

1. GENERAL

1.1 PROJECT CONDITIONS SEPARATION OF WATER LINES AND SANITARY SEWERS

- 1.1.1 FOLLOW VDI STANDARDS FOR THE SEPARATION OF SANITARY SEWER AND WATER DISTRIBUTION SYSTEMS
- 1.1.2 PARALLEL INSTALLATION
 - 1.1.2.1 NORMAL CONDITIONS: SEWER LINES AND MANHOLES SHALL BE CONSTRUCTED AT LEAST 10 FEET HORIZONTALLY FROM A WATER LINE WHENEVER POSSIBLE. THE DISTANCE SHALL BE MEASURED EDGE-TO-EDGE.
 - 1.1.2.2 UNUSUAL CONDITIONS: WHEN LOCAL CONDITIONS PREVENT A HORIZONTAL SEPARATION OF AT LEAST 10 FEET, THEN MAXIMUM HORIZONTAL SEPARATION SHALL BE PROVIDED WITH VERTICAL SEPARATION OF BOTTOM OF WATER LINE AT LEAST 18 INCHES ABOVE TOP OF SEWER. WHERE THIS VERTICAL SEPARATION CANNOT BE OBTAINED, THE SEWER SHALL BE CONSTRUCTED OF AWWA APPROVED WATER PIPE PRESSURE-TESTED IN PLACE TO 50 PSI WITHOUT LEAKAGE PRIOR TO BACKFILLING. THE SEWER MANHOLE SHALL BE OF WATERTIGHT CONSTRUCTION AND TESTED IN PLACE.
- 1.1.3 CROSSING
 - 1.1.3.1 NORMAL CONDITIONS: SEWERS CROSSING UNDER WATER LINES SHALL BE LAID TO PROVIDE A SEPARATION OF AT LEAST 18 INCHES BETWEEN THE BOTTOM OF WATER LINE AND THE TOP OF THE SEWER WHENEVER POSSIBLE.
 - 1.1.3.2 UNUSUAL CONDITIONS: WHEN LOCAL CONDITIONS PREVENT A VERTICAL SEPARATION DESCRIBED IN "CROSSING, NORMAL CONDITIONS," PARAGRAPH ABOVE, THE FOLLOWING CONSTRUCTION SHALL BE USED:
 - 1.1.3.2.1 SEWERS PASSING OVER WATER LINES SHALL BE LAID TO PROVIDE:
 - 1.1.3.2.1.1 VERTICAL SEPARATION OF AT LEAST 18 INCHES BETWEEN BOTTOM OF SEWER AND TOP OF WATER LINE.
 - 1.1.3.2.1.2 ADEQUATE STRUCTURAL SUPPORT FOR THE SEWERS TO PREVENT EXCESSIVE DEFLECTION OF THE JOINTS AND SETTLING ON AND BREAKING THE WATER LINE.
 - 1.1.3.2.1.3 MAXIMUM SEPARATION OF WATER AND SEWER LINE JOINTS
 - 1.1.3.2.2 SEWERS PASSING OVER OR UNDER WATER LINES SHALL BE CONSTRUCTED OF CAST OR DUCTILE-IRON WITH MECHANICAL JOINTS AS DESCRIBED IN "PARALLEL INSTALLATION, UNUSUAL CONDITIONS," PARAGRAPH ABOVE.

- 1.1.4 SANITARY SEWERS OR SEWER MANHOLES: NO WATER PIPES SHALL PASS THROUGH OR COME IN CONTACT WITH ANY PART OF A SEWER OR SEWER MANHOLE.
- 1.1.5 DRINKING WATER WELLS: NO SANITARY SEWER LINE SHALL PASS WITHIN 50 FEET OF A DRINKING WATER SUPPLY WELL, SOURCE, OR STRUCTURE UNLESS THE SANITARY SEWER IS ENCASED IN A MINIMUM 6-INCH THICK LAYER OF FOOT CLASS 45 CONCRETE.

- 1.2 SUBMITTALS: PROVIDE THE FOLLOWING SHOP DRAWING SUBMITTALS AS ONE COMPLETE PACKAGE, APPROVED AND SIGNED BY THE DEVELOPER'S ENGINEER, FOR APPROVAL BY THE TOWN MANAGER. A TOTAL OF FOUR (4) COPIES OF THE COMPLETE SHOP DRAWING PACKAGE SHALL BE SUBMITTED FOR APPROVAL. ONE (1) REVIEWED COPY WILL BE RETURNED TO THE DEVELOPER/CONTRACTOR.

- 1.2.1 PIPE AND FITTINGS: CATALOG CUTS AND CERTIFICATES OF COMPLIANCE FOR PIPE, FITTINGS, LININGS, AND MATERIALS FOR APPROVAL. CERTIFICATES SHALL STATE THAT MATERIALS FURNISHED COMPLY WITH THE STANDARDS SPECIFIED HEREIN.
- 1.2.2 PIPE RESTRAINT DEVICES
- 1.2.3 VALVES: CATALOG CUTS AND CERTIFICATES OF COMPLIANCE FOR VALVES.
- 1.2.4 VALVE BOXES
- 1.2.5 FLEXIBLE COUPLINGS
- 1.2.6 CASING SPACERS/END SEALS
- 1.2.7 PRECAST CONCRETE MANHOLE SECTION DETAILS
- 1.2.8 MANHOLE FRAMES AND COVERS
- 1.2.9 MANHOLE STEPS
- 1.2.10 PIPE TO MANHOLE CONNECTION DETAILS

- 1.2.11 CERTIFICATION REPORTS FOR MANHOLE AND SANITARY SEWER/FORCE MAIN PIPING TESTING

- 1.3 THE CONTRACTOR SHALL PHYSICALLY VERIFY THE LOCATION AND ELEVATION OF THE EXISTING UTILITIES, WHETHER INDICATED OR NOT, PRIOR TO STARTING CONSTRUCTION. THE CONTRACTOR SHALL CONTACT MISS UTILITY TELEPHONE: 811 AND RESPECTIVE UTILITY OWNERS FOR EXACT LOCATIONS PRIOR TO ANY EXCAVATION NEAR UTILITIES.

- 1.4 CONSTRUCTION ACTIVITIES WHICH INVOLVE THE TEMPORARY INTERRUPTION OF ESSENTIAL SERVICES OR TRAFFIC PATTERNS SHALL BE SCHEDULED IN CONSULTATION WITH THE TOWN OF AMHERST AND VDOT OR THEIR REPRESENTATIVES. SCHEDULING IS ESSENTIAL TO ACCOMPLISH THE PURPOSE FOR SUCH INTERRUPTIONS, AND SHALL BE COORDINATED TO GIVE THE TOWN OF AMHERST THE ABILITY TO MAINTAIN SANITARY SERVICE. THE CONTRACTOR SHALL COORDINATE ANY INTERRUPTION OF SANITARY SEWER SERVICE WITH THE TOWN AT LEAST 1 WEEK IN ADVANCE OF SUCH WORK. UPDATED CONSTRUCTION SCHEDULES SHALL BE SUBMITTED TO THE TOWN EACH WEEK TO COORDINATE UPCOMING CONSTRUCTION ACTIVITIES.

2. PRODUCTS

2.1 PIPING APPLICATION

- 2.1.1 THE FOLLOWING PIPING SYSTEMS, 4-12 INCHES IN DIAMETER, SHALL BE CONSTRUCTED OF PRESSURE CLASS 350 DUCTILE IRON PIPE UNLESS OTHERWISE INDICATED.
 - 2.1.1.1 BELOW GRADE FORCE MAIN PIPING: PIPE RESTRAINT SHALL BE PROVIDED AS SPECIFIED HEREIN UNLESS OTHERWISE INDICATED.
 - 2.1.2 THE FOLLOWING PIPING SYSTEMS, 4-12 INCHES IN DIAMETER, SHALL BE CONSTRUCTED OF SDR 35 SOLID WALL POLYVINYL CHLORIDE (PVC) GRAVITY SEWER PIPE OR PRESSURE CLASS 350 DUCTILE IRON PIPE UNLESS OTHERWISE INDICATED.
 - 2.1.2.1 BELOW GRADE SANITARY SEWER PIPING
 - 2.1.2.2 BELOW GRADE SANITARY SEWER LATERALS
 - 2.1.3 THE FOLLOWING PIPING SYSTEMS, 4-6 INCHES IN DIAMETER, SHALL BE CONSTRUCTED OF SCHEDULE 80 POLYVINYL CHLORIDE (PVC) PIPE OR PRESSURE CLASS 350 DUCTILE IRON PIPE UNLESS OTHERWISE INDICATED.
 - 2.1.3.1 BELOW GRADE SANITARY SERVICE LATERALS AND CLEANOUTS
 - 2.1.4 THE FOLLOWING PIPING SYSTEMS, 4-12 INCHES IN DIAMETER, SHALL BE CONSTRUCTED OF PRESSURE CLASS 350 DUCTILE IRON PIPE.
 - 2.1.4.1 BELOW GRADE SANITARY SEWER AND FORCE MAIN PIPING AT ROAD AND STREAM CROSSINGS
 - 2.1.4.2 BELOW GRADE PIPING BENEATH STRUCTURES
 - 2.1.4.3 BELOW GRADE PIPING NOT OTHERWISE SPECIFIED
 - 2.1.5 THE FOLLOWING PIPING SYSTEMS, 4-12 INCHES IN DIAMETER, SHALL BE CONSTRUCTED OF FLANGED JOINT SPECIAL THICKNESS CLASS 53 DUCTILE IRON PIPE.
 - 2.1.5.1 ABOVE GRADE PIPING ON PIER SUPPORTS
 - 2.1.5.2 ABOVE GRADE PIPING NOT OTHERWISE SPECIFIED
 - 2.1.6 THE FOLLOWING PIPING SYSTEMS, SMALLER THAN 4 INCHES IN DIAMETER, SHALL BE CONSTRUCTED OF ASTM B-88, TYPE K COPPER TUBING.
 - 2.1.6.1 PIPING INSIDE AIR RELEASE VALVE MANHOLES
 - 2.1.6 PROVIDE ADEQUATE LENGTH SECTIONS OF ABOVE GRADE DUCTILE IRON PIPING TO SPAN THE HORIZONTAL DISTANCE BETWEEN THE CENTERLINE OF REINFORCED CONCRETE PIPE SUPPORT PIERS OR BRIDGE ABUTMENTS, WHILE SIMULTANEOUSLY MAINTAINING A 2-FOOT MAXIMUM DISTANCE BETWEEN THE PIPE BELL AND THE CENTERLINE OF THE SUPPORT AS INDICATED ON THE CONTRACT DRAWINGS.

- 2.1.7 ACCESSORIES: PROVIDE FLANGES, JOINT RESTRAINTS, CONNECTING PIECES, TRANSITION GLANDS, TRANSITION SLEEVES, TAPPING SADDLES, AND OTHER ADAPTERS AS REQUIRED FOR COMPLETE AND OPERABLE PIPING SYSTEMS FOR SERVICE INDICATED. PROVIDE RESTRAINED JOINTS WHERE INDICATED ON THE DRAWINGS, AND AS SPECIFIED HEREIN.

2.2 PIPE

- 2.2.1 DUCTILE IRON PIPE
 - 2.2.1.1 DUCTILE IRON PIPE SHALL BE PRESSURE CLASS 350 UNLESS OTHERWISE INDICATED AND SHALL MEET REQUIREMENTS OF ANSI/AWWA C150 AND C151. FLANGED PIPE SHALL BE SPECIAL THICKNESS CLASS 53 UNLESS OTHERWISE INDICATED AND SHALL MEET REQUIREMENTS OF ANSI/AWWA C115.
 - 2.2.1.2 FITTINGS SHALL MEET REQUIREMENTS OF ANSI/AWWA C110 AND C153 WITH PRESSURE RATING NOT LESS THAN THAT OF THE PIPE.
 - 2.2.1.3 PROVIDE MECHANICAL JOINTS OR PUSH-ON JOINTS FOR UNDERGROUND PIPING. JOINTING MATERIALS SHALL MEET REQUIREMENTS OF ANSI/AWWA C111.

- 2.2.1.4 MECHANICAL JOINT RETAINER GLANDS SHALL BE ASTM A535 DUCTILE IRON, "MEGA LUG" SERIES 1100 MANUFACTURED BY EBAY IRON, INC. OR APPROVED EQUAL. BY AMERICAN CAST IRON PIPE COMPANY, CLOW CORPORATION, FORD METER BOX COMPANY, STAR PIPE PRODUCTS, OR ROMAC INDUSTRIES, INC.
- 2.2.1.5 RESTRAINED PUSH-ON JOINTS SHALL BE "FLEX-RING" AS MANUFACTURED BY AMERICAN CAST IRON PIPE COMPANY, "TRIFLEX" AS MANUFACTURED BY U.S. PIPE AND FOUNDRY COMPANY, "SHARLOK" AS MANUFACTURED BY GRUFFIN PIPE PRODUCTS COMPANY, OR APPROVED EQUAL. JOINTING MATERIALS SHALL MEET REQUIREMENTS OF ANSI/AWWA C111.
- 2.2.1.6 PUSH-ON JOINT AND RUBBER GASKET SHALL MEET REQUIREMENTS OF ANSI/AWWA C111. RESTRAINED PUSH-ON JOINTS MAY BE USED WHERE RESTRAINED JOINTS ARE REQUIRED.
- 2.2.1.7 PROVIDE FLANGED JOINTS FOR ALL ABOVEGROUND PIPING AND AS INDICATED ON THE DRAWINGS. FLANGES SHALL MEET REQUIREMENTS OF CLASS 125 AND B16.1.
- 2.2.1.8 FLANGED JOINT GASKETS SHALL BE FULL FACE, MADE OF RUBBER AND SHALL MEET REQUIREMENTS OF ANSI/AWWA C111/A21.11. EXTERIOR ABOVE GRADE, LONG-SPAN INSTALLATIONS USING FLANGED DUCTILE IRON PIPING SHALL USE FULL FACE BLACK MOLDED SBR RUBBER "TORUSAL" FLANGE GASKETS AS MANUFACTURED BY AMERICAN CAST IRON PIPE COMPANY OR APPROVED EQUAL, DESIGNED SPECIFICALLY FOR LONG-SPAN INSTALLATIONS.
- 2.2.1.9 CEMENT MORTAR LINING WITH BITUMINOUS SEAL COAT FOR DUCTILE IRON PIPE AND CAST IRON FITTINGS SHALL MEET REQUIREMENTS OF ANSI/AWWA C104. CEMENT MORTAR LINING SHALL BE STANDARD THICKNESS.
- 2.2.1.10 EXTERIOR, BITUMINOUS COATING SHALL MEET REQUIREMENTS OF ANSI/AWWA C110, C115, C151, AND C153, AS APPLICABLE.

- 2.2.2 SCHEDULE 80 POLYVINYL CHLORIDE (PVC) PIPING
 - 2.2.2.1 PIPE, COUPLINGS, AND FITTINGS SHALL BE SCHEDULE 80 MEETING THE REQUIREMENTS OF ASTM D 1785. MANUFACTURED OF MATERIAL MEETING THE REQUIREMENTS OF ASTM D 1784. TYPE 120 PROVIDE SDR 35. TYPE 2401 PROVIDE SDR 35. FITTINGS, ASTM D 2954. SOLVENT WELDED. MEETING REQUIREMENTS OF ASTM D 2855.
 - 2.2.2.2 PROVIDE SCREWED JOINTS AND FLANGES AS REQUIRED TO CONNECT DISSIMILAR PIPE MATERIALS, VALVES, EQUIPMENT, AND APPURTENANCES.
 - 2.2.2.3 POLYVINYL CHLORIDE (PVC) PLASTIC GRAVITY SEWER PIPING SHALL MEET REQUIREMENTS OF ASTM D 3034 AND BE INTEGRAL BELL, GASKETED JOINT PIPE WITH DIMENSION RATIO (DR) OF 35 AND MINIMUM PIPE STIFFNESS (PSI) OF 49 PSI.
 - 2.2.2.4 PIPE JOINT GASKETS SHALL MEET REQUIREMENTS OF ASTM D 3212.
 - 2.2.2.5 RUBBER GASKETS SHALL MEET PHYSICAL REQUIREMENTS SPECIFIED IN ASTM F 477 IN ALL RESPECTS.
 - 2.2.2.6 COPPER TUBING
 - 2.2.2.6.1 COPPER TUBING AND ASSOCIATED FITTINGS SHALL BE ASTM B 88, TYPE K.
 - 2.2.2.6.2 FITTINGS SHALL BE SOLDER JOINT. ANSI B16.18 OR B16.22, USING ASTM B 32, 95-S TIN-ANTIMONY SOLDER.

- 2.3 STEEL CASING PIPE FOR BORING OR JACKING UNDER HIGHWAYS OR CROSSING UNDER STREAMS SHALL MEET REQUIREMENTS OF ASTM A 139, GRADE B. NOMINAL PIPE DIAMETER AND WALL THICKNESS SHALL BE AS INDICATED ON THE DRAWINGS. NO PROTECTIVE COATING OR LINING, NOR HYDROSTATIC TESTING WILL BE REQUIRED.

2.4 CASING SPACERS/END SEALS

- 2.4.1 CASING SPACERS SHALL BE BOLT-ON STYLE WITH A TWO-PIECE SHELL MADE FROM 1/304 STAINLESS STEEL OF A MINIMUM 1/4-GAUGE THICKNESS. THE SHELL SHALL BE LINED WITH A RIBBED PVC EXTRUSION WITH A RETAINING SECTION THAT OVERLAPS THE END OF THE SPACER AND PREVENTS SPACERS (RUNNERS) MADE FROM UHMW POLYMER WITH A STATIC COEFFICIENT OF FRICTION OF 0.11-0.13 SHALL BE ATTACHED TO SUPPORT THE FITTING. BEARING SURFACES OF SPACERS SHALL BE PROPERLY SUPPORT THE CARRIER WITHIN THE CASING AND TO EASE INSTALLATION. CASING SPACERS SHALL BE MODEL 5120-2 AS MANUFACTURED BY PIPELINE SEAL AND INSULATOR, INC. 6525 GORPOTH STREET, HOUSTON, TEXAS 77021. TELEPHONE NUMBER: (800) 423-2410. OR APPROVED EQUAL.
- 2.4.2 END SEALS SHALL BE MODEL C AS MANUFACTURED BY PIPELINE SEAL AND INSULATOR, INC. OR APPROVED EQUAL.

2.5 VALVES

- 2.5.1 PLUG VALVES SHALL BE TIGHT CLOSING, RESILIENT FACED, NON-LUBRICATING VARIETY, AND SHALL BE OF ECCENTRIC DESIGN SUCH THAT THE PLUG RISES OFF THE BODY SEAT CONTACT AREA IMMEDIATELY UPON SHUT ROTATION DURING THE OPENING MOVEMENT. VALVES SHALL BE THROTTLING SERVICE, AS WELL AS FREQUENT OR INFREQUENT ON-OFF SERVICE. THE VALVE-CLOSING MEMBER SHALL ROTATE APPROXIMATELY 90° FROM THE FULL-OPEN TO THE FULL-CLOSED POSITION AND VICE VERSA. ALL PLUG VALVES SHALL PROVIDE WATERTIGHT SHUTOFF SERVICE.
- 2.5.2 THE VALVE BODY SHALL BE CONSTRUCTED OF CAST-IRON CONFORMING TO ASTM A 126, CLASS B. VALVES FOR BELOWGRADE SERVICE SHALL BE MECHANICAL JOINT MEETING THE REQUIREMENTS OF AWWA C111/ANSI A21.11. VALVES FOR ABOVEGRADE SERVICE SHALL BE FLANGED MEETING THE REQUIREMENTS OF ANSI B16.1, UNLESS OTHERWISE INDICATED ON THE DRAWINGS.
- 2.5.3 VALVES 3 TO 12 INCHES SHALL HAVE 175-PSI NONSHOCK WORKING PRESSURE RATING. EACH PLUG VALVE SHALL BE TESTED AGAINST THE SEAT AT THE FULL RATED WORKING PRESSURE AND A HYDROSTATIC SHELL TEST AT TWICE THE RATED WORKING PRESSURE.
- 2.5.4 ECCENTRIC PLUG VALVES SHALL HAVE A RECTANGULAR SHAPED PORT. PORT AREAS FOR 3 TO 20-INCH VALVES SHALL BE A MINIMUM OF 80% OF FULL PIPE AREA.
- 2.5.5 VALVE SEAT SURFACE SHALL WELDED-OVERLAY, CYLINDRICALLY SHAPED OF NOT LESS THAN 80% PURE NICKEL. SEAT AREA SHALL BE RAISED, WITH RAISED AREA COMPLETELY COVERED WITH WELD TO ENSURE PROPER CONTACT. THE MACHINED SEAT AREA SHALL BE A MINIMUM OF 1/8-INCH THICK AND 1/2-INCH WIDE.
- 2.5.6 THE VALVE PLUG SHALL BE CONSTRUCTED OF CAST IRON CONFORMING TO ASTM A 126, CLASS B. THE ENTIRE PLUG SHALL BE 100% ENCAPSULATED WITH BUNAN RUBBER IN ALL VALVE SIZES. THE RUBBER COMPOUND SHALL BE APPROXIMATELY 70 SHORE A DUROMETER HARDNESS. THE RUBBER TO METAL BOND MUST WITHSTAND 75-POUND PULL UNDER TEST PROCEDURE ASTM D 429, METHOD D. THE PLUG SHALL HAVE A CYLINDRICAL SEATING AREA THAT IS OFFSET FROM THE CENTER OF THE PLUG SHAFTS. THE PLUG SHAFTS SHALL BE INTEGRAL.
- 2.5.7 UPPER AND LOWER SHAFT BEARINGS SHALL BE SLEEVE TYPE METAL BEARINGS, SINTERED, OIL-IMPREGNATED, AND PERMANENTLY LUBRICATED. THE UPPER BEARING SHALL CONFORM TO ASTM A 754, GRADE CF-8M. THRUST BEARINGS SHALL BE NYLTRON.
- 2.5.8 PLUG VALVE SHAFT SEALS SHALL BE MULTIPLE V-RING TYPE AND BE ADJUSTABLE. BALL PACKING SHALL BE REPLACEABLE WITHOUT REMOVING THE BONNET OR ACTUATOR AND WHILE THE VALVE IS IN SERVICE. SHAFT SEALS SHALL BE CONSTRUCTED OF BUNAN RUBBER.
- 2.5.9 VALVES 3 TO 8 INCHES IN DIAMETER SHALL HAVE A 2-INCH SQUARE NUT AND REMOVABLE LEVER FOR ABOVE GRADE SERVICE. SIZED FOR 75-PSI MINIMUM PRESSURE DROP ACROSS VALVE. VALVES 8 INCHES AND LARGER SHALL HAVE TOTALLY ENCLOSED GEAR OPERATORS, INCLUDING ADJUSTABLE MEMORY STOPS WITH HANDWHEEL ACTUATORS FOR ABOVE GRADE SERVICE.
- 2.5.10 PLUG VALVES SHALL HAVE PORT POSITIONS INDICATED ON THE OPERATING NUT OR VALVE CASING. EXTERIOR VALVES SHALL BE SUITABLE FOR ABOVE GRADE SERVICE AND HAVE A STANDARD 2-INCH SQUARE OPERATING NUT THAT EXTENDS WITHIN 12 INCHES OF THE PREVAILING GROUND SURFACE.
- 2.5.11 VALVES SHALL BE MANUFACTURED BY CLOW VALVE, DEZURIK WATER CONTROLS, M&H DIVISION OF DRESSER INDUSTRIES, HENRY PRATT COMPANY, OR APPROVED EQUAL.
- 2.5.2 BALL VALVES: BALL VALVES SHALL BE CLASS 150, MEETING REQUIREMENTS OF ANSI B16.34. VALVES SHALL HAVE ANSI CARBON STEEL BODIES. BALL VALVES SHALL HAVE STAINLESS STEEL STEM AND TRIM, AND VITON OR TEFLOM SEATS, BODY SEALS, AND STEM SEALS. VALVES SHALL BE LEVER OPERATED. VALVES SHALL BE MANUFACTURED BY VELAN VALVE CORPORATION, IIT-GRINNELL, WORCHESTER, INC. OR APPROVED EQUAL.

- 2.5.3 SEWAGE COMBINATION AIR VALVES
 - 2.5.3.1 SEWAGE COMBINATION AIR VALVES SHALL BE APCO MODEL 445 SEWAGE COMBINATION AIR VALVES AS MANUFACTURED BY VALVE AND PRIMER CORPORATION, 1420 SOUTH WRIGHT BLVD, SCHAUMBURG, ILLINOIS 60193 OR APPROVED EQUAL. VALVES SHALL HAVE THE FOLLOWING DIMENSIONS:
 - INLET DIAMETER: 2-INCH NPT
 - OUTLET DIAMETER: 2-INCH NPT
 - SMALL ORIFICE DIAMETER: 1/32-INCH
 - 2.5.3.2 VALVES SHALL HAVE CAST IRON BODY AND COVER, BRONZE MECHANISM AND SEAT, BUNAN NEEDLE, AND STAINLESS STEEL FLOAT AND LEVER PINS. VALVES SHALL BE EQUIPPED WITH VALVED QUICK-DISCONNECT COUPLING FOR BACKFLUSHING, INLET AND BLOWOFF VALVES, AND MINIMUM OF 10 FEET OF HOSE FOR BACKFLUSHING.

- 2.6 VALVE BOXES SHALL BE ADJUSTABLE CAST IRON VALVE BOXES OF THE THREE-PIECE TYPE, CONSISTING OF LID, TWO-PIECE SIDING EXTENSION, AND BASE. BASE SHALL BE PROPER TYPE AND SIZE FOR THE VALVE WITH WHICH IT IS USED. VALVE BOXES SHALL BE MANUFACTURED BY MUELER COMPANY, DEWEY BROTHERS, TYLER, OR BINGHAM-TAYLOR.
- 2.7 FLEXIBLE COUPLINGS FOR CONNECTING PIPES OF DISSIMILAR MATERIALS SHALL BE AS MANUFACTURED BY FERROCO OF DAVISON, MICHIGAN.
- 2.8 FLEXIBLE COUPLINGS FOR DUCTILE IRON PIPING SHALL BE OF A GASKETED, SLEEVE TYPE. EACH COUPLING SHALL CONSIST OF A STEEL MIDDLE MEMBER, TWO RUBBER COMPOUNDED WEDGE SECTION GASKETS, AND SUFFICIENT GALVANIZED TRAP HEAD STEEL BOLTS TO PROPERLY COMPRESS THE GASKETS. COUPLINGS SHALL BE OF THE TYPE TO MATCH PIPING IN WHICH INSTALLED. COUPLINGS SHALL BE STYLE 38 MANUFACTURED BY DRESSER

- MANUFACTURING DIVISION OF DRESSER INDUSTRIES OR APPROVED EQUAL. BY SMITH-BLAIR PRODUCTS OF ROCKWELL INTERNATIONAL. ALL COUPLINGS SHALL BE PROVIDED WITH THE ROOF RESTRAINT.

2.9 PIPE LABELING

- 2.9.1 DETECTABLE TAPE SHALL BE PROVIDED FOR ALL BELOW GRADE PIPING SYSTEMS AND SHALL HAVE A METALLIC CORE PROTECTED BY A PLASTIC JACKET. THE TAPE SHALL BE CONTINUOUSLY MARKED INDICATING THAT A SEWER LINE IS BENEATH THE TAPE.

2.10 MANHOLES

- 2.10.1 PRECAST REINFORCED CONCRETE MANHOLE SECTION
 - 2.10.1.1 PRECAST REINFORCED CONCRETE MANHOLE SECTIONS SHALL MEET REQUIREMENTS OF ASTM C 1220. THE FRAME AND COVER SHALL MEET REQUIREMENTS OF CLASS 125 AND B16.1. MANUFACTURING PROCESS: GASKETS FOR SECTION JOINTS SHALL MEET REQUIREMENTS OF ASTM C 143. JOINTS MAY ALSO BE SEALED WITH FLEXIBLE BUTYL RESIN SEALANT AS MANUFACTURED BY THE CONCRETE SEALANTS, INC. SEALANT SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S WRITTEN RECOMMENDATIONS. TOP SECTIONS FOR ALL MANHOLES SHALL BE DESIGNED TO WITHSTAND HS-20 TRAFFIC LOADING.
 - 2.10.1.2 PROTECTIVE COATING FOR CONCRETE MANHOLE SECTION INTERIOR SHALL BE TWO COATS OF COAL TAR SOLUTION SUCH AS INTERNATIONAL PROTECTIVE COAT "INTERPU" 107 OR PITTSBURGH PAINT "COAL CAT 97-540/97-541" OR MANUFACTURED WITH CALCEAREOUS AGGREGATE SO THAT THE FINISHED PRODUCT SHALL HAVE AN AZ FACTOR EQUAL TO 90.
- 2.10.2 MANHOLE FRAMES AND COVERS SHALL BE ROADWAY TYPE WITH DEEP SOCKET COVERS, MACHINE FRAMES AND COVERS TO PREVENT RATTLING. FRAMES SHALL BE PROVIDED WITH HOLES FOR BOLTING IT DOWN TO MANHOLE RISER SECTION. PROVIDE COVER WITH TWO 1/4-INCH DIAMETER HOLES FOR VENTILATION. CASTINGS SHALL BE GRAY IRON MEETING REQUIREMENTS OF ASTM A 48, CLASS 30, AND HAVE 24-INCH DIAMETER RIBS. COVER SHALL BE MANUFACTURED BY AMERICAN CAST IRON PIPE COMPANY TYPE R-1916-F WITH TYPE "C" COVER AND BOLT HOLES FOR FOUR ANCHOR BOLTS, OR APPROVED EQUAL BY U.S. FOUNDRY OR EAST JORDAN IRON WORKS. FRAMES SHALL BE PROVIDED WITH HOLES FOR BOLTING IT DOWN TO MANHOLE RISER SECTION. THE FRAME AND COVER SHALL WEIGH AT LEAST 330 POUNDS.
- 2.10.4 MANHOLE FRAMES SHALL BE ANCHORED TO THE TOP OF THE MANHOLE RISER SECTIONS WITH 1/4-INCH EXPANSION BOLTS. TWO PASSES OF "CONSEAL" BITUMASTIC SEALANT IN 1-INCH ROPE FORM SHALL BE USED TO PROVIDE WATERTIGHT SEAL BETWEEN FRAME AND MANHOLE RISER SECTION. CLEAN MANHOLE RISER AND FRAME THOROUGHLY PRIOR TO INSTALLATION.
- 2.10.5 MANHOLE STEPS SHALL BE "SUREFOOT" STEP CONSTRUCTED OF A NO. 4 STEEