be permitted using a carbon or steel rod. Only qualified and experienced workmen shall undertake this work. The flame cutting of pipe by means of an acetylene torch shall not be allowed.

b. Pipe Deflection

Wherever it is necessary to deflect the pipe from a straight line, either in vertical or horizontal plane, to avoid obstructions or to plumb the line for valve installation, or where long-radius curves are permitted, the amount of deflection allowed shall not exceed that required for satisfactory jointing of the pipes, as specified by the manufacturer. The following table shall be used as a guideline. In no case shall these limits be exceeded.

Longitudinal Deflection of Ductile Iron Pipe

Pipe Size	Min. Allow. Per 18' Length Radius (ft)	Offset per 18' Length (in.)	Offset per 20' Length (in.)
4	205	19	21
6	205	19	21
8	205	19	21
10	205	19	21
12	205	19	21

6. Hydrants, Valves, and Fittings Construction

a. Bracing of Fittings

All tees, valves, fittings, plugs, caps and fire hydrants shall be substantially braced, blocked and/or anchored to prevent any movement by providing adequate reaction backing. This backing shall be a concrete thrust block with a compressive strength of not less than 2500 psi. Backing shall be placed between solid undisturbed earth and the fitting to be anchored and shall be so placed that pipe and fitting joints will be accessible for repairs (See Part VII, Figures W-3, W-3A, W-3B, and W-3C.)

b. Fitting Installations

Hydrants, valves and valve boxes shall be set plumb, and centered, with valve boxes placed directly over the valves. If possible, valve boxes shall be located outside the area of roads and streets. Earth

fill shall be carefully tamped around the valve box to a distance of four (4) feet on all sides of the box, or to the undisturbed trench face if less than four (4) feet.

c. Cross Anchor Restraints

Wherever it is not practical to use threaded rods to restrain valves on the end of water lines or fire hydrants, cross anchors shall be constructed in accordance with the typical detail Figure W-3C "Cross Anchor Restraints for Valves." Cross anchors shall be installed around ductile iron pipe wherever the last valve on a water line is greater than six (6) feet from a mechanical joint tee. Such installations shall include fire hydrant assemblies and ends of transmission mains, where a future extension is possible.

7. Pipe Foundation

a. General

The trench shall be excavated to a depth required so as to provide a uniform and continuous bearing and support for the pipe. It shall be permissible to disrupt the finished surface of the trench over a maximum length of eighteen (18) inches near the middle of each length of pipe for the withdrawal of pipe slings or other lifting tackle. The finished subgrade shall be prepared accurately by means of hand tools. Where excavation is made in rock or boulders, the subgrade shall be made by backfilling with six (6) inches of No. 68 or 21A Virginia Department of Transportation stone which shall be thoroughly compacted. The bedding material shall extend evenly to the trench wall.

b. Foundation in Good Soil

The bottom of the trench shall be scraped and compacted. All stones shall be removed to insure the pipe doesn't rest on rock, or a four (4) inch bedding of No. 68 Virginia Department of Transportation Stone shall be provided. The bedding material shall extend evenly to the trench wall. Bell holes shall be cut for the proper marking of the joints and to prevent the pipe from resting on the bells.

c. Foundation in Poor Soil

Whenever the soil at the bottom of the trench is soft, unstable or saturated with water, a foundation of granular fill beneath the bedding shall be provided to a depth required to stabilize the soil (See Part VII, Figure W-2.) Bedding type shall be submitted to the ACSA and approved before incorporating into the work.

8. Backfilling and Compaction

a. *General*

All trenches or excavations shall be backfilled to the original surface of the ground or to such other grades as may be shown on the approved plans. Backfilling shall be subject to the approval of the ACSA for the type of construction used. All backfilling shall be carried along as speedily as possible with the trench being filled, in general, as soon as the cement, or mortar and masonry are sufficiently set. New trenching will not be permitted when earlier trenches need backfilling or labor is needed to restore the surfaces of streets or other areas to a safe and proper condition.

b. *Materials*

All material used for backfilling of trenches shall be free of excessive amounts of unsuitable materials such as all organic material, frozen clods, and sticky masses of clay and gumbo which are difficult to properly compact. Backfill material shall contain no rock or asphalt larger than six (6) inches in any dimension and in no case shall rock or asphalt be placed closer than two (2) feet vertically to the installed pipe.

c. *Backfilling*

Backfill over all pipe to a depth of twenty-four (24) inches shall be carefully placed in layers approximately six (6) inches thick, each layer being thoroughly tamped and compacted by hand or pneumatic tamper in place. Special care shall be taken in using a mechanical tamper directly over the pipe.

Above twenty-four (24) inches, backfill shall be deposited in six (6) inch layers in traffic areas, 12" layers in non-traffic areas or a thickness which will permit compaction to a density of at least 95% of the maximum density at optimum moisture content as determined by the AASHTO Standard Proctor test (AASHTO Designation T-99) under all proposed traffic areas. Backfill in existing traffic areas shall be in accordance with the Virginia Department of Transportation's standards.

d. *Compaction*

Unless otherwise shown on the plans, the backfill in all trenches shall be thoroughly compacted. The compacting shall be done by suitable mechanical means. In all cases, special care shall be taken to see that the spaces at the sides of the trench are thoroughly filled and

compacted. If necessary, the earth shall be moistened during the operations.

It shall be required that a minimum of one (1) compaction test will be conducted on trench backfill per 400 linear feet of waterline. Compaction tests may be waived by the ACSA on projects less than 400 linear feet in length. The contractor shall bear the expense of all compaction tests. The location of tests shall be selected in the field by the ACSA and will not necessarily be limited to regular intervals.

The results of all compaction tests shall be submitted to the ACSA for review and approval prior to acceptance of construction. The degree of compaction required for trenches in streets and paved areas is 95% of maximum density and for trenches in all other areas the required density shall be 90% of maximum density. If the tests indicate the required density has not been obtained, the contractor shall remove, replace and recompact the material to the specified density. Failure of any compaction tests may result in additional compaction tests being required.

e. Protection of Pipe & Appurtenances

Backfilling shall be done in such a way as to prevent dropping of material directly on top of the pipe from more than a three (3) foot vertical distance. When placing material from a bucket it must be lowered so that the shock of the falling earth will not damage the water line.

D. WATER PIPE MATERIAL & JOINTING

All pipe shall be approved by the ACSA.

1. General Requirements

Unless otherwise approved in writing by the ACSA, all water mains and distribution lines shall be of the material herein listed. The ACSA reserves the right to select the type and/or class material which shall be used from the following list:

a. Ductile Iron Pipe & Fittings

Ductile iron pipe shall be centrifugally cast pipe manufactured in accordance with AWWA/ANSI C151/A21.51-02 or current revision. The joints shall be push-on, mechanical or flanged in accordance with AWWA/ANSI C111/A21.11-00, or current revision. All ductile iron pipe shall have a cement mortar lining in accordance with AWWA/ANSI C104/A21.4-03 or current revision.

The minimum wall thickness for ductile iron pipe shall be the thickness necessary to safely and effectively install corporation stops. Pipe eight (8) inches and smaller shall have a minimum wall thickness of 0.31". Pipe ten (10) inches and larger shall have a minimum wall thickness of 0.34". Structural requirements for the pipe under field installation shall be used in determining the appropriate class of pipe. Under no circumstances shall the pipe wall thickness be less than that noted above.

Cast iron or ductile iron fittings shall have standard mechanical joints manufactured in accordance with AWWA/ANSI C110/A21.10-03, or current revision, or AWWA/ANSI C153/A21.53, current revision. All fittings shall be cement mortar lined inside in accordance with AWWA/ANSI C104/A21.4-03 or current revision.

b. Galvanized Steel Pipe & Fittings

Galvanized steel pipe shall conform to ASTM A-102-77, Schedule 40 or 80 or current revision.

Fittings for galvanized steel pipe shall be galvanized malleable iron in accordance with ASTM A-120-77 or current revision.

Galvanized pipe shall not be used below ground except for blow-off assemblies and where exposed to atmosphere. Galvanized pipe shall not be used under wet conditions in any event, except where special approval of application is given.

c. Copper Pipe & Fittings

Copper pipe for service laterals shall be soft type "k" copper with standard water works flare or compression fittings.

2. Jointing

Jointing of all pipe shall conform to the manufacturer's published recommendations and specifications. Gaskets for water pipe and fittings shall be vulcanized natural or vulcanized synthetic rubber free of porous areas, foreign material or visible defects. Rubber gaskets shall conform to all applicable provisions of AWWA/ANSI C111/A21.11-00, or current revisions. Gaskets shall be protected from exposure to excessive heat and cold, direct sunlight, ozone (from electric motors and equipment), oil, grease or other contaminants.

E. VALVES & ACCESSORIES

1. Gate Valves

Two (2) inch and smaller gate valves shall be inside screw, solid bronze, tapered seat, double disc construction and rated for 200 psi working pressure.

Larger gate valves shall be double disc type or resilient seated. The double disc type shall be parallel seat, bronze mounted type with non-rising stems in accordance with ANSI/AWWA C500-02, or current revision. The resilient seated type shall be non-rising stem, fully encapsulated wedge in accordance with ANSI/AWWA C509-01 or current revision.

Gate valves shall be one make and shall open by a counterclockwise rotation of the valve stem with a two (2) inch square operating nut. The operating nut shall be no greater than three (3) feet below finished ground. Operating nuts placed greater than three (3) feet below finished ground shall be equipped with approved operating nut extensions to meet the minimum depth requirement. Gate valves installed in access vaults, pumping stations, etc., shall be equipped with handwheels.

Gate valves fourteen (14) inches and larger shall have a working pressure of no less than 150 psi and a test pressure of 300 psi. Four (4) inch to twelve (12) inch gate valves shall have a working pressure of no less than 120 psi and a test pressure of 400 psi. Gate valves greater than or equal to twelve (12) inches on high pressure systems (greater than 100 psi) shall be provided with gear case and a by-pass. Gate valves shall have one "O" ring above and one "O" ring below the stem thrust collar. The thrust collar shall be lubricated with oil to assure positive operation in opening and closing.

2. Butterfly Valves

Butterfly valves shall be designed, manufactured and tested in accordance with the provisions and requirements of ANSI/AWWA C504-00, or current revision, and in accordance with the requirements of these Specifications. All valves shall be drop-tight when subjected to the specified working pressure (differential pressure), and all valves shall be capable of droptight seating under bidirectional flow conditions (maximum working pressure applied as differential pressure from either direction).

Valve bodies shall be constructed of cast (gray) iron ASTM A126-73 Class B, ductile iron ANSI/ASTM A536-80 Grade 65-45-12, or alloy cast iron ANSI-ASTM A436-78 Type 1 or 2 or ANSI/ASTM 439-80 Type D2.

Valve discs shall be solid construction, and shall be stainless steel as specified under Section 2.2.4 of the above referenced AWWA Standard or alloy

cast iron ANSI/ASTM A436-78 Type 2. Edges of discs shall be shaped, machined and polished to such configuration as will ensure smooth and even mating with the rubber seat over an acceptable angle of interference ($\pm 2\text{-}1/2$ degrees). The disc shall rotate 90 degrees from full open position to tightly closed position.

Valve seats shall be new natural rubber or new synthetic rubber conforming to the requirements of ANSI/AWWA C504-00, or latest revision. Rubber seats shall mate with the seating surfaces of the valve discs specified hereinabove. Rubber seats shall be either bonded in the valve body or mechanically fastened in the valve body. All clamps, retaining rings and fasteners shall be stainless steel specified in the above referenced AWWA Standards.

Valve shafting shall be stainless steel in accordance with the above referenced AWWA Standard, and may be either one-piece through-body-and-disc construction or may be stub-shaft construction. If of stub-shaft construction, each stub-shaft shall be inserted into hubs integral with the valve disc for a distance of at least 1-1/2 times the diameter of the shaft. Lengths of hubs extending from the disc shall be such that the full required insertion can be attained. The connection between the shaft and the disc shall be designed to transmit shaft torque equivalent to at least 75% of the torsional strength of the minimum shaft diameters. Dowel and taper pins, if used, shall be mechanically secured. Any penetrations in the shaft shall be compensated for so that the relationship of transmitted torque to shaft torsional strength will be maintained.

Valve bearings shall be sleeve type, non-corrosive, and of "self-lubricated" materials. Thrust rings and/or bearings shall maintain the disc in designed centered position. Valve shafts shall be designed for connections to operators as required, and shaft seals shall be provided at capped ends and projecting ends.

All valves shall fully meet or exceed the requirements of ANSI/AWWA C504-00, or current revision. The valves shall be furnished in complete accordance with the requirements of Section 5 of ANSI/AWWA C504-00, or current revision.

Valve operators shall be traveling-nut type or geared type designed to withstand 300 ft. lbs. of input torque at fully open or fully closed positions without damage to valve or operator. Operator case shall be fully-enclosed type to prevent entrance of dirt or moisture, and the case shall be grease-packed. Stop-limiting devices shall be provided in the operators for open and closed positions. Travel of the valve shall be indicated on quadrant bolted to the body (exposed valves).

Valves installed in locations accessible from floor or ground shall be equipped with handwheels and valves installed in locations higher than six (6) feet, six (6) inches above finished floor or ground shall be equipped with chainwheels and chain. The last stated provisions shall apply except when valves are indicated to be operated through floorstands or benchstands located above the valves, and in such cases valves shall be equipped with enclosed operators, extension stems, floorstands (or benchstands), and indicators.

Valves installed underground shall be equipped with grease packed operators having gasketed covers to prevent entrance of moisture into case when subjected to external hydrostatic pressure of 10 psi; and valves shall be operated through a valve nut mounted on vertical operating shaft extending through top of gear case. Operator extension, valve box, indicator, and cover shall be provided for each valve. Extensions and valve boxes shall be of correct length and height to suit elevation of ground surface. Valve boxes shall be fitted with cast iron covers marked "WATER".

All valves shall open counterclockwise.

3. Tapping Valves

Tapping valves shall meet the same specifications as gate valves, except they shall have a full, unobstructed opening to receive a full size shell cutter. It shall be a standard mechanical joint type on one end and a flanged joint on the other end.

4. Tapping Sleeves

Tapping sleeves may be split sleeve with mechanical joint type end seals or stainless steel. They shall have the same working and test pressures as noted for the gate valves.

5. Check Valves

Check valves shall be designed for 175 psi working pressures and 350 psi test pressures for sizes up to twelve (12) inches. Check valves from fourteen (14) inches to twenty-four (24) inches shall have an opening suitable for cleaning without disconnecting from the pipe. They shall have a cast iron body with bronze mountings, discs, arms, and seat rings. Check valves shall conform to the most current revision of the ANSI/AWWA C-508-93 standard.

6. Detector Check Valves (Private Fire Protection Line)

Private fire lines may be required to have a detector check valve installed on the line at a point as close to the main supply line as possible. This detector check valve shall be installed in a custom-designed vault.

7. Valve Boxes

Each valve on underground piping shall be provided with a screw-type adjustable cast iron valve box. They shall have a round shaft (5 1/4 inside diameter), a flared base, and a coat of bituminous paint applied to both surfaces. Also, the head shall be cast iron, round, and have the word "Water" cast on it.

Valve boxes shall be adjusted flush with the finish grade. If the street surfaces are renewed or replaced by the developer, owner or his representative after the water system has been approved and accepted by the ACSA, but while such streets are still the obligation of the developer or owner, the valve boxes therein shall be readjusted to the proper finished grade at the developer's or owner's expense. If changes are made in grade at valve boxes by parties other than the developer, owner or his representative after initial construction approval, the cost of this adjustment shall be borne by the party responsible for the construction adjustments. In remote areas, valve boxes shall extend six (6) inches above finished grade and have a witness post securely placed next to the box.

The witness post shall consist of a five (5) foot long 2-inch galvanized pipe, capped on either end and painted blue.

8. Corporation Stops

At the location indicated on the plans and where directed, corporation stops of sufficient size with quarter-bend couplings, if required, shall be furnished and installed approximately 45° below the top of the pipe in accordance with applicable standards and specifications. All corporation stops shall have ball style valves and have a pressure rating of 300 psi.

9. Copper Meter Yokes & Coppersettters

All 5/8" and 1" water meters shall be placed in a horizontal inlet and outlet copper meter yoke. The yoke shall have a multi-purpose connection on the customer side and the supply side. It shall also have a lock-winged ball valve on the supply side and a ball valve on the customer side. Coppersettters shall be installed a minimum of 10"-15" from the top of the meter box for meters 1" or less. Coppersettters for 5/8" and 1" water meters shall be restrained vertically in the box with a piece of reinforcing steel passed through the horizontal eye. All 1½-inch and 2-inch water meters shall be placed in a horizontal inlet and outlet copper meter yoke. The yoke shall have FIP threads on the customer side and the supply side. It shall also have a lock-winged ball valve on the supply side and a ball valve on the customer side. Setters for meters greater than one (1) inch and less than three (3) inches shall be installed no less than eighteen (18) inches from the top of the meter vault. Meters three

(3) inches and larger shall be installed no less than thirty-six (36) inches from the top of the meter vault.

10. Service Laterals

Copper pipe for lateral connections shall be soft type "k" copper with standard water works flare or compression fittings.

11. Concrete Thrust Blocks

All fittings, plugs, tees, bends, and reducers shall be sufficiently anchored with concrete thrust blocks. Concrete thrust blocks shall have bearing on undisturbed earth with bearing area no less than detailed in Figures W-3, W-3A, W-3B, and W-3C in Part VII.

12. Marking Tape

A two (2) inch wide minimum size blue colored non-metallic water marking tape shall be buried at a distance of approximately one (1) foot below ground and directly over all water mains to alert water construction and maintenance crews that a water pipe is below. The marking tape shall be continuous. Marking tape disturbed during the course of construction on existing waterlines shall be restored to its original condition and to the satisfaction of the project inspector.

13. Conductive Wire

Conductive wire disturbed during the course of construction shall be restored to its original condition and to the satisfaction of the project inspector.

F. METER BOXES & METER VAULTS

1. Meter Boxes

Meter boxes shall be installed in non-paved areas. The box and lid shall conform to the finished grade after installation. Meter boxes of appropriate size shall be installed around all meter yokes or coppersettlers as indicated on the plans. Meter box locations shall be in non-paved areas except as approved by the Authority for the single application. Meter boxes shall be located and installed so as to prevent water, dirt or debris from entering or covering them. If changes in grade at the meter box are made by the owner or customer after initial construction approval, the cost of box adjustment shall be borne by the party responsible for the grade change. Coppersettlers shall be placed in the meter boxes a minimum of 10"-15" from the top of the box.

All meter boxes shall have non-locking cast iron lids and will be used for water meters up to and including one (1) inch in size (See Part VII, Figure W-7).

Lids shall be provided with a 1-3/4" hole tapped into the lid. Blind taps or plugs shall be provided to prevent debris from entering the box prior to use. The contractor must ensure a clear 1-3/4" opening where the hole is cast into the lid to accommodate a Touch Read sensor.

2. Meter Vaults

a. *General*

No sweated fittings are allowed underground. Sweated fittings will be allowed inside 1-1/2" and larger meter vaults only. At no time shall mortar touch copper or galvanized pipe. The internal pipe may need bracing to support the valves and meter assembly. Any such bracing shall be approved by the Authority. Meter vaults shall be designed, located and installed so as to prevent water, dirt or debris from entering or covering them. If changes in grade at the meter vault are made by the owner or customer after initial construction approval, the cost of the vault adjustment shall be borne by the party responsible for the grade change.

b. *1-1/2" and 2" Meters*

Concrete or masonry floorless vaults shall be provided with 6" minimum stone bedding for 1-1/2" and 2" meters. The outside shall be waterproofed with a tar based paint, or approved equal. The minimum wall and top thickness for concrete vaults, either precast or cast in-place shall be 4". A 24"x36" aluminum access hatch shall be provided directly over the water meter. The hatch shall be provided with a 1.75" hole, properly plugged, for future installation of a touch read sensor. Vault dimensions and setter requirements shall conform to Figures W-7A, W-7B and W-7C in Part VII.

c. *Meters 3" and Larger*

A masonry or concrete structure shall be used for meters 3" or larger. The outside shall be waterproofed with a tar based paint, or approved equal. Sleeves will be required around the water pipe entering and leaving the vault. The openings around the sleeves shall be sealed against water seepage. A positive drain extending to grade, or a sump pump shall be provided, whichever is more practical. A sump shall be located on the side of the vault with the floor sloping to it. The top shall be made of reinforced concrete or metal with a metal door insert. In any case, the access door must be waterproof, air-tight, 2' x 3' in size, located over the meter, and easy for one person to lift. The door shall be provided with a 1.75" hole, properly plugged, for future installation of a Touch-Read sensor. Doors shall have a lift handle and hinges, as shown on Figure W-7A in Part VII.

G. WATER SERVICE LATERALS

Water service laterals are to be installed for all lots or parcels of land within the development and shall extend from the main to the property line of the lot or parcel. Water service laterals are to be Type "k" copper tubing, installed at a minimum depth of thirty-six (36) inches from the main line to a meter setting below finished grade. Detached single family and attached single family residential service laterals shall be 1-inch in diameter. Attached single family residential service laterals can also be grouped into a dual service with a shared 1-inch diameter service line. Water service laterals for 1½-inch and 2-inch meter installations shall be 2-inch in diameter. Water service laterals larger than 1" diameter, crossing under existing roadways, shall be installed in sleeves of appropriate size and material, as approved by the ACSA. Meter boxes with meter yokes or coppersettors are to be installed at the end of each service lateral and are to be constructed in such a manner as to prevent conflict with proposed finished grading or other proposed construction such as driveways, drainage ditches, etc. All water service laterals must be well referenced for future location (See Part VII, Figure W-6).

All irrigation systems shall be served by a separate water meter, sized based on system design. Separate irrigation meters, for residential use, may be provided using the dual service detail as shown in Figure W-6. Irrigation meters for commercial property shall be sized based on system demand.

H. BLOW-OFF ASSEMBLIES

Provisions shall be made for blow-offs by means of a regular blow-off assembly or hydrant assembly, as may be directed by the ACSA. All pipe work for the hydrant blow-off assemblies shall conform in all respects to applicable portions of these specifications and to the plans. Blow-off assemblies shall not be connected directly to any storm drain or sanitary sewer systems. Blow-off assemblies shall be placed behind the curb, and shall be required at all dead-ends (See Part VII, Figure W-8.)

Dead-end blow-off assemblies (type A) shall be installed as shown and in accordance with the following specifications:

1. Blow-off lines shall be two (2) inch diameter galvanized or brass pipe. A PVC nipple shall be provided at the end of the assembly with a PVC threaded cap. The threads between the nipple and the cap shall be lubricated before installation to allow removal when needed.
2. Gate valves and boxes shall be of the type described in the applicable sections of these specifications.

3. If the grade allows, a two (2) inch diameter drain pipe shall be properly installed in the meter box.

In-line blow-off assemblies (Type B) shall be located at major low points in the system as determined by the ACSA.

I. AIR RELIEF VALVE ASSEMBLIES

Approved automatic air relief valves shall be installed at the high points in the system. Each assembly shall consist of a riser pipe, gate valve, fittings, and a precast concrete manhole cone section (including frame and cover with the word "WATER" cast on it), or approved equal. The riser shall be Type K copper pipe. Fittings shall be brass or bronze. Gate valves shall be of the type described in Section E-1. A one (1) inch diameter air relief valve shall be used on lines smaller than twelve (12) inches in diameter. A two (2) inch diameter air relief valve shall be used on lines equal to or larger than twelve (12) inches in diameter.

If the grade allows, a two (2) inch drain pipe shall be properly installed in the cone section of the manhole.

Air relief valve assemblies shall not be connected directly to any storm drain or sanitary sewer systems (See Part VII, Figure W-9.)

J. FIRE HYDRANT SPECIFICATIONS

Hydrants shall be manufactured in accordance with the most current revision of ANSI/AWWA C502-05 and shall be approved by the National Board of Fire Underwriters. Hydrants shall have six-inch (6") barrel with 5.25-inch clear opening through the valve and shall be provided with a 4.5-inch pumper connection and two (2) 2.5-inch I.D. hose connections.

Fire hydrants shall be installed in such a manner as to provide the proper fire protection as approved by the County's fire prevention officer to all structures and no hydrant shall be more than 800 feet from any other hydrant measured along the centerline of the public right-of-way, private road, or other applicable access route. Generally, fire hydrants shall be placed no closer than 40 feet nor further away than 400 feet from all major structures.

Fire hydrants shall be installed in areas where weep holes are above the prevailing groundwater table. Design elevations and the location of drainage structures shall be used to ensure the weep holes of the hydrant are not subject to groundwater immersion. If, during the course of construction, groundwater is observed in the trench, the fire hydrant shall be moved to higher ground and the separation between fire hydrants will be adjusted accordingly. If fire hydrants cannot be placed above groundwater, the weep holes shall be plugged and the

hydrant shall be pumped dry.

Hydrants shall be of the frost-proof and non-flooding type which will not flood in case the barrel or valve stem is damaged, with orifices for draining the hydrant when the valve is closed. A safety flange shall be provided so that the barrel will not break if struck by a vehicle or other object, and the hydrant can be repaired without digging. Hydrants shall have a three foot, six inch (3'6") minimum bury and be designed for 150 psi working pressure and 300 psi hydrostatic pressure. All working parts shall be bronze to bronze. All hydrants shall open counterclockwise and be preceded in the line by a gate valve. The pumper connection shall face the roadway. Fire hydrants shall have a moisture-proof chamber around operating threads filled with USDA H-1 food grade oil or grease which shall lubricate the threads.

Hydrants shall be set plumb with the invert of the pumper connection eighteen (18) inches above grade. The maximum number of allowable hydrant risers for each hydrant is 2. Unless the hydrant location is specifically indicated otherwise, it shall be located so that the center is not less than two (2) nor more than ten (10) feet from the back of the curb of the adjacent street, with the pumper connection facing the street, unless otherwise directed by the fire official. The connecting pipe will have the same depth of cover as the distribution mains. The base and back of the hydrant, opposite the pipe connection, shall be firmly blocked against the vertical face of the trench with cast-in-place concrete to prevent the hydrant from blowing off the line. If the character of the soil is such that in the opinion of the Authority the hydrant cannot be securely blocked, bridle rods and rod collars and/or a pipe type bracing shall be used. Bridle rods and rod collars shall not be less than three-quarter (3/4) inch stock and shall be protected by a coat of bituminous paint. Not less than seven (7) cubic feet of broken stone shall be placed around the base of the hydrant to ensure drainage. The backfill around hydrants shall be thoroughly compacted to grade line. Hydrants and valves shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and the hydrant or valve shall be inspected in open and closed positions, to see that all parts are in working condition (See Part VII, Figure W-4). Bags shall be tied securely over all fire hydrants as soon as they are installed. These bags shall not be removed until approved by the Authority. Each new fire hydrant shall be freshly painted.

The threads on the 4.5-inch pumper (steamer) connection and on the operating nut shall be National Standard threads. The threads on the hose connections shall be Albemarle County Service Authority standard thread (Charlottesville thread), 3 21/64" female, 3 9/32" male, eight threads per inch (Gauge 8-322) except for the Scottsville service area which are National Standard threads. All threads shall be thoroughly lubricated with a food grade lubricant. All of the male connections shall have caps and chains. The cap nuts and the operating nut shall be 1 1/2" Pentagon and shall open counterclockwise.

K. ACCEPTABLE TESTS

All testing will be performed in accordance with the ANSI/AWWA C600-05 or current revision. The contractor shall provide the ACSA with 48 hours notice prior to undertaking any tests.

Note: Reinspection fees are charged for retesting when initial tests fail. Contact the Authority for current rate schedules.

1. Pressure Test

After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 200 psi.

a. Test Pressure Restrictions.

Test pressures shall:

- I. Not exceed pipe or thrust restraint design pressure;
- II. Be of at least 2-hour duration;
- III. Not vary by more than ± 5 psi;
- IV. Not exceed twice the rated pressure of the valves or hydrants when the pressure boundary of the test section includes closed gate valves or hydrants;
- V. Not exceed the rated pressure of the valve.

b. Pressurization

Each valved section of pipe shall be filled with water slowly and the specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the ACSA. The water and container used to pump up the line to be tested shall be properly disinfected.

c. Air Removal

Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants.

d. Examination.

All exposed pipe, fittings, valves, hydrants, and joints shall be

examined carefully during the test. Any damaged or defective pipe, fittings, valves, or hydrants that are discovered following the pressure test shall be repaired or replaced with sound material and the test shall be repeated until it is satisfactory to the Authority.

2. Leakage Test

A leakage test shall be conducted concurrently with the pressure test.

a. *Leakage defined.*

Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.

b. *Allowable leakage.*

No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{148,000}$$

in which L is the allowable leakage, in gallons per hour; S is length of pipe tested in feet; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test, in pounds per square inch gauge.

When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal./hr./in. of nominal valve size shall be allowed. When hydrants are in the test section, the test shall be made against the closed hydrant valve.

c. *Acceptance of installation.*

Acceptance shall be determined on the basis of allowable leakage. If any test of pipe laid discloses leakage greater than the allowable amount, the contractor shall, at his own expense, locate and repair the defective material until the leakage is within the specified allowance. All visible leaks are to be repaired regardless of the amount of leakage.

L. DISINFECTION

Precautions shall be taken to protect pipe interior, fittings and valves against contamination. When pipelaying is not in progress, all openings in the pipeline shall be closed with watertight plugs. If water accumulates in the

trench, plugs shall remain in place until the trench is dry. All pipe and fittings shall be kept free of dirt or any foreign material likely to cause contamination.

Mains shall be disinfected by the continuous feed method or the tablet method in accordance with AWWA C651-05 or current revision, except as specified otherwise or approved in writing by the ACSA.

1. Continuous Feed Method

Prior to feeding chlorine, the water line shall be thoroughly flushed with potable water to remove any debris that may have entered the line during construction. Potable water shall be introduced into the pipe line at a constant flow rate protected by an approved backflow prevention device. Chlorine shall be added at a constant rate to this flow so that the chlorine concentration in the water in the pipe is at least 50 mg/l. The chlorinated water shall remain in the pipe line at least 24 hours, after which, the chlorine concentration in the water shall be at least 10 mg/l.

2. Tablet Method

Tablets of calcium hypochlorite, containing 70 percent available chlorine by weight, shall be affixed to the top of each section of pipe and in appurtenances by a food grade adhesive. Tablets shall not be completely covered by adhesive. After completion of the construction the main shall be filled with water at a velocity of less than one (1) foot per second in accordance with the following schedule:

Schedule of Maximum Flow Rates

<u>Pipe Diameter</u>	<u>Flow Rate</u>	<u>Pipe Diameter</u>	<u>Flow Rate</u>
4"	40 GPM	14"	500 GPM
6"	90 GPM	16"	600 GPM
8"	160 GPM	18"	800 GPM
10"	260 GPM	20"	1000 GPM
12"	350 GPM	24"	1400 GPM

A minimum concentration of 50 mg/l of chlorine solution shall be in the system at this time. A concentration of 25 mg/l residual chlorine must be present after 24 hours.

Number of Hypochlorite Tablets of 5-G Required for Dose of 50 mg/l (based on three and three-quarters grams of 70% available chlorine per tablet):

<u>Joint Length (Ft.)</u>	<u>Diameter of Pipe (In.)</u>					
	2	4	6	8	10	12
13 or less	1	1	2	2	3	5
18	1	1	2	3	5	6
20	1	1	2	3	5	7
30	1	2	3	5	7	10
40	1	2	4	6	9	14

Grams of HTH Powder Required for Dose of 50 mg/l (based on 65% available chlorine in HTH powder):

Joint Length (Ft.)	Diameter of Pipe (In.)					
	2	4	6	8	10	12
13	0.6	2.5	5.56	9.88	15.45	22.24
18	0.85	2.5	7.69	13.69	21.39	30.80
20	0.95	3.8	8.56	15.21	23.76	34.22
30	1.43	5.7	12.83	22.81	35.65	51.33
40	1.90	7.6	17.11	30.42	47.53	68.44

The cost of all such testing will be the responsibility of the Contractor. All valves and appurtenances shall be operated while chlorinated water is in the pipe line. After the retention period, the main shall be flushed of the high chlorine water until the water leaving the system shows a chlorine concentration of less than 1 mg/l or no higher than that prevailing in the water used for flushing. Water with a chlorine concentration greater than 2.0 mg/l shall either be dechlorinated or the high chlorine water shall be discharged directly to sanitary sewer line. After final flushing, two (2) water samples shall be collected 24 hours apart for bacteriological tests. The samples shall be collected at regular intervals not to exceed 2,000 feet throughout the length of the pipe. All bacteriological samples collected following disinfection shall be analyzed by a lab certified by the Virginia Department of General Services, Consolidated Laboratory Services. The results of these samples must indicate the absence of coliform contamination.

Disinfection shall include hydrants and other special pipe, taps and fittings used at connections to existing piping. These shall be thoroughly disinfected before installation. Excavation for such connections shall be kept free from water until the connection is completed and great care shall be exercised to prevent contamination of the pipe and connection fittings.

The inside of the existing pipe within three (3) feet of point of connection shall be disinfected by spraying with a solution containing not less than 200 mg/l

of chlorine immediately before connection is made. On completion of disinfection the piping shall be flushed thoroughly with potable water, and samples shall be taken and tested by a recognized testing laboratory. The water shall be proven safe for human consumption before acceptance of disinfection. Should the samples show the water is unsafe, the piping shall be disinfected until satisfactory tests are obtained.

Note: It is the contractor's and developer's responsibility to ensure their operations do not contaminate the public water supply. If at any time, the water in the existing system becomes contaminated, they shall be held financially accountable for any corrective action taken by the ACSA, as well as for cost of defending and settlement of all claims resulting from their negligence, including, but not limited to, costs and attorney's fees.

PART V

WORK ASSOCIATED WITH SEWER CONSTRUCTION

A. GENERAL INFORMATION

Any new sewerage system to be connected to the public sewer shall not be constructed until final plans are approved by the ACSA. The ACSA shall be furnished for review three (3) sets of plans and specifications prepared by a registered engineer certified to do business in the state of Virginia. Plans shall be in sufficient detail to accurately indicate all pertinent design and construction details for a comprehensive interpretation of the work to be performed. Plans shall be reviewed for compliance with the following standards as have been adopted by the ACSA.

B. DESIGN CRITERIA

1. Slope

Sewers shall have a uniform slope and straight alignment between manholes, and be designed and constructed in accordance with these specifications.

Minimum grades shall not be less than those required to produce a velocity of approximately two (2) feet per second when the size pipe selected is flowing full and using an "n" value of 0.014 in the Manning Formula.

Minimum grades shall be as follows (however, slopes greater than these are desirable):

Sewer Size	Minimum Slope in Feet per 100 Feet
8"	.50
10"	.28
12"	.22
14"	.17
15"	.15
18"	.12
21"	.10
24"	.08

Pipelines shall be sized to serve buildout of the planned development. Pipe sizes shall not be arbitrarily increased in order to take advantage of a flatter grade.

The maximum permissible velocity shall not exceed fifteen (15) feet per second. Suitable provisions shall be provided to break steep slopes to limit the velocities in the connecting sewer pipes between manholes. Where it is impractical to reduce the velocity, the sewer main shall be ductile iron.

2. Drop Manhole Requirements

Drop manhole connections shall be constructed for sewers entering manholes at elevations greater than or equal to twenty-four (24) inches above the manhole invert. Drop connections shall be ductile iron pipe, backfilled in six (6) inch lifts and compacted by hand tampers (See Part VII, Figure S-1-C.) Sewer lines entering a manhole less than twenty-four (24) inches above the manhole invert shall not enter the manhole greater than twelve (12) inches above the manhole invert and shall be incorporated into a smooth transition by filleting the invert.

3. Sewers Exceeding 20% Slope

Sewers on a 20% slope or greater shall be anchored securely with concrete anchors and be constructed of ductile iron pipe (See Part VII, Figure S-4.) Anchor spacing shall be in accordance with the following table:

<u>Slope</u>	<u>Anchor Spacing</u>
20% to 35%	not over 36'
35% to 50%	not over 24'
50% or greater	not over 16'

The first anchor shall be placed on the first joint upstream from the lower manhole. The location of the first anchor and the maximum spacing required shall determine the number of anchors used between manholes.

4. Sewer Junctions

New sanitary sewer main connections shall only be made at manholes. Junctions between sanitary sewers, with differing pipe materials or diameters shall only be made at manholes. The relative elevation of the inverts shall be set to maintain the same energy gradient. The sewers shall be set so the water surface of each sewer flowing at 80% of its capacity is at the same elevation, or the crown of both sewers are set at the same elevation.

5. Minimum Size

No public sewer shall be less than eight (8) inches in diameter. Minimum size for each service lateral connection is four (4) inch inside diameter. The Authority reserves the right to specify the size of any sewer mains.

6. Manhole Requirements

Manholes for access to sewers shall be provided at all intersections with other sewers, at all points of change in alignment, changes in pipe size or grade, and at the end of the line. The maximum distance between manholes shall be 400 feet. All sewer lines shall be straight between manholes. A manhole shall be constructed at the end of all lines, regardless of length.

Sewer manholes for sewers up to twenty-four (24) inch diameter shall not be less than forty-eight (48) inch inside diameter. Manholes for sewers larger than twenty-four (24) inches and up to forty-eight (48) inches shall have an inside diameter of not less than sixty (60) inches.

Manhole top elevations shall be above the 100-year Flood Elevation or watertight and ventilated in accordance with the Virginia Sewage Collection & Treatment Regulations.

Where practical manholes shall be placed on undisturbed soil. Where manholes must be installed in fill areas, the fill shall be compacted to 95% of the optimum density, as determined by AASHTO T-99 to an elevation not less than thirty-six (36) inches above the proposed invert before excavation begins. Certification of compaction at the manhole location shall be provided before setting the manhole base.

7. Ventilation

Ventilation of gravity sewers shall be provided where continuous watertight sections greater than 1000 feet in length are incurred. Vents shall be protected against the 25-year flood level either by elevation or mechanical means.

8. Depth of Cover

All sewers should be constructed in such a manner that a minimum of three (3) feet of cover is maintained between the top of the pipe and the finished grade elevation. Only under extraordinary conditions shall any sewer line be installed with less than three (3) feet of cover from the top of the pipe to finished grade.

This will only be allowed by special permission from the ACSA. If such a condition arises, the pipe shall be ductile iron, Class 52, and adequately protected. Greater depths may be required if deemed necessary to provide service to adjacent properties or to serve lower-lying properties. PVC pipe shall not be used when the final cover over top of the pipe exceeds fifteen (15) feet.

9. Design

The structural design of the sewer shall conform with the methods given in ASCE Manual No. 37, as amended, for the design and construction of sanitary and storm sewers.

The proposed design shall identify and adequately address the protection of all potable water supply structures within one hundred (100) feet of the proposed project.

10. Industrial Waste

Sources of waste other than domestic shall be evaluated on an individual basis and plans of all industrial or commercial pretreatment facilities shall be reviewed by the ACSA in accordance with current Albemarle County Industrial Waste Ordinance.

11. Storm & Sanitary Sewer Crossings

The minimum distance where sewer lines and storm drainage appurtenances cross shall be twelve (12) inches.

C. SEWER LOCATIONS

1. General

It is understood that topographic constraints dictate the appropriate location for installation of sanitary sewers. Sewers shall be designed to accommodate gravity sewer flow whenever possible. If sewers are to be constructed within streets or highway rights-of-way, preliminary approval must be obtained from VDOT.

If sewer lines are to be constructed on private property, a permanent sanitary sewer easement shall be provided in accordance with Part II of these specifications.

Whenever possible, sewers should not be located in areas subject to flooding, or in drainage ditches, or in any location that would encourage infiltration. Structures located by necessity in areas prone to inundation shall be provided with watertight covers.

2. Stream Crossings

Sewers crossing streams shall remain fully operational during flood/wave action. Sewers shall be watertight when located within the 100 Year Flood Plan. Sewers shall be constructed of watertight ductile iron pipe of

the same size inside diameter as the appurtenant sewer or the next size larger in ductile iron, if equal size is not available. The pipe and joints shall be tested in place, shall exhibit "0" infiltration, and shall be designed, constructed and protected against anticipated hydraulic and physical, longitudinal, vertical and horizontal loads and erosion and impact.

Where stream crossings are proposed below the channel the tops of all sewers crossing streams shall be at a sufficient depth below the natural bottom of the stream to protect the sewer line. Where less than three (3) feet of cover is available at crossings, the line shall be encased in concrete and shall not interfere with future improvements to the stream channel. Encasement shall be in accordance with detail shown in these specifications (See Part VII, Figure S-7.)

Sewers laid on piers across ravines or streams shall be allowed only when it can be demonstrated that no other practical alternative exists. Construction methods and materials of construction shall be such that sewers will remain watertight and free from change in alignment or grade. Pier design shall be submitted to the Authority for approval.

D. SEWER SERVICE LATERALS

1. General

A sewer service lateral shall be required for each customer and/or lot, unless otherwise approved by the ACSA. Sewer service laterals shall be constructed to the property line and sealed until said sewer lateral is put in use. In no case shall the lateral be less than four (4) inches inside diameter.

Sewer service lateral connections to sewer mains eighteen (18) inches in diameter, or larger, shall only be made at manholes. If necessary, a new "doghouse" manhole shall be installed on an existing sewer main to accommodate a new connection.

2. Pipe Installation

All pipe from the main sewer line to the property line shall be laid in a straight line and to a minimum grade of not less than one-quarter inch per foot. The minimum depth of cover shall be three (3) feet over the sewer service lateral, unless otherwise approved by the ACSA (See Part VII, Figure S-2.)

When it becomes necessary to connect to an existing sewer main, a saddle or manhole will be required at the point of connection. Saddles shall be approved by the ACSA, prior to installation. Where dissimilar materials exist between a service lateral and the building sewer, a satisfactory adaptor shall be provided in order to ensure a tight joint and smooth transition.

3. Marking

All service lateral stub-outs shall be marked with a pressure treated 2x4 piece of lumber no less than four (4) feet in length. The 2x4 shall extend approximately two (2) feet above grade and shall be painted green. The depth to the service lateral shall be noted on the 2x4. Alternate markers may be approved by the ACSA.

4. Inspection

All in-line wyees/tees or saddles shall be left exposed for visual inspection by the ACSA, so that measurements to the nearest downstream manhole can be obtained. The pipe between the property line and the building shall conform to the applicable sections of the ICC International Plumbing Code Chapter 7, 2003, or latest revision. This section of the sewer service lateral shall be inspected by the County of Albemarle.

E. SANITARY SEWER CONSTRUCTION

1. Pipe Laying-General Requirements

Construction of sanitary sewer lines and appurtenances shall be in accordance with the approved plans and specifications. The ACSA shall insist that good workmanship and standard sewer line construction principles apply in the work in order that the finished project may qualify on final inspection for acceptance into the ACSA sewerage system.

Prior to the construction of any sanitary sewer, the owner's or developer's engineer shall place adequate line and grade stakes and shall also set stakes and furnish grades so that all manhole tops can be set to grade, all in accordance with the approved plans and specifications. Whenever obstructions not shown on plans are encountered during progress of the work, which interfere to such an extent that an alteration in plans is required, the ACSA or its representative shall be advised.

If any deviation is contemplated in location, line or grade of any sewer line, masonry structure, or accessory from that shown on the plans approved by the ACSA, details of the proposed deviation shall be submitted to the ACSA for review and approval before the changes are constructed. Verbal approval may be granted for minor alterations. Major alterations will require written approval before such alterations are put into effect. The severity of the alteration and its remedial action shall be determined by the ACSA.

2. Excavation and Laying of Pipe

a. *Excavation*

Pipeline construction shall be made by open cut unless otherwise specified or required. During the excavation operations, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins.

All open trenches shall be adequately shored and braced to provide a safe working environment. Trench boxes shall be made available onsite and utilized in accordance with appropriate OSHA standards. It is the contractor's responsibility to comply with the requirements of OSHA pertaining to men working in an open trench.

All excavated material not suitable for backfill shall be removed and disposed of in an acceptable manner. Grading shall be done as may be necessary to prevent water from flowing into trenches or other excavations and any water accumulating therein shall be removed by approved methods.

The trenches in which the pipe is to be laid shall be opened in accordance with the lines and grades on the approved plans and designated in the field by the developer's or owner's engineer. The exposed end of all pipes shall be fully closed by means of an approved stopper to prevent earth or other substances from entering the pipe. All sewers shall be laid true to line and grade with bells upstream. The sections of pipe shall be so laid and fitted together that, when complete, the sewer will have a smooth and uniform invert.

Where a proposed sanitary sewer system connects to an existing manhole, main line or any other sewage facility, the outlet pipe of the first manhole upstream from said existing sewer facilities shall be completely blocked with an expansion plug. This plug shall remain in place throughout the construction and testing phases of the project and shall not be removed until final approval of the project is granted by the ACSA. The exposed end of all sewer pipe in the trench (particularly throughout the first reach upstream from the existing sewer facility) shall be completely blocked with an approved plug when pipelaying is not in progress in order to protect the existing sewer facility.

All trenches shall be kept free of water during the laying operations. Not more than one hundred (100) feet of trench shall be opened in advance of the completed sewer when located along streets

or highways, and not more than two hundred (200) feet at other locations.

b. Construction in Fill Areas

Where pipelines are to be installed in fill areas, the fill shall be compacted to 95% of the optimum density, as determined by AASHTO T-99, before excavation begins for the pipe trench. Certification at intervals as directed by the Authority shall be required of all compaction in fill areas.

c. Trench Width

The width of the trench at any point below the crown of the pipe shall be no greater than the width necessary to accommodate shoring the trench, setting and aligning the pipe. Trench walls in this area shall be kept as nearly vertical as possible. Trench walls above the crown of the pipe may be sloped or shored to meet the applicable OSHA trenching standards.

Excavation at manholes and similar structures shall be sufficient to leave at least twelve (12) inches clearance between their outer surface and the embankment or sheeting. Minimum clearance between side of trench and pipe shall be eight (8) inches.

d. Rock Excavation

Where rock is encountered in trench excavation, whether solid or in the form of loose rock or shale, or large boulders, it shall be removed by blasting or other approved methods to the extent that no projection of rock shall be nearer than six (6) inches to any part of the sewer pipe when laid, nor project beyond the lines and grades of structures. No blasting shall be done within twenty-five (25) feet of any completed work or adjacent to any other structure unless proper precautions are taken. Ends of sewer line adjacent to blasting shall be covered to avoid receiving debris. No rock or asphalt over six (6) inches in any dimension shall be placed in the trench and in no case shall rock or asphalt be placed closer than two feet vertically to the installed pipe.

e. Over Excavation

Where the excavation has been carried too deep the contractor shall refill the over-excavated trench with VDOT specification No. 68 stone, in order to ensure the stability of the various structures.

f. Pipe Installation (General)

When installing pipe in the trench, proper implements, tools, and facilities satisfactory to the ACSA and as recommended by the material manufacturer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, fittings, and accessories shall be carefully lowered into the trench piece by piece by means of a derrick, ropes, slings, or other suitable tools or equipment in such a manner as to prevent damage to the sewer main materials and any protective coatings and linings (when ductile iron is used). Under no circumstances shall sewer main materials be dropped or dumped into the trench.

g. Condition of Ductile Iron Pipe

All lumps, blisters and excess coal tar coating shall be removed from the ends of each pipe. The outside of the spigot and the inside of the bell shall be wire-brushed and/or clean and dry and free from oil and grease before the pipe is laid.

h. Special Precautions

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. During the laying operation, no debris, tools, clothing or other materials shall be placed in the pipe. Sewer lines shall be plugged at the end of each construction day to prevent foreign matter from entering them.

3. Pipe Foundation

a. Foundation in Good Soil

For PVC pipe the bottom of the trench shall be excavated from four (4) to six (6) inches below the bottom of the barrel of the pipe and a bedding shall be provided of No. 68 Stone, per Virginia Department of Transportation specifications. The bedding shall be shaped to the spring line of the exterior diameter of the pipe to support one-half of the circumference of the pipe for the entire length of the barrel and shall extend to the trench walls.

For ductile iron pipe, the bottom of the trench shall be scraped and compacted, and all stones shall be removed or a four (4) inch bedding of No. 68 stone shall be provided. Bell holes shall be cut to prevent the pipe from resting on the bells (See Part VII, Figure S-3.)

Where excavation is made in rock or boulders a bedding of No. 68 stone with a minimum thickness of six (6) inches shall be provided for both PVC and ductile iron pipe. The bedding material shall extend evenly to the trench wall.

b. Foundation in Poor Soil

Whenever the soil at the bottom of the trench is soft, unstable or saturated with water, a granular fill under the bedding to a depth required to stabilize the soil shall be provided. Maximum size of gravel shall be one (1) inch. Ductile iron pipe shall be provided in unstable soils as determined by the ACSA (See Part VII, Figure S-3.)

c. Pressure Sewer

Where pressure sewers are required, all tees, bends, and plugs shall be braced, blocked, and/or anchored to prevent any movement by providing adequate reaction backing. This backing shall be a concrete thrust block with a compressive strength not less than 2500 psi. Backing shall be placed between solid undisturbed earth and the fitting to be anchored and shall be so placed that pipe and fitting joints will be accessible for repair (See Part VII, Figure W-3, W-3A, and W-3B.)

4. Backfilling and Tamping

a. General

All trenches or excavations shall be backfilled to the original surface of the ground or to such other grades as may be shown on the approved plans. Backfilling shall be subject to the approval of the ACSA for the type of construction used. All backfilling shall be completed promptly. Backfilling around structures should be started as soon as the mortar and masonry are sufficiently set. New trenching will not be permitted when earlier trenches need backfilling or labor is needed to restore the surfaces of streets or other areas to a safe and proper condition.

b. Materials

All material used for backfilling of trenches shall be free of excessive amounts of unsuitable materials such as all organic material, frozen clods, and sticky masses of clay and gumbo which are difficult to properly compact. Backfill material shall contain no rock or asphalt larger than five (5) inches in any dimension and in no case shall rock or asphalt be placed closer than two (2) feet vertically to the installed pipe.

c. Backfilling

Backfilling around PVC pipe shall be carefully done by hand and tamped with suitable tools of approved weight. Backfill over all pipe to a depth of twenty-four (24) inches shall be carefully placed in layers approximately six (6) inches thick, each layer being thoroughly tamped and compacted by hand or pneumatic tamper in place. Special care shall be taken in using a mechanical tamper directly over the pipe.

Above this point, backfill shall be deposited in layer thicknesses which will permit compaction to a density of at least 95% of the maximum density at optimum moisture content as determined by the AASHTO standard Proctor test (AASHTO Designation T-99) under all proposed traffic areas. Backfill in existing traffic areas shall be in accordance with the Virginia Department of Transportation's standards.

d. Compaction

Unless otherwise shown on the plans, the backfill in all trenches from two (2) feet above the top of the pipe to finish grade shall be deposited and thoroughly compacted in six (6) inch layers in traffic areas and twelve (12) inch layers in non-traffic areas. The compacting shall be done by suitable mechanical means. In all cases, special care shall be taken to see that the spaces at the sides of the trench are thoroughly filled and compacted.

It shall be required that a minimum of one (1) compaction test will be conducted on trench backfill per 400 linear feet of sewer line. The location of tests shall be selected in the field by the ACSA and will not necessarily be limited to regular intervals. Compaction tests may be waived by the ACSA on projects less than 400 linear feet in length. The contractor shall bear the expense of all compaction tests.

The results of all compaction tests shall be submitted to the ACSA for review and approval prior to acceptance of construction. The degree of compaction required for trenches in streets and paved areas is 95% of maximum density and for trenches in all other areas the required density shall be 90% of maximum density. If the tests indicate the required density has not been obtained, the contractor shall remove, replace and re-compact the material to the specified density. Failure of any compaction tests may result in additional compaction tests being required.

e. Protection of Pipe and Appurtenances

Backfilling shall be done in such a way as to prevent dropping of

material directly on top of the pipe from more than a three (3) foot vertical distance. When placing material from a bucket it must be lowered so that the shock of the falling earth will not damage the sewer line or structure.

F. SANITARY SEWER PIPE, JOINTING AND ACCESSORIES

1. General Requirements

Unless otherwise approved in writing by the ACSA all sanitary sewer lines shall be of the material herein listed. The ACSA reserves the right to select the type and/or class material which shall be used from the following list:

a. *Ductile Iron Pipe & Fittings*

Ductile iron pipe shall be centrifugally cast pipe manufactured in accordance with AWWA/ANSI C151/A21.51-02, or current revision, Class 50, 51, or 52, as conditions require. All ductile iron pipe shall have a cement mortar lining in accordance with AWWA/ANSI C104/A21.4-03, or current revision.

Fittings shall be standard mechanical joint fittings in accordance with AWWA/ANSI C110/A21.10-03, or current revision, AWWA/ANSI C153/A21.53, current revision and AWWA/ANSI C111/A21.11-00, or current revision. All fittings shall be cement mortar lined inside in accordance with AWWA/ANSI C104/A21.4-03, or current revision.

Pipe and fittings shall be coated inside and out with coal tar coatings.

No cast iron soil pipe shall be used as a public sewer.

b. *Concrete Pipe*

Non-Pressure Sewer Pipe. Reinforced concrete sewer pipe shall be used only when sewer lines are twenty-four (24) inch in diameter or larger and shall be in conformance with ASTM designation C-76 or current revision, for Class II, Class III, Class IV or Class V with the exception that absorption shall be limited to 5%.

c. *Polyvinyl Chloride (PVC) Pipe*

Non-Pressure Sewer Pipe. PVC gravity sewer pipe shall be manufactured of compounds conforming to ASTM D-1784-81, or current revision. Pipe and fittings shall meet and/or exceed all of the requirements of ASTM Specification D-3034-89 PSM SDR 35, or current

revision, for heavy wall PVC.

PVC pipe shall be installed in strict conformance with ASTM Designations D-2321-89 or current revision. PVC pipe shall be shipped and stored so that warping of pipe does not occur. PVC pipe to be stored outside should be covered to protect it against the sun's rays, per manufacturer's published recommendation.

Certificates of compliance with applicable ASTM designations and strength classifications covering the pipe, joints, gaskets, and fittings will be required directly from the pipe manufacturer as deemed necessary by the Authority.

d. Marking Tape

A two (2) inch wide minimum size green colored non-metallic sewer marking tape shall be buried at a distance of approximately two (2) feet above the top of, and directly over all, sewer mains to alert construction and maintenance crews that a sewer pipe is below. The marking tape shall be continuous between manholes. Marking tape disturbed during the course of construction on existing sewer mains shall be restored to its original condition and to the satisfaction of the project inspector.

2. Joints

Jointing of concrete, cast iron, ductile iron, and plastic pipe shall conform to the manufacturer's published recommendations and specifications.

Joints in sewer pipe shall conform to the following:

a. Ductile Iron and Cast Iron Pipe

Gravity Sewers: Mechanical or push-on joints in accordance with AWWA/ANSI C111/A21.11-00, or current revision.

Pressure Sewers: Mechanical, push-on or flanged joints in accordance with AWWA/ANSI C111/A21.11-00, or current revision, or approved rubber gasket type joint to lock against displacement.

b. Concrete Pipe

Concrete pipe joints shall be made by the use of an "O" ring type round rubber gasket, ASTM C-443-79, or current revision. These gaskets will be furnished by the pipe manufacturer and installed in strict conformance with his published recommendations. The gasket shall be

the sole element utilized in sealing the joint from either internal or external hydrostatic pressure.

c. Polyvinyl Chloride Pipe

PVC pipe shall be joined by bell and spigot type connections. The pipe joint shall be tightly sealed against infiltration and exfiltration by means of a locked-in rubber sealing ring conforming to ASTM D-3212-89, or current revision. The connection shall also permit the thermal expansion or contraction of the pipe.

d. Gaskets

Gaskets for sewer pipe and fittings shall be vulcanized natural or vulcanized synthetic rubber free of porous areas, foreign material or visible defects. Rubber gaskets shall conform to all applicable provisions of AWWA C111-00, or current revision.

Gaskets shall be protected from exposure to excessive heat, cold, direct sunlight, ozone (from electric motors and equipment), oil, grease, or other contaminants.

G. MANHOLES

1. General Requirements

All manholes on one project shall be constructed of the same materials. All concrete work shall be in accordance with the applicable sections of these specifications.

Sealing around all pipes entering manholes shall be done with a quick setting non-shrinking grout.

Height control rings may be used to adjust manhole tops to proper grade; however, a maximum of twelve (12) inches total of height control rings will be permitted.

2. Frames & Covers

a. Materials

Manhole frames and covers shall be heavy duty, traffic resistant, gray cast iron. Frame and cover castings shall conform to the details and dimensions shown in these specifications and shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow-holes and other defects in positions affecting their strength

and value for the use intended. They shall be boldly filleted on angles and the arises shall be sharp and perfect. They shall be sand blasted or otherwise cleaned or scaled so as to present a smooth, clean, and uniform surface.

Standard and watertight manhole covers shall have no pick holes. The marking "Sewer" must be cast in their body. Watertight manhole covers provided with locking lugs or similar restraints shall be required in all low lying areas subject to flooding and as required by the Authority. Four (4) 5/8" anchor bolts shall be placed in the cone section to secure the manhole frame to the concrete on watertight cones.

b. Frame & Cover Installations

Manhole frame and cover castings shall be installed so that the cover shall be exposed and flush with the existing street surface. In no case shall the existing pavement surface be raised or lowered to meet the grade of installed manhole frame and cover castings. If street surfaces are renewed or replaced by the developer or owner after the sewer system has been approved and accepted by the ACSA, but while such streets are still the obligation of the developer or owner, the manhole frames and covers therein shall be readjusted to proper location relative to new street surfacing by the original developer or owner. Where frames and covers are located in off-street areas, they shall be placed flush with the finished grade. Where manholes are installed in sloped areas the finished grade of the slope shall intersect the top rim of the frame and cover on the uphill side.

The manhole frame shall be sealed to the concrete manhole section using a bed of mortar on either side of a butyl rubber sealant. The frame and cover shall be mortared to the outside of the concrete manhole section.

3. Precast Concrete Manholes

Pre-cast concrete manholes shall conform to the following specifications:

a. *General Information*

Manholes shall be constructed of precast reinforced concrete manhole sections conforming to ASTM designation C-478-80, or current revision. Manholes will be required to have a flexible boot connection at the pipe entry to prevent infiltration. The flexible boot connections shall be cast in the manhole section.

The minimum inside diameter of the manhole shall conform to the requirements of Section B.6, unless otherwise approved by the ACSA.

The uppermost section of the manhole shall be tapered eccentrically and shall be a minimum of three (3) feet in height. Where field conditions dictate "flat top" manhole sections can be utilized with the approval of the ACSA. The height of the lower section shall be at least three (3) times the inside diameter of the largest sewer pipe entering the section and in no case less than two (2) feet.

b. Concrete

The walls of the manholes shall have a minimum thickness of five (5) inches and shall be constructed of reinforced concrete with a compressive strength of 3000 psi at 28 days. If the manhole bottom is not monolithically molded with the walls, a concrete floor slab shall be provided with a minimum thickness of twelve (12) inches and a minimum outside diameter of five feet, ten inches. The concrete shall have a minimum compressive strength of 3000 psi at 28 days. The manhole base slab, if cast in place as opposed to being furnished as a monolithic component of the precast manhole section, shall be reinforced with Style 6x6 - W5.5 welded wire fabric or equivalent area of reinforcing steel. The base slab, if cast in place, shall be poured so as to ensure a watertight seal at the joint formed by the base slab and riser section.

c. Joints

The joints between manhole sections shall be tongue and groove with an "O" ring rubber gasket or "STEP" section with sliding flap seal ring, conforming to ASTM designation C-443-79 or latest revision. Jointing of the precast manhole sections shall conform to the manufacturer's published recommendations and specifications. A flexible joint sealant may be required between precast manhole sections.

d. Steps

Manhole steps shall be designed for installation in a sanitary sewer and shall be steel encapsulated in corrosion resistant rubber, and shall be in accordance with OSHA standards and ASTM C-478-80 or current revision. Manhole steps shall be a minimum of ten (10) inches wide and shall project no less than five (5) nor more than seven (7) inches from the wall. Vertical spacing of manhole steps shall be uniform with a maximum of sixteen (16) inches and a minimum of twelve (12) inches.

e. Inverts

All flow lines shall be constructed through manholes to a minimum of three-fourths (3/4) the depth of the contributing sewer. Inverts shall be true to line and grade with flow lines having a minimum drop of 0.2 feet and a maximum drop of one (1) foot from inlet to outlet. Sides of flow lines shall be built up with low slump concrete or with masonry and plastered with mortar to provide a smooth channel and prevent solids deposition. Manhole benches shall be sloped to drain to flow lines.

4. Connection to Existing Manholes

Whenever connections are to be made to an existing manhole, care shall be taken to prevent debris from entering the sewer line. Flow into existing manholes will not be permitted until all "upstream" sewer lines have been tested, approved and thoroughly cleaned of all debris.

Pipe connections to existing manholes shall be made with flexible boot connections. Existing manholes not provided with flexible boot connections already cast in place, shall be field cored and have boots installed. Drop connections shall be made in accordance with the detail in Part VII, Figure S-1-C.

5. Doghouse Manholes

Wherever sanitary sewer main connections are to be made to an existing sanitary sewer, they shall be made by constructing a "doghouse" style manhole with a base as shown in Figure S-1-A1. The doghouse opening shall be no less than four (4) inches or more than eight (8) inches greater than the outside diameter of the existing pipe. The doghouse shall sit on a twelve (12) inch thick stone sub-base and twelve (12) inch concrete base as shown. The new sewer shall connect with a flexible boot at the pipe entry as specified in Section 3.(a) of this Section. An invert shall be formed in the shelf to allow flow to the existing pipe. The space between the existing pipe and doghouse opening shall be filled with 3000 psi concrete and coated with a waterproof sealant. The manhole shall be tested in accordance with these specifications prior to cutting into the existing sewer line. The top half of the pipe shall be cut and removed after the shelf and invert have been cured.

H. ACCEPTABLE TESTS

1. General Requirements

All sanitary sewer lines and manholes shall be subjected to the applicable tests described in this section. All labor and equipment for such

tests shall be furnished by the contractor. In the event that leakage exceeds the stated allowance in any section tested, the developer or owner shall cause such repairs to be made to the line, manholes or appurtenances as may be necessary to comply with the specifications, to the satisfaction of the Authority. 48 hours notice is required prior to undertaking any tests.

2. Gravity Sewers

a. *Alignment*

A light will be flashed between manholes by means of a flashlight or reflection of sunlight with a mirror or by other methods as may be adopted by the ACSA. If the illuminated interior to the pipe shows poor alignment, displaced pipe, blockage or other defects, the defects shall be corrected so as to meet all standards governing the construction of sewer mains. All costs involved shall be born by the contractor.

b. *Deflection*

All PVC gravity sewer lines shall be subject to vertical deflection testing as deemed necessary by the ACSA. The maximum allowable deflection following completion of backfill shall not exceed 5% of the pipe's internal diameter. Deflection testing shall be conducted using a properly sized Go-No-Go Mandrell or by other methods as may be adopted by the ACSA. Any sewer sections failing to meet deflection requirements shall, at the contractor's expense, be corrected so as to meet all standards governing the construction of sewer mains.

c. *Testing*

I. Infiltration

Infiltration tests will be allowed when a contractor can demonstrate to the satisfaction of the ACSA that the groundwater table is a minimum of four (4) feet above the crown of the sewer pipe throughout the full length of the segment to be tested. Measurements shall be made using an in-line weir gauge or other method as may be approved by the ACSA. A series of three (3) measurements shall be made at not less than one (1) hour intervals, and the results shall be reduced to an average. All such tests shall be made only under the supervision of the ACSA at the expense of the contractor.

State highway restrictions may limit the use of infiltration testing in streets or future street areas. Approval of infiltration tests shall be obtained from the ACSA before testing by the

contractor.

The leakage allowed into the sewer shall not exceed a rate of fifty (50) gallons per inch of nominal pipe diameter per day per mile for any section between successive manholes. Leakage into the sewer shall not exceed a maximum of 2,400 gallons per day, regardless of pipe diameter.

II. Exfiltration

Exfiltration testing is only acceptable in dry areas or when the ground water level is suitably low.

The contractor shall conduct leakage tests of the completed sewers at his expense and only under the supervision of the ACSA. Exfiltration testing of the lines shall be conducted between successive manholes by plugging the inlet to the lower manhole, using a plumber's expansion plug, and by plugging the outlet sewer pipe in the upper manhole using a plumber's expansion plug with a two (2) inch fill pipe through the middle. The two (2) inch fill pipe through the plumber's expansion plug shall have an ell installed in a turned up position into which a two (2) inch threaded riser pipe shall be screwed in place to form a filler pipe. Positive means shall be provided for releasing entrapped air in the sewer pipe prior to taking measurements. As an alternate, the inlet pipe or pipes to the upper manhole may be plugged and the manhole then used as a means of filling the section of pipe to be tested.

During exfiltration testing, the maximum internal pressure at the lowest end may not exceed twenty-five (25) feet of water or 10.8 psi. The internal water head must be four (4) feet higher than the top of the pipe or four (4) feet higher than the ground water level, whichever is higher. Exfiltration shall be determined by measuring the amount of water added to keep the standpipe or manhole, as the case may be, filled to a depth of four (4) feet.

Leakage shall not exceed fifty (50) gallons per inch of nominal pipe diameter per day per mile for sewers. Leakage out of the sewer shall not exceed a maximum of 2,400 gallons per day, regardless of pipe diameter.

The contractor shall conduct either infiltration or exfiltration tests as directed by the ACSA and in all cases such tests and allowable quantities for infiltration and exfiltration shall be in strict accordance with the applicable sections of these specifications.

III. Low Pressure Air Test

In lieu of the water exfiltration test, a low air pressure test may be used. Testing methodology for differing pipe materials shall be in conformance with ASTM standards. The following standard is based on ASTM F1417-92 (1998) for PVC sewer pipe. The same methodology can be used for ductile iron gravity sewer pipe. Standard deviations for other materials shall be subject to the applicable ASTM standard and approval of the ACSA.

The air test is to be conducted between two (2) consecutive manholes. The test equipment shall consist of two (2) plugs (one tapped and equipped for air inlet connection), a shut-off valve, a pressure regulating valve, a pressure reduction valve, and a monitoring pressure gauge having a pressure range from 0 to 5 psi, graduated in 0.10 psi with an accuracy of ± 0.04 psi. The test equipment shall be set up outside the manhole for easy access and reading.

Air shall be supplied to the equipment slowly and shall be regulated to prevent the pressure inside the pipe from exceeding 5.0 psig. The pipeline shall be filled until a constant internal pressure of 3.5 psig is maintained. The internal pressure shall be maintained at 3.5 psig or slightly above for a five (5) minute stabilization period, after which time the internal pressure will be adjusted to 3.5 psig, the air supply shut off and the test begun. No person shall remain in the manhole while the pipe is being pressurized or throughout the test for safety reasons.

The engineer or inspector specifies the duration permitted for a prescribed low pressure air exfiltration pressure drop between two consecutive manholes. Table 3 (below) is taken from UNI-BELL recommended practice for low pressure air testing of installed sewer pipe. The prescribed drop shall not exceed 0.5 psi (3.4 kN/m²) in excess of the groundwater pressure above the top of the sewer pipe for the time allotted in Table 3.

TABLE 3
TIME REQUIREMENT FOR A 0.5 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED

Pipe Dia. (inches)	Specified Time for Length Shown (min.)							
	<100 ft	100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft
4	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	2:50	2:50	2:50	2:50	2:50	2:50	2:51
8	3:47	3:47	3:47	3:47	3:47	3:48	4:26	5:04
10	4:43	4:43	4:43	4:43	4:57	5:56	6:55	7:54
12	5:40	5:40	5:40	5:42	7:08	8:33	9:58	11:24
15	7:05	7:05	7:05	8:54	11:08	13:21	15:35	17:48
18	8:03	8:03	9:37	12:49	16:01	19:14	22:26	25:38
21	9:55	9:55	13:05	17:27	21:49	26:11	30:32	34:54
24	11:20	11:24	17:57	22:48	28:30	34:11	39:53	45:35
27	12:45	14:25	21:38	28:51	36:04	43:16	50:30	57:42

An air pressure correction for groundwater shall be required when the prevailing groundwater table is above the sewer being tested and shall be calculated as follows:

$$\frac{\text{Groundwater Depth (ft. above sewer line)}}{2.31} + 3.5 \text{ psi} = \text{Starting Pressure (psi)}$$

$$\text{Ending Test Pressure} = \text{Starting Pressure (psi)} - 0.5 \text{ psi}$$

There is no change in the time requirement when the groundwater correction is applied.

Should any test on any section of the pipeline disclose an air loss rate greater than permitted, the contractor shall, at his own expense, locate and repair the defective joints or pipe sections. After the repairs are completed, the section shall be retested until the air loss rate is within the specified allowance.

3. Manhole Testing

a. *General*

Manholes shall be tested by exfiltration or vacuum. Where water exfiltration tests are performed on the sewer line, the manholes may be included in these tests in lieu of the independent manhole testing

procedures outlined below.

b. Exfiltration

If the water exfiltration test is to be used, the manholes shall be filled with water to the top, by the contractor, unless otherwise directed by the ACSA. Inflatable stoppers shall be used to plug all lines into and out of the manhole being tested. The stoppers shall be positioned in the lines far enough from the manhole to assure testing of those portions of the lines not otherwise tested. Once the manhole has been filled with water to the top, a twelve (12) hour soak shall be required prior to testing. Leakage during a one-hour test shall not exceed one half gallon.

c. Vacuum Testing

Installation and operation of vacuum testing equipment and indicating devices shall be in accordance with the latest edition of ASTM C1244.

Manholes may be tested by vacuum testing only if constructed of precast concrete. Testing shall include the joint between the concrete cone section and the manhole frame, unless otherwise directed by the ACSA. Stub-outs, boots, and pipe plugs shall be secured to prevent movement while the vacuum is being drawn.

A measured vacuum of ten (10) inches of mercury shall be established in the manhole. The time for the vacuum to drop to nine (9) inches of mercury shall be recorded. Acceptance standards for leakage shall be established from the elapsed time for a negative pressure change from ten (10) inches to nine (9) inches of mercury. The maximum allowable leakage rate shall be in accordance with the following:

<u>Manhole Size</u>	<u>Depth</u>	<u>Minimum Time for a 1" Hg Pressure Change</u>
4 ft. diameter	less than 10 ft.	60 sec.
4 ft. diameter	greater than 10 ft. less than 15 ft.	75 sec.
4 ft. diameter	greater than 15 ft. less than 25 ft.	90 sec.
5 ft. diameter	less than 10 ft.	75 sec.

5 ft. diameter	greater than 10 ft. less than 15 ft.	90 sec.
5 ft. diameter	greater than 15 ft. less than 25 ft.	105 sec.
6 ft. diameter	less than 10 ft.	90 sec.
6 ft. diameter	greater than 10 ft. less than 15 ft.	105 sec.
6 ft. diameter	greater than 15 ft. less than 25 ft.	120 sec.

Manholes greater than twenty-five (25) feet in depth shall be reviewed and testing requirements established on a case-by-case basis. If the manhole fails the test, necessary repairs shall be made and the vacuum test and repairs shall be repeated until the manhole passes the test or the manhole shall be tested in accordance with the standard exfiltration test and rated accordingly. If a manhole joint mastic is completely pulled out during the vacuum test, the manhole shall be disassembled and the mastic replaced. The test shall then be repeated as specified above.

4. Pressure Sewer

Hydrostatic Pressure Test. All sewer force mains shall be tested at a hydrostatic pressure of 150 psi or 50% above the design operating pressure, whichever is greater, for at least one hour. Leakage shall not exceed the amount given by the following formula, as provided in the latest edition of AWWA C600.

$$L = \frac{SD\sqrt{P}}{148,000}$$

Where:

L= allowable leakage in gallons per hour
D= diameter of pipe in inches
P= average test pressure during the hydrostatic test in pounds /sq inch (gauge)
S= length of pipe tested in feet

The method and equipment for conducting this test and specific pressure of the test shall be subject to the approval of the ACSA.

5. Acceptance

Should deflection, infiltration, exfiltration, air test, vacuum test or pressure leakage limits be exceeded as specified above, the ACSA reserves the right to reject all or any portion of the facilities. Any project or portion of a project rejected by the ACSA or its authorized representative shall not be permitted to discharge into any previously approved system until the rejected system or portion of system has been repaired so as to meet all standards governing the construction of sewer mains. All repair methods, other than replacement of the defective area with new sound materials, shall be subject to prior approval of the ACSA. Grouted, collared, clamped or otherwise patched-up gravity or force main sewer pipe will not be acceptable.

Upon completion of such inspection or tests as required in these specifications, all foreign matter, including sand, rock, gravel, etc. shall be removed from all sewers and manholes before final approval is granted.

PART VI

SUPPLEMENTAL SPECIFICATIONS

A. CONCRETE

1. General Requirements

Unless otherwise approved in writing, or as specifically indicated on approved plans, all concrete work shall conform to this section.

2. Materials

a. *Concrete.*

Concrete for structures shall be proportioned and mixed in accordance with the current edition of the Road and Bridge Specifications, Virginia Department of Transportation, Section 217. The concrete shall be Class A3. Concrete for miscellaneous purposes, such as fill concrete, thrust blocks, concrete encasement, etc., shall have 2500 psi strength at 28 days. The mix proportions and test data for this concrete shall be submitted by the Contractor for approval.

b. *Steel Reinforcement.*

Reinforcement bars shall be deformed intermediate-grade new billet steel conforming to ASTM A615, 60 ksi yields grade billet steel deformed type, ANSI/ASTM A497. Bars shall be formed to the dimensions indicated by the drawings. The contractor shall submit shop drawings to the engineer for approval.

c. *Wire Reinforcement.*

Welded wire fabric shall conform to ASTM Specification A185.

d. *Curing Compound.*

Curing compound shall conform to ASTM Specification C309, latest issue, Type 2.

e. *Joint Filler.*

Expansion joint material shall be preformed and shall conform to Federal Specification HH-F-341.

3. Slump

Slump tests shall be taken on every load delivered to the site. One test shall be required per load. If water is added to the mix at the site, the amount added shall be noted and the slump test repeated. Slump shall be from two (2) to four (4) inches and will be determined in accordance with ASTM Method C143. Samples for slump determination will be taken from the concrete during placement in the forms.

4. Testing

The 28-day compressive strengths will be verified during the progress of the work by testing standard concrete cylinders. The contractor shall furnish the necessary labor and facilities for taking the samples and handling and storing the cylinders at the site of the work. The owner will provide for testing of cylinders. The making, curing, and testing of specimens will be in accordance with ASTM Methods C31 and C39. All concrete cylinders shall be stored at the job site and under the same curing conditions as that of the concrete pour they represent.

5. Forms

All concrete shall be formed unless directed otherwise. Forms shall be true to line and grade and shall be mortartight. All exposed joints, edges, and external corners shall have three-quarter (3/4) inch chamfer. Forms shall be of wood, plywood, or steel. Form design shall be subject to approval, but adequacy of ties, supports, etc. shall remain the responsibility of the contractor.

Embedded wall ties shall be set one and one-half (1-1/2) inches from exposed concrete surfaces. In conventional thickness walls, the height of form for each vertical lift shall not exceed ten (10) feet. Forms for continuous surfaces shall be fitted over the completed surface to assure accurate alignment and to prevent leakage of mortar. All forms shall be constructed so that they can be removed without damage to the concrete. Before placing concrete, the contact surfaces of forms shall be cleaned and coated with a non-staining form oil. Forms of columns, walls, sides of beams and other members not supporting the weight of the concrete may be removed thirty-six (36) hours after placing of concrete.

Supporting forms for beams, girders and slabs shall remain in place until the concrete has reached its 28-day strength. Reshoring of such members will only be permitted for just cause and after review and approval by the engineer.

6. Placing Reinforcement

Steel reinforcement bars shall be placed in accordance with the approved shop drawings and supported by concrete block or metal chairs.

Reinforcement shall be free from loose, flaky rust, mill scale, oil, grease and other coatings that would destroy the bond.

7. Placing of Concrete

Concrete placing equipment and methods shall be subject to approval. Poor quality subgrades which would contaminate the concrete shall be covered with building paper or other approved material. All surfaces upon which concrete is to be placed shall be thoroughly dampened. The maximum free fall of concrete during placement shall be six (6) feet. Placement at greater heights than six (6) feet shall be accomplished by chutes, slides or other approved methods. Concrete shall be worked around the reinforcement and embedded fixtures and into corners of the forms with care being taken to avoid segregation. Concrete shall be placed so as to avoid formation of cold joints between successively deposited layers. Concrete shall be placed in the dry and placement will not be permitted during adverse weather conditions as determined by the ACSA.

8. Vibration

All concrete shall be consolidated with high frequency, internal, mechanical vibrating equipment supplemented by hand spading and tamping.

Vibrators shall be designed to operate with vibratory element submerged in the concrete, and shall have a frequency of not less than 6000 impulses per minute when submerged. The vibrating equipment shall be at all times adequate in number of units and power of each unit to consolidate the concrete properly. Vibration of forms and reinforcement shall not be permitted. Vibrators shall not be used to transport the concrete in the forms. Where concrete is placed in more than one lift, the vibrator shall penetrate into the previous lift to prevent the formation of cold joints.

9. Construction Joints

Construction joints shall be provided where indicated. Construction joint surfaces shall be thoroughly cleaned before placement of concrete. All laitance, coatings, stains, debris and other foreign material shall be removed from the surface and the surface shall be broomed with neat portland cement grout immediately before the new concrete is deposited. Water stops shall be provided at construction joints where indicated. Joints in metal water stops shall be brazed, welded, or soldered. Joints in rubber water stops shall be vulcanized. Water stops shall be installed so as to form a continuous watertight seal in each joint.

10. Placing Concrete in Cold Weather

Except on specific authorization, concrete shall not be placed when the atmospheric temperature is below 40 degrees fahrenheit.

11. Repair of Surface Defects

Surface defects shall be repaired immediately after form removal. Honeycombed and other defective concrete shall be removed down to sound concrete. A 1:1 bonding grout shall be brushed into the surface; then a stiff patching mixture of the same proportions as the concrete, except coarse aggregate, shall be applied to the defective area. The patching mixture shall be thoroughly consolidated and struck off slightly higher to permit shrinkage, then finally finished one hour later. The patch shall be kept damp for seven (7) days.

Tie holes shall be cleaned, thoroughly dampened and filled solid with patching mortar.

12. Surface Finish

Exposed wall surfaces shall be rubbed after completion of all patching. Surfaces shall be wetted and rubbed with carborundum brick or other abrasive until a uniform color and texture are produced. No additional cement grout shall be used other than that past drawn from the green concrete by the rubbing process.

Floor slabs shall receive a steel trowel finish. The surface shall be initially float-finished after the mix has hardened sufficiently to permit proper operation of a power-driven float. Power troweling and hand troweling shall complete the slab finish which shall be free from trowel marks, uniform in texture and appearance and shall be true within one-quarter (1/4) inch in ten (10) feet, determined by a 10-foot straightedge placed anywhere on the slab.

13. Protection and Curing

Concrete shall be protected adequately from injurious action by the sun, rain, flowing water, frost, mechanical injury, and shall not be allowed to dry out for seven (7) days after placing. Curing shall be accomplished by water curing or by application of a curing compound, except that compound shall not be used on surfaces to be rubbed, or where its appearance would be objectionable or where coverings are to be bonded to the concrete. Vertical wall forms shall be kept continuously wet while the forms are in place.

14. Concrete Walks

Wherever existing concrete walks are cut or disturbed, they shall be replaced to the next joint.