B. Related work specified elsewhere.

11 Wilhight Water Shift Series Specifications a Specific Series

C. General Conditions — Any reference to General Conditions refers to the EJCDC C-700 Standard General Conditions of the Construction Contract (2002 edition).

The following ANS/AWWA Standards (igtest revision) are hereby incorporated by reference. Where a conflict exists between these written standards, and the standards incorporated by reference, the Participating Utility will determine which standard shall apply. In general, the Participating Utility will select the Standard that gives a final product that is in best interest of the Participating Utility. Applicant shall provide the Participating Utility with manufacturer's certification that materials meet these standards.

C104 Standard for cement—mortar lined for ductile—iron and gray—iron pipe and fittings.
C110 Standard for ductile—iron and gray—iron fittings.
C111 Standard for rubber gasket joints for ductile—iron and gray—iron pipe and fittings.
C115 Standard for flanged ductile—iron and gray—iron pipe with threaded flanges.
C150 Standard for thickness design of ductile—iron pipe
C502 Standard for ductile—iron pipe
C502 Standard for dry—barrel fire hydrants
C506 Standard for resilient—seated gate valves
C515 Reduced—wall, resilient—seated gate valves
C515 Standard for protective interior coatings for valves and hydrants
C500 Standard for installation and testing of ductile—iron
water mains and their appurtenances

C600 Standard for installation and testing of ductile—iron water mains and their appurtenances C651 Standard for disinfecting water mains C900 Polyvinyl chloride (PVC) pressure pipe & fabricated fittings, 4 In. Through 12 In.for water transmission and distribution (DR—14 minimum class to be considered). C906 Polyethylene (PE) pressure pipe & fittings, for water distribution and transmission (DR—11 minimum class to be considered). C909 Molecularly oriented polyvinyl chloride (PVCO) pressure pipe, for water (Minimum class 200 to be considered).

2.1 WATER PIPE AND APPURTENANCES

All pipe for water main construction shall be one of the following or as directed by the Participating Utility:

1. Ductile iron pressure pipe (DIP) of the push—on joint or mechanical joint variety, conforming to ANSI/AWWA C151, latest revision. For all pipe twelve inches (12") in diameter or smaller, the minimum pressure class (PC) shall be 350, the minimum thickness class shall be 50. Water mains larger than twelve inch (12") diameter in size shall have a wall—thickness as determined

2. Polyvinyl chloride (PVC) conforming to ANSI/AWWA C900 with ductile iron O.D. Dimension Ratio (DR) 14 PC 305 shall be minimum requirements for all four—inch through 12—inch (4"—12") PVC pipe. Two—inch (2") inch diameter SDR PVC pipe shall be the only SDR PVC used as part of any water system all PVC pipe larger than two inch (2") shall be (DR). Water mains larger than twelve inch (12") diameter in size shall meet the requirements of, ANSI/AWWA C905 for DR 18, PC 235, and have integral bell with bonded in ring and spigot joint. On specific authorization of the Participating Utility, transmission lines may be PVC meeting ANSI/AWWA C905 with DR-25, PC 165 rating, or:

3. Polyethylene (PE) conforming to ANSI/AWWA C906, with dimension ratio (DR) 11, PE 4710 shall be minimum for PE pipe. PE pipe shall be assembled and joined using the butt-fusion method in strict compliance with the manufacturer's recommendations, or:

4. Molecularly oriented polyvinyl chloride (PVCO) conforming to ANSI/AWWA C909, pressure class 235 shall be minimum for PVCO pipe. This material is only acceptable for water mains up to twelve inch (12°) diameter in size.

1. All ductile iron standard mechanical joint water pipe shall conform to ANSI/AWWA C151/A21.51 and shall be lined with cement mortar and have a protective exterior coating. Linings and protective coatings equal to "Enameline" with tar coating in the exterior will be considered as a satisfactory lining for water pipe; however, any substitution in pipe lining and/or coating from ANSI/AWWA C104/A21.4 shall be specifically approved by the Participating Utility.

2. Joints of standard mechanical joint pipe shall conform to ANSI/AWWA C111/A21.1.

4. In making connections of ductile iron pipe using standard mechanical joint, the gland followed by the rubber gasket shall be placed over plain end of the pipe, which shall be carefully inserted and aligned into socket end of pipe line. Gasket shall then be pushed into position so that it is evenly seated in the socket. Gland shall then be moved into position against face of the gasket, bolts inserted and made finger tight. Bolts shall then be tightened in accordance with ANSI/AWWA C600 (75–90 FT-LB Torque for pipe size 4-12"). All other requirements concerning bedding, alignment, and cleaning of pipe before making joint shall be followed.

1. All "push—on" or "slip" joint pipe shall conform to requirements of standard mechanical joint pipe in regard to strength, class, protective coatings, etc.

D. Restrained Joint Pipe Systems

1. Approved restrained joint pipe systems shall include the following:
a. Mechanical joint pipe with use of joint restraint gland such as EBAA Iron "Mega—Lug", Ford
"Uni—Flange", Romac Industries "Grip Ring", US Pipe "MJ Field Lok", Tyler Union "Tuf Grip" or other
restraint gland as approved by the Participating Utility. b. Ductile iron pipe push—on joint with use of U.S. Pipe "Field LOK" gaskets, American Ductile Iron Pipe "Fast Grip", or Griffin Pipe Talon RJ Gasket. c. Restrained joint ductile iron pipe such as U.S. Pipe "TR FLEX" pipe, Griffin Pipe "Snap—LOK" pipe, American Ductile Iron Pipe "Flex Ring" or other restraint joint pipe as approved by the Participating Utility.

d. Restrained joint C900 DR 14 PVC pipe such as Diamond Lok-21 or approved equal. e. Ductile iron, PE, or PVC pipe push—on joints, valves or hydrants with use of Mueller Company "AquaGrip" system. E. PVC Plastic Bell and Spigot Joint

1. PVC pipe meeting the ANSI/AWWA Specification C900 for dimension ratio (DR) 14, pressure class 305, may be used for water lines. DR-18 or DR-25 may be used as noted above for pressure pipe larger than twelve inches (12") in diameter. Specification — Water Distribution Piping 1/1/12

2. PVC pipe shall be installed, bedded and backfilled according to the manufacturer's written instructions.

3. All service line connections to PVC pipe shall be made using a stainless steel service saddle and full port, Teflon coated ball valve corporation stop. Service saddle shall be of the extra wide or double—band type and manufactured specifically for PVC pipe. No direct tap to PVC pipe shall 4. Only bell and spigot with elastomeric gasket joints shall be used. Solventcement joints or use of couplings shall not be allowed.

F. PE Pipe 1. PE pipe shall be high density polyethylene meeting the ANSI/AWWA Specification C906 for dimension ratio (DR) 11, ductile iron O.D., and applicable requirements of ASTM D3350, may be used for water lines. 2. PE pipe shall be installed, bedded and backfilled according to the manufacturer's written

3. All service line connections to PE pipe shall be made using a fused service saddle and full port, Teflon coated ball valve corporation stop. No direct tap to PE pipe shall be permitted. 4. PE pipe shall be assembled and joined at the site using the butt-fusion method to provide leak proof joint. Threaded or solvent-cement joints and connections shall not be permitted. All equipment and procedures used shall be used in strict compliance with the manufacturer's

5. Qualifications of Personnel: HDPE pipe jointing shall be performed by personnel certified by the pipe manufacturer in the use of butt—fusion equipment and recommended methods for new pipe connections. Personnel directly involved with installing the new pipe shall have current certification in the proper methods for handling and installing the HDPE pipe. Certification shall be performed by a qualified representative of the pipe manufacturer.

6. Butt—fused joint shall be true alignment and shall have uniform roll—back bead resulting from the use of proper temperature and pressure. Joint shall be allowed adequate cooling time before removal of pressure. Fused joint shall be watertight and shall have tensile strength equal to that of the pipe. All joints shall be subject to acceptance by the Participating Utility and/or his representative prior to insertion. All defective joints shall be cut out and replaced at no cost to the Participating Utility.

a. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than ten percent (10%) of the wall thickness, shall not be used and must be removed from the site. However, a defective area of the pipe may be cut out and the joint formal procedures extend choice and the pipe may be cut out and the joint formal procedures extend choice.

b. In addition, any section of pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing or handling as determined by the Participating Utility and/or his representative

7. Terminal sections of pipe that are joined within the insertion pit shall be connected with a full circle pipe repair clamp or equal. Butt gap between pipe ends shall not exceed one—half (½) inch. Unicore Plastic Fusion System may be used to butt fuse the sewer pipe material.

1. PVCO pipe meeting the ANSI/AWWA Specification C909 for pressure Class 235, may be used for water lines up to twelve inches (12") in diameter. 2. PVCO pipe shall be installed, bedded and backfilled according to the manufacturer's written instructions.

3. All service line connections to PVCO pipe shall be made using a stainless steel service saddle and full port, Teflon coated ball valve corporation stop. Service saddle shall be of the extra wide or double—band type and manufactured specifically for PVCO pipe. No direct tap to PVCO pipe shall be permitted.

4. Only bell and spigot with elastomeric gasket joints shall be used. Solventcement joints or use of couplings shall not be allowed.

H. Encasement Pipe — Encasement pipe shall be steel or HDPE in accordance with general water and sewer drawings and VDOT Road and Bridge Standard detail.

1. Ductile iron water pipe fittings shall conform with ANSI/AWWA C153/A-21.53 or ANSI/AWWA C110/A-21.10, A21.11 for flange fittings. Specifications for ductile iron compact fittings shall be considered as meeting the requirements of this section. 2. One Bolt, Inc. "One Bolt" fittings may be used for DIP and PVC pipe.

3. Infact Corporation's "Foster Adaptor" may be used to connect between mechanical joint fittings,

1. All gate valves shall be resilient seat type valves meeting ANSI/AWWA C509 or C515 latest revision Standards. All gate valves shall be resilient seat and full bronze mount or stainless steel stem. All gate valves shall withstand a working pressure of 250 psi. Wrench nut shall turn to the left (counterclockwise) to open valve. Valves shall be so arranged to fit into pipe lines having standardized mechanical joints or slip joints.

2. On valves fourteen inches (14") or larger, butterfly valves conforming to ANSI/AWWA C504 may be used. iki itim Hydrunts 1. Hydrants shall be traffic model, dry-barrel type, meeting ANSI/AWWA C502 latest revision standard; see Fire Hydrant Assembly Detail for approved manufacturers and models.

2. Hydrents shall be at compression type with main valve easinings not less than five and one—quarter inches (5 ½) in diameter. Hydrants shall have cost or ductile iron body with full, bronze trim, and shall withstand a hydrostatic test pressure of 300 psi. Hydrants shall have a six inch (6") connection base for setting with a minimum of thirty—six inches (36") cover on connection pipe. Hydrants shall be equipped with hose connections as follows:

Two each 2-1/2", N.S.T. hose connections One each 4-1/2", N.S.T. pumper connections

3. Hydrant shall be operated by a National Standard one and one half inch (1-1/2") pentagon shaped, operating nut, opening counterclockwise. Direction of opening shall be clearly marked by an arrow cast on outside of hydrant. Hydrants shall be connected to the main with a six-inch (6") pipe and shall be controlled by an independent six-inch (6") gate valve. Six-inch (6") gate valve shall be located as near to service main as practical, and connected to the tee with tie rods. A gravel dry well shall be provided for hydrant drain. Fire hydrant drain shall be plugged if drain hole is located below the water table.

4. Hydrant assembly shall be restrained from connection to distribution main to hydrant. Approve restraint methods shall include threaded "Corten" rodding between hydrant, hydrant valve and connection to water distribution main with concrete thrust blocks behind hydrant and distribution main tee fitting. Approved mechanical joint gland restraint may be used in lieu of concrete thrust blocking.

5. Public hydrant barrels shall be painted silver with an oil—based paint, and private hydrant barrels shall be painted white with an oil—based paint. Bonnets will be painted by the jurisdictional fire departments. L. Valve Vaults

1. Adjustable cast iron valve boxes of suitable diameter, length, and design shall be furnished and installed for all buried valves, unless otherwise indicated. Boxes shall be 3-piece screw type, in accordance with fire hydrant assembly detail, with round base and 5 ½-inch shaft similar to buffalo type by Bingham and Taylor, or 2-piece boxes will also be acceptable and shall be installed with valve box adapter as manufactured by Adapter, Inc. The word "water" shall be cast on the box lid in letters not less than 1 inch high.

N. Water Service Connection — Standard 1. Standard meter connection shall be installed when static pressure is less than 120 PSI. 2. Water meter box and accessories therein necessary for Standard meter installation shall be furnished and installed by CONTRACTOR just within right—of—way/easement at the property line as shown on construction plans. Water meter box and meter setter shall be furnished and installed as shown in the Detail Drawings. All meter setters shall be equipped with an integral lockable valve and check valve.

3. For pressure ranging between 80 — 120 PSI it is recommended that a pressure reducing valve (PRV) be installed on the private side of the water meter to protect the private plumbing, and to ensure compliance with Uniform Statewide Building Code, and/or the governing jurisdictions building code requirements. It is encouraged that the PRV be installed in a separate meter box just downstream of the water meter box. This installation will allow easy access for maintenance and will reduce the pressure on the service line between the PRV and the structure.

 High Pressure meter connection shall be installed when main line pressure exceeds 120 PSI. High
Pressure service incorporates installation of water meter and individual three—quarter inch (3/4") pressure
reducing valve in a standard double meter setter and box situated, just within right—ofway/easement at
the property line as shown on construction detail. 2. Water meter, three—quarter inch (3/4") pressure reducing valve with integral pressure relief valve, connecting S—bar, and accessories therein necessary for High Pressure meter installation shall be furnished and installed by CONTRACTOR just within right—of—way/easement at the property line as shown on construction plans. Water meter box and double meter setter shall be furnished and installed as shown in the Detail Drawings. All meter setters shall be equipped with an integral lockable valve and check valve.

High Pressure configuration is not allowed in City of Salem or Town of Vinton service areas, all water services installed in these localities shall be "Standard". P. Water Meters - All water meters shall be installed by the Participating Utility per the current fee schedule. Q. Wet Taps — Consult the Participating Utility for their policy regarding taps to existing mains

R. Pipeline Bedding Materials — Where pipeline installation requires granular bedding materials, they shall meet requirements of VDOT gradation. See General Details. S. Special Conditions — The Participating Utility may require special material and/or construction be used where normal water pressure exceeds pressure rating used in these standards and where design will not permit reducing pressures to acceptable levels.

PART THREE - EXECUTION 3.1 WATER LINE CONSTRUCTION

1. Except as specifically modified below, water line construction shall meet requirements of ANSI/AWWA C600 latest edition Standards. 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 such materials be dropped. Pipe shall be so handled that any coating or lining is not damaged. 2. The water main shall be laid and maintained to the required lines and grades with fittings, valves, hydrants and accessories set at the required locations as indicated on the approved drawings for the project. All valve and hydrant stems shall be set plumb. Whenever obstructions not shown on the plans are encountered during progress of the work and interfere to such an extent that altering the drawings is required, the Participating Utility approval shall be given before such alternative design shall be designed or approved by the Engineer—of—Record for the original design.

3. No pipe shall be laid in water or when, in the opinion of the Participating Utility, trench conditions a unsuitable. If the Participating Utility is of the opinion that trench bottom consists of wet, washable material or is otherwise incapable of properly supporting the pipe or structures, such material shall be removed and replaced with proper bedding material in addition to the standard bedding required. 4. All construction of water mains and appurtenances in the Participating Utility shall be in strict accordance with drawings and specifications prepared as part of the Contract Documents and as approved by the Participating Utility. All materials shall be new and unused. Prior to construction of the approved water main, CONTRACTOR shall provide horizontal field stakeout in order that water line and appurtenances may be constructed in accordance with Contract Drawings. 5. Slopes over 20% require restrained joints and anchor blocks in accordance with Anchor Block Detail drawing.

1. When installing pipe in trench, proper implements, tools, and facilities satisfactory to the Participating Utility and as recommended by material manufacturer shall be provided and used by the CONTRACTOR for safe and convenient prosecution of the work. All pipe, valves, fittings, hydrants and accessories shall be carefully lowered into 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 water main material and any protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into trench. Pipe and fittings shall be inspected for defects, and while suspended above grade, be rung with a light hammer to detect cracks. 2. All lumps, blisters and excess coal tar coatings shall be removed from ends of ductile iron pipe, and outside of the spigot and inside of the bell shall be wiped clean and dry and free from oil and greases before the pipe is laid. 3. Every precaution shall be taken to prevent foreign material including nonpotable water from entering the pipe while it is being placed in the line. If the pipe—laying crew cannot put the pipe into the trench and in place without getting earth into it, a heavy tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe. At the end of each day a watertight plug shall be placed in the end of all pipe opening.

4. After placing a length of pipe in the trench, the spigot end shall be centered in the open bell of the pipe line and the pipe pushed home as recommended by the manufacturer. Water pipe shall be laid with the bell facing the direction of the laying. 5. No stub of any water main shall terminate with a capped or plugged valve. Where a valve is required to be installed near a stub end, not less than thirtysix feet (36") of pipe shall be installed between valve and plugged stub end of pipe for adequate anchoring

6. 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 axis of the pipe. 7. Whenever it is necessary to deflect pipe from a straight line, either in vertical or horizontal plane, to avoid obstructions or plumb stems, or where long—radius curves are approved, the amount of deflection allowed shall not exceed the maximum required, for satisfactory joining of the pipe, as specified herein. Maximum deflection permitted per joint shall be in accordance with ANSI/AWA C600 Table 3 for push—on joint and Table 4 for mechanical joint pipe. C900 PVC pipe deflection may not exceed 75% of manufacturer's recommendation. See Detail for Joint Deflection Allowance.

8. All tees, bends, plugs, caps, and fire hydrants shall be substantially braced, blocked and/or strapped to prevent any movements by providing adequate reaction backing and/or tie rods. Reaction backing shall be designed and installed as indicated in the Detail Drawings. Hydrants shall be set to established finished grade as follows:

a. Bottom of the four and one—half inch (4-1/2") nozzle shall be between eighteen inches (18") and twenty—four inches (24") above finish elevation, and at a minimum of six feet (6') or maximum of twelve feet (12') from edge of the shoulder on streets without curb and gutter and between eighteen (18") and twenty—four inches (24") above elevation of the curb on streets with curb and gutter and at a minimum b. Two and one-half inch (2-1/2") hose connections shall have a minimum of four feet (4") clearance on all sides.

c. Surface shall be approximately level within a four-foot (4') radius of the hydrant. 9. Locator wire shall be installed with all non-metallic pipe. Warning tape shall be required for ALL pipe installed by open trenching. Refer to Detail Drawings. C. Installation of Valves, Air Relief Assemblies and Blow-Off Chambers 1. During construction, air and sediment accumulations may be removed through a standard fire hydrant. Compressed air and/or pumping may be used for dewatering mains through hydrants.

Chambers or pits containing valves, blow—offs, meters or other such appurtenances to a distribution system shall not be connected directly to any storm drain or sanitary sewer, nor shall blow—offs or air relief valves be connected directly to any sewer. 3. Such chambers or pits shall be drained to the surface of the ground where they are not subject to flooding by surface water, or to absorption pits underground in areas with a sufficiently deep water table.

1. All new water mains shall be tested, after backfilling, to a hydrostatic pressure of 100 psi above design water pressure for the system or 200 psi, whichever is greater, unless otherwise required by the Participating Utility. Allowable leakage shall be calculated by the following formula:

L = SD√P Where: L = testing allowance (makeup water) in 148,000 gallons per hour

S = length of pipe tested in feet

D = nominal diameter of pipe in inches

P = average test pressure during leakage test in psi.

\* If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size. B. No water line shall be placed in service until the leakage is less than the allowable leakage as indicated above. Testing of water mains shall only be done after installation of all valves, taps and service laterals are complete. All portions of the water system, including hydrants and service lines, shall be subject to hydrostatic pressure during the leakage test. Testing of water mains shall be observed and documented by the Participating Utility's Inspector/Engineer. C. All high points and service lines in portion of system under test shall be vented and all air expelled from system prior to beginning test. All fittings and hydrants shall be properly braced or blocked before applying pressure. Where concrete thrust blocks are used, they shall have attained their final set prior to testing.

D. After section of system under test has reached required pressure as stated above, said pressure she maintained for two (2) hours. The test pressure shall not vary by more than +/- 5 psi for the duration of the test. At conclusion of pressure test, volume of makeup water required to refill pipeline shall be determined by measurement with displacement meter or by pumping from vessel of known

E. At joints or fittings at which leakage accurs shall be reworked to insure tightness. All yields leaks shall the shall be reworked to insure tightness. All yields leaks shall the shall be the shall be shall b

A. Concret — After teating and before final inspection of the completed systems, with Milita indicated in accordance with ANSI/AWWA Specification DEG1 latest revision. Flushing shall be accomplished at a flow velocity of not less than 2.5 feet per second.

1. Disinfection as described in ANSI/AWWA C651 — "Placing of granular calcium hypochlorite tablets" shall be used. Five—gram (5g) calcium hypochlorite tablets with 3.25 gram available chlorine per tablet shall be attached at the inside top of the pipe by an adhesive such as Permatex No. 2 or equal. The following number of tablets for the given pipe size shall be used for an initial dose of twenty—five (25 mg/L) — chlorine: chlorine: Number Tablets Per

Pipe Diameter 18-20 Ft. Pipe Section

or the number of tablets equal to 0.0012d2L rounded to the next higher integer, where d is the inside diameter, in inches, and L is the length of the pipe section, in feet. Use of the continuous feed or slug method of disinfecting may only be used to re-chlorinate a water pipe after the initial disinfection or in other specific cases approved by the Participating Utility. 3. Following chlorination, piping shall be thoroughly flushed. Water in the new main shall be proven comparable in quality, by testing, to the existing public water supply. The Virginia Waterworks Regulations require at least two consecutive satisfactory bacteriological samples (taken twenty—four hours apart) from distribution system for every two—thousand feet (2,000') of pipe before system can be placed in service. The Participating Utility will pay the cost of lab testing for first set of bacteriological samples. Developer/Contractor shall pay all costs associated with disinfection and testing of installed facilities and any additional bacteriological samples required after first set.

SANITARY SEWER COLLECTION PIPING

PART ONE - GENERAL

A. Work included — Furnish all labor, materials, tools and equipment necessary to install, backfill and test all sanitary sewer collector lines and associated structures in accordance with the Drawings and as specified herein.

B. Related work specified elsewhere:
1. General Water and Sewer Specifications — Section CS-1 C. General Conditions — Any reference to General Conditions refers to EJCDC C—700 Standard General Conditions of the Construction Contract (2002 edition).

PART TWO - PRODUCTS

2.1 STRUCTURAL REQUIREMENTS A. Structural Design of Sewers — Structural design of sewers shall conform with the methods given in the ASCE Manual Number 37 — "Design and Construction of Sanitary and Storm Sewers". In the use of this manual, backfill weight shall equal 130 pounds per cubic feet and Ku shall be 0.130. The live load for sewers subject to traffic effect shall be determined from a minimum wheel load equivalent to an AASHTO H—20 loading (16,000 pound wheel load). An allowance of fifty percent (50%) of the design wheel load shall be added for impact. A minimum wheel load of 10,000 pounds per wheel shall be applied to all other sewers not subject to traffic load. Ultimate lengths of high pipe shall be measured in terms of ultimate three-dege bearing strength divided by a safety factor of 1.5. Allowable load shall be working strength times a 2.9 load factor for concrete tradle or arch bedding and times a 1.9 load factor for Class B gravel bedding condition.

2.2 SEWER PIPE AND MATERIALS A. General — All sanitary bewer pipe installed shall conform to the type, classification, and size as shown on the Drawings and as specified herein. The pipe materials listed below have been approved for use by the Participating Utility. However, the acceptability of specific pipe material for use within a specific boil type or condition shall be determined by the Participating Utility an individual basis at the time of design review of the Drawings. The type or types of pipe allowed for use on any specific project shall be shown on the approved Drawings.

2. Pipe plugs shall be of the same material as the pipe. The cost of furnishing and placing plugs shall be included in the unit prices bid for furnishing and installation of pipe and pipe stubs.

1. Ductile Iron Pipe — Ductile iron pipe shall be centrifugally cast manufactured in accordance with ANSI/AWWA C151/A21.51, latest revision. Slip joint or mechanical joint pipe shall be used for gravity sewers. Slip joint pipe shall be designed in accordance with ANSI/AWWA C150/A21.50 and specified according to ANSI/AWWA C111/A21.11. Class 350 pipe shall be minimum strength used in all sewer applications. All ductile iron pipe and fittings shall be lined with Protecto 401TM Epoxy, or approved equal. Cement lining is not acceptable. Gaskets shall be furnished by the manufacturer and installed in accordance with their recommendations. Ductile iron pipe shall be used in exposed pipe installations, or where approved by the Participating Utility when other pipe materials are subject to crushing.

2. Polyvinyl Chloride (PVC) — PVC sewer pipe shall be manufactured in accordance with ASTM Designation 3034-77 (SDR 35). Gravity sewer pipe shall be unplasticized polyvinyl chloride with integral rubber ring wall bell and spigot joints furnished in 12.5' and 20' nominal lengths. Installation of PVC gravity sewer pipe and fittings shall be in accordance with ASTM Designation

D 2321 and manufacturer's recommendations. a. PVC sewer pipe shall be stored in accordance with manufacturer's recommendations on flat, even surfaces and shall remain racked on the pallets as delivered to the job site until such time as the trench is ready for placement of the pipe; i.e., PVC pipe shall not be laid along proposed alignment in excess of one day's work. b. Additional strength PVC pipe including SDR-26, SDR-21, DR-18 or concrete encasement of SDR-35, or both, shall be required where depth exceeds twelve feet (12') or where additional protection is required for the pipe as determined by the Participating Utility.

3. PVC (Ribbed Pipe) — Ultra—Rib pipe meeting ASTM F—794 with a stiffness factor of 46 may be used on Participating Utility projects. Installation shall be in strict compliance with manufacturer's written instructions. All fittings used shall be designed specifically for pipe used and be approved for use by same manufacturer of pipe. Connections to manholes shall be made by manufacturer's recommended methods and approved by the Participating Utility. 4. PE Pipe — PE Pipe may be allowed by the Participating Utility based on project type and conditions. Polyethylene plastic pipe shall be high density polyethylene pipe which meets the applicable requirements of ASTM F714 Polyethylene (PE) Plastic Pipe (SDR—PR) based on Outside Diameter, and ASTM D3350 cell classification 345464E.

a. Dimension Ratios: The minimum wall thickness of the polyethylene pipe used as gravity sewer line shall be a minimum of SDR 17. Additional strength pipe material may be required for deep

b. All pipes shall be made of virgin material. No rework except that obtained from manufacturer's own production of the same formulation shall be used. c. The pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters, or other deleterious faults. d. For sewer installations, interior of pipe shall have a light reflective color to enhance viewing for television inspection. e. PE pipe for sewer installations of four inch (4") diameter or larger shall be straight pipe sections of 40" or shorter. Rolled pipe is not approved for use.

f. All service line connections to PE pipe shall be made using a fused service saddle. No direct tap to PE pipe shall be permitted. g. PE pipe shall be assembled and joined at the site using the butt-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections shall not be permitted. All equipment and procedures used shall be used in strict compliance with the manufacturer's

h. Qualifications of Personnel — HDPE pipe jointing shall be performed by personnel trained in the use of butt—fusion equipment and recommended methods for new pipe connections. Personnel directly involved with installing the new pipe shall receive training in the proper methods for handling and installing the HDPE pipe. Training shall be performed by a qualified representative. i. Butt—fused joint shall be true alignment and shall have uniform roll—back beads resulting from the use of proper temperature and pressure. Joint shall be allowed adequate cooling time before removal of pressure. Fused joint shall be watertight and shall have tensile strength equal to that of the pipe. All joints shall be subject to acceptance by the Participating Utility and/or his representative prior to insertion. All defective joints shall be cut out and replaced at no cost to the Participating Utility. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than ten percent (10%) of the wall thickness, shall not be used and must be removed from the site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. In addition, any section out and the joint fused in accordance with the procedures stated above. In addition, any section of pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing or handling as determined by the Participating Utility and/or his representative shall be discarded and not used. C. Encasement Pipe — Encasement pipe shall be steel or HDPE in accordance with general water and sewer drawings and VDOT Road and Bridge Standards. D. Combination Air Valve — Force main combination air valve shall be in accordance with Sewer Detail Drawings.

E. Bedding — Bedding, haunching, and initial backfill construction shall be in accordance with the manufacturer's recommendation and requirements of governing jurisdiction. See General Details. F. Service Connections — Polyvinyl chloride (PVC) sewer pipe conforming to ASTM Designation D3034 (SDR—35) shall be used between the sewer main and the cleanout. SDR—21 PVC pipe shall be used where additional strength pipe is required.

1. The PVC SDR 35 joints shall be made with bonded—in—bell elastomeric seal. 2. No—hub pipe shall not be permitted. 3. There shall be no bends in service line from main to cleanout except as indicated on approved Sewer Detail Drawings. G. Hydraulic Cement Mortar and Gravel — Cement Mortar and grout shall consist of a mixture of hydraulic cement, fine aggregate, water and admixture. 1. Cement shall be Portland Cement Type I or II.

2. Fine aggregate Grade C shall be used. 3. Water used with coment or lime shall be potable, clean, clear, and free of oil, acid, sait, alkali, organic matter or other deleterious substances.

4. Admixtures shall conform to Section 217 of VDOT Specifications Martar and grout shall be properly cured and protected for not less than three (3) days.

b. Near-Shrink Morter shall consist of one part hydraulic cement, BASF "Masteriow 555" or approved equal, 2 1/2 parts fine aggregate by weight, a set retardant or other admixture which will reduce the amount of required mixing water and sufficient water to produce a stiff mix. Grade C Fine Aggregate shall be used. c. Cement Grout shall consist of one part hydraulic cement, 2 parts fine aggregate by weight and sufficient water to produce a free flowing mix. Grade A fine aggregate shall be used. d. High Strength Grout and Mortar shall consist of a prepackaged, non shrink hydraulic cement mixture with a 7—day compressive strength of at least 4,000 psi when tested in accordance with ASTM C109 and with a 7—day bond strength of at least 1,000 psi when tested in accordance with VTM—41, except that epoxy will not be used to develop the bond.

A. All construction of sanitary sewer mains and appurtenances shall be in strict accordance with Drawings and Specifications approved by the Participating Utility. All materials shall be new and unused. Prior to construction of the approved sanitary sewer, CONTRACTOR shall provide field stakeout including adequate line and grade stakes in order that sanitary sewer and appurtenances may be constructed in accordance with Drawings. 3.2 EXCAVATION

A. Dewatering equipment shall be sized to maintain the trench in a satisfactory dewatered condition suitable for pipe laying and backfilling. Pipe laying will be permitted only where the depth of water is maintained below the bedding material. Bedding material shall not be placed on unstable trench material. B. Excavation at manholes and similar structures shall provide a minimum clearance of eighteen inches (18") between the outer surface of the structure and the embankment or sheeting.

A. Manholes and cleanouts shall be backfilled in same manner as the sewer pipe.

A. All gravity sewer mains, service laterals and force mains shall have a minimum cover of three feet (3') as measured from top of pipe to finish grade. The Participating Utility may require additional cover as needed for pipe protection. Sewers, which have a depth of cover less than three feet (3'), shall be approved and installed as per the Participating Utility's written

B. All pipe and fittings shall be carefully handled with non-metallic slings or other approved devices to prevent damage to protective coatings or joints. Lifting equipment shall be satisfactorily rated to handle the pipe sizes used. Pipe shall not be dumped or dropped into trench. Each section of pipe shall be thoroughly inspected for defects before being lowered into the trench.

C. Pipe shall be laid true to line and grade with bells upstream and shall be jointed together such that the completed pipe will have a smooth invert. Pipe shall be pushed home by hand. The use of equipment (i.e. backhoe) shall not be permitted. Cutting of pipe shall be performed by sawing. Standard bedding shall be shaped to the curvature of both the bell and barrel of the pipe. The trench shall be kept free of water while the work is in progress. The ends of the pipe shall be cleaned so that proper joints can be made. As the work progresses, the interior of the pipe shall be cleared of dirt, cement, or other deleterious material.

D. Except as required for use of a laser level, exposed end of all pipe and fittings shall be fully closed to prevent earth, water or other substances from entering pipe. Trench shall be completely backfilled at end of each workday. When new pipe is tied into an existing manhole, new pipe shall be plugged with a standard sewer plug and shall remain plugged until all new line(s) that will flow to existing manhole have been completed, tested, and accepted. E. Locator wire shall be installed with all non-metallic pipe. Warning tape shall be required for ALL pipe installed by open trenching. Refer to General Detail Drawings.

A. CONTRACTOR shall be responsible at all times for rifluintaining sewer flows during the work to include any required by—pass pumping of wastewater between manholes during installation of sewer lines and/or manholes. By—pass pumping system shall provide continuous full conveyance and containment of wastewater present during the work and shall not surcharge the upstream (suction) manhole by more than two feet (2°) above the manhole invert. CONTRACTOR shall be liable for any damage caused by backups or overflows.

B. CONTRACTOR shall furnish all pumps, pipe, fittings, blugs, etc. required to perform by-pass pumping operation. Backup or replacement pumping equipment shall be available to the project site to ensure that continuous by-pass pumping can be provided. All pumping equipment shall be provided with sufficient mufflers to prevent excessive noise. C. Authorization from the Participating Utility shall be required to utilize by-pass pumping overnight or during the weekends. In the event it is not possible to temporarily reconnect sewer lines at the end of the work day or over week-ends. CONTRACTOR shall be responsible for

operating and maintaining by—pass pump operations around the clock to insure continued conveyance of existing wastewater flows. D. By—pass pumping shall not be diverted to another sanitary sewer system without the approval of the Participating Utility. E. A by—pass pumping plan shall be submitted for approval prior to beginning the work. This plan shall outline the by—pass pumping procedures and include the capacity and components of all by—pass pumping equipment.

3.6 TRENCH DEWATERING DURING SEWER LINE INSTALLATION A. All ground water that may be found in the trenches and any water that may get into them from any cause whatsoever shall be pumped or bailed out so that the trench shall be dry during the pipe laying period. No water shall be permitted to reach concrete until it has set sufficiently. All water pumped from the trenches shall be disposed of in a manner satisfactory to the Participating Utility. The CONTRACTOR shall provide at least two (2) pumps for each trench

opened in wet ground and at the same time, he shall have one (1) pump in reserve. B. If, during any time that the CONTRACTOR is permitted to tay pipe in a trench containing unavoidable trench water and construction is interrupted for any reason, the open ends of pipe shall be closed by watertight plugs or caps, or other means approved by the Participating Utility. In any case, such protection shall be provided when work is suspended overnight or on weekends and holidays, regardless of the condition of the trench with respect to water at the time that the work is suspended.

C. The CONTRACTOR shall be responsible for the protection of all structures, including pipes and manholes, against any tendency to float under conditions of high water, whether due to high ground water or flood conditions on the project site. It shall be the responsibility of the CONTRACTOR to take whatever steps may be required, including the installation and operation of pumps and pumping systems, well points or relief devices, to prevent any structure from floating during construction.

D. Cost of the necessary pumps, well points or other appurtenances required to prevent flotation shall be included in the unit prices bid in the proposal for the various bid items, and no extra compensation shall be allowed for such work. Any damage which may occur to any part of the work as the result of the flotation effect of ground or flood waters shall be repaired in a manner fully satisfactory to the Participating Utility, at no additional cost to the Participating Utility.

E. The CONTRACTOR shall provide and place all necessary flumes or other channels of adequate size to carry temporarily all streams, brooks, stormwater or other water, which may flow along or across the lines of the pipe line. All flumes or channels thus utilized shall be tight so as to prevent leakage into the trenches. Water pumped from trenches shall be led to natural watercourses. Existing sewers shall not be employed as a drain for the removal of dewatering 3.7 SERVICE CONNECTIONS

A. SDR 35 pipe lateral service connections to the sewer main shall be made by means of a commercially manufactured tee, wye, or wye branch. Service laterals may also be connected to the sewer system at a manhole using inside drop connection. A sewer cleanout the same size as the service line shall be installed in accordance with the Detail Drawings. Pipe material shall be of the same type to and including the cleanout stack. B. All taps to an existing pipe will be performed by the Participating Utility or may be performed by the CONTRACTOR if approved and inspected by the Participating Utility. A minimum of 48 hours notification is required by the Participating Utility when scheduling

C. Sewer service line shall be four inches (4") minimum for single—residential service and six inches (6") minimum for combined—residential (maximum 2 equivalent residential connections), or non—residential services. Sewer cleanouts shall be same size as service line and shall be installed per the Participating Utility's Sewer Detail Drawing. Additional sections of pipe shall be installed behind cleanout as indicated on Detail Drawings to prevent conflict with other utilities generally leasted in this green.

D. Sewer service connections from manhole or sewer main to the cleanout shall be installed with the same care as the sewer main. Proper excavation, slope of pipe and standard granular bedding shall be provided throughout. All gravity sewer mains and service laterals shall be air tested. For air testing procedures see Section 3.11. E. No connection shall be made to the vertical portion of a cleanout except for private force mains. Refer to Sewer Detail Drawings for specific requirements including the use of Schedule 40 material. F. All sewer service connections or portions of sewer service connections outside of the public right—of—way or sewer easement shall be privately owned and maintained.

A. Only precast manhole sections shall be used. Manholes shall be constructed with manhole frames, covers and steps. Frames and covers shall be in conformance with Sewer Detail Drawings. Bolt—down covers are to be used in areas subjected to flooding or as directed by Participating Utility.

B. Casting shall be best quality tough, gray iron, free from defects, blow holes, and other imperfections and shall meet the requirements of ASTM Designation A48, Class 35 and current edition of AASHTO M 306. The castings shall be sound, free to form and thickness, cleaned by means of sand blast and neatly finished. The material bearing surfaces shall be machine ground and finished to insure satisfactory seating. Covers shall have the words "Sanitary Sewer" cast into the top. Locations and type of manhole vents will be as indicated on the Drawings. 

WWWA will require its logo in top of casting, in accordance with Standard Details.

C. Covers shall be furnished with two means of lifting, pickbar and pick slot. Covers that rock under normal load, will be rejected. Frames shall be bolt—down type, with butyl mastic sealer placed between frame and manhole. Mortar shall not be permitted. Frames shall have a nut and washer installed on top and bottom to facilitate minor elevation adjustments. The adjustment space between the bottom of the frame and the top of the manhole section shall be formed and filled with 3000 psi concrete or AASHTO H—20 load rated HDPE grade rings. Sealant shall be used between each grade ring to provide a water tight seal.

D. If steps are required by the Participating Utilities for manholes, steps shall be made of fiberglass construction, cast iron, or steel and shall have a plastic coating. Steps shall be spaced sixteen inches (16") apart. The first step shall be within twelve inches (12") of the cover. The bottom step shall be within twentyfour inches (24") of the bottom of the manhole. The state of the s F. Precast base section shall be installed on a compacted stabilized foundation of bedding material foundation prepared similar to that required for the proper installation of the adjac sewer pipe as described elsewhere in these Specifications.

G. Precast manhole sections shall be manufactured in accordance with ASTM Designation C478, latest revision. Each section shall have not more than two (2) holes for the purpose of handling and setting. These holes shall be tapered and shall be plugged with an approved non—shrink grout after installation.

H. A cold applied butyl mastic joint sealer manufactured specifically for the purpose or other approved gasket material in accordance with ASTM C443 and meets ASTM C1244 testing standards shall be used to make a watertight joint between manhole sections and/or grade rings. Mortared joints are not permitted. All new manholes shall be pre—cast concrete inverts except straddle manhole. All straddle manhole and all field—constructed inverts shall be with ready mix (3,000 psi) concrete and shall only be used with approval of Participating Utility.

J. Standard manhole drop connections shall be installed where indicated on the drawings. Drop connections shall conform to the Detail Drawings. K. The invert channels of the manhole shall be smooth and semi-circular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. The horizontal deflection angle from the inflow pipe to the outflow pipe at any junction shall not be less than 90-degrees. Invert benches shall be constructed of ready mix concrete (3,000 psi) over the entire existing bench.

M. Where grade rings are required to meet specified grade, the maximum height/thickness and minimum number of rings shall be used. Cone sections and grade rings shall be predrilled with matching holes to accept threaded rod installation. Refer to Detail Drawings.

L. The invert channel shall be at least 0.75 times the diameter of the pipe in depth. The minimum difference in elevation of inverts of incoming and outgoing pipes shall be 0.10 feet, or 0.50 feet for a change of flow direction equaling 90—degrees.

3.10 PIPE CONNECTION AT MANHOLES A. All new manholes shall be supplied with an approved flexible boot connection suitable for specified pipe and manhole. All rubber boots for 8 inch (8") pipe shall have a maximum flexibility of 24—degrees in any direction from center. Boot flexibility for pipe sizes larger than 8 inch (8") shall be per the manufacturer's recommendations. Twenty inch (20") and larger pipe connections shall have the first joint located four feet (4") from the inside face of the manhole. Flexible joint manhole connection shall be as manufactured by Pres—Seal Gasket Corporation, or approved equal.

B. Connection to existing manhole shall be made by coring existing manhole and installing rubbe boot in accordance with above. Core to be made by the CONTRACTOR with Participating Utility inspector on—site. C. Manhole to pipe installation procedures shall be as follows:

1. After manhole has been set to line and grade, inspect flexible connector boot for damage and clean the inside of the boot. Clean surface of pipe barrel to be installed. 2. Insert pipe into connector boot until end of pipe breaks plane of manhole wall and flush with manhole invert. Position pipe in center of connector. 3. Install stainless steel band(s) in groove(s) at pipe receiving end of boot and tighten clamps to manufacturers recommended torque PRIOR to adjusting pipe to desired angle of deflection. 4. After desired deflection angle of pipe has been achieved, install bedding and backfill material in accordance with these Standards.

D. Precast Manhole sections shall be manufactured for the specified size, angle and number of pipe connections required. Field modification or abandonment of any part of a precast manhole will not be permitted without written approval of the Participating Utility. Any approved field modification(\*\*) or repairs shall be performed by a qualified person(s) approved by the manufacturer:

E. Inside of manholes (walls, steps, invert, pipe connections, benches) and frame and cover shall be kept cleah and free of dirt, stone, mastic, trash and construction materials. Manholes shall be cleaned prior to testing. F. Abandonment of manholes and sewer lines shall be performed in accordance with the Detail Drawings. G. An approved water stop shall be used around pipe at manhole connection of straddle manhole. Refer to Detail Drawings.

3.11 ACCEPTANCE TESTS 1. Sewers will be inspected to determine if any deviation from line and grade have occurred. Following successful leak test and prior to Substantial Completion, a CCTV inspection shall be performed by the CONTRACTOR, and a copy of the digital video disk provided to the Participating Utility. Any defects identified by the CCTV inspection shall be corrected by the contractor, retested and re-televised as required by the Participating Utility. Participating Utilities reserve the right to require an additional CCTV inspection prior to the end of the Warranty Period.

Air testing shall be used; test methods and acceptability criteria shall be in accordance with the Uni—Bell low pressure air test. Air testing of gravity lines shall be required for all types of pipe and materials.

B. Manhole Acceptance Tests Manholes, including frame, shall be tested by vacuum testing in accordance with ASTM C1244 latest revision, from the top of the frame. Inflatable stoppers shall be used to plug all lines interest and out of the manhole being tested including any vent line. The stoppers shall be positioned in the lines far enough from the manhole to insure testing to those portions of the lines not air tested. Vacuum tests shall be made with a vacuum of ten inches (10") Hg. The time for the vacuum to drop from ten inches (10") to nine inches (9") of Hg must be greater than 60

2. CONTRACTOR shall furnish weirs, stand pipes, pipe plugs, water, pressure gauges, stop watches, air compressor, vacuum pump, hose and such materials and assistance as required to perform these tests. All acceptance tests shall be conducted by CONTRACTOR in the presence of a Participating Utility's inspector. 3. Acceptance tests shall not be made until sanitary sewer, manholes and proposed sewer service connections, as shown on the approved sewer plans, have been installed, the sewer trenches (including manholes and cleanout stacks) backfilled and compacted to finished sub—grade. 4. The CONTRACTOR shall schedule all acceptance tests with the project inspector at least forty—eight (48) hours in advance. Each section of completed sewer shall be tested from manhole to manhole. No sewers or sewer service connections are to be excluded from this

C. Sewer Pipe Testing Procedures 1. Whenever it is necessary to construct underdrains or place gravel under pipe lines in order to dewater trench during construction of sewers, acceptance test will not be made until any pumps, which have been used in dewatering process, have been disconnected or drains have been taken 2. Contractor shall schedule all acceptance tests with the Participating Utility at least forty—eight (48) hours in advance. Each section of completed sewer shall be tested. Generally, sewers will be tested from manhole to manhole. No sewer or sewer service connection is to be excluded from 3. Low Pressure Air Testing Procedure — The test procedure shall be conducted in the following manner: (Vacuum test of manholes is generally inverse of low pressure air test of sewer lines)

a. PVC and PE - ASTM F1417, latest revision Ductile iron pipe - ASTM C924, latest revision b. The CONTRACTOR shall thoroughly clean and remove all debris, silt, earth or other materials from the sewer prior to acceptance testing. c. Proper test plugs shall be supplied and installed by the CONTRACTOR. Test gauges used in air test procedure shall have a range of 0-10 psi and shall be calibrated in divisions of 0.10 psi with an accuracy of +/- one percent. Test gauges shall be calibrated at least once a year and the date and results displayed on the equipment including date of calibration. Calibrations shall be certified by an independent testing lab. Test gauges shall be located outside of manhole during testing.

d. If pipe to be tested is expected to be below ground water table, the CONTRACTOR shall either: Install a small diameter perforated vertical pipe from invert elevation of the sewer to the surface prior to backfilling; or
 Insert a pipe probe by boring or driving into the backfilling material adjacent to the invert elevation of the pipe, and determine the depth of the ground water level above the pipe invert immediately prior to acceptance testing the sewer.
 All gauge pressures for test shall be increased by the amount of this back pressure due to ground water over the invert of the pipe. Back pressure to be calculated by multiplying height (in feet) of groundwater above pipe invert x 0.433 to obtain back pressure in units of PSI. e. The CONTRACTOR shall add air slowly to the portion of the pipe under test until the internal air pressure is raised to 4.0 psi gauge plus the ground water pressure. f. As a safety precaution, no one shall be allowed in manhole after air pressure is increased in the sewer line. If the inspector suspects that the test plug may be leaking, pressure shall first be relieved before any adjustments are made to eliminate air leakage at the plug.

g. The CONTRACTOR shall allow air temperature to stabilize for at least two (2) minutes with the pipe subjected to an internal pressure of 4.0 psi by adding only the amount of air required to maintain the pressure between 3.5 and 4.0 psi. h. After temperature stabilization, the test will begin. If the internal air pressure decreases, the time required for the pressure to drop from 3.5 to 2.5 psi gauge will be observed and recorded. The time interval shall be compared with the established standards in accordance with Sewer Detail Drawings for time and length of test section for various diameters of the sewer. All pipes fifteen inches (15°) or less shall be tested for a pressure drop of 1.0 psi gauge.

i. Pipe which fails to maintain the stipulated pressure for a period equal to or greater than the holding time shown in the above referenced tables shall be deemed to have failed the low pressure air test and is unsatisfactory for acceptance by the Participating Utility. Any sewer that fails to pass this test shall be replaced by the CONTRACTOR at his expense. A single coupling or pair of repair clamps shall be allowed between manholes to facilitate replacement of defective materials or workmanship.

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12 Albemarle Ave soanoke, Virginia 24013

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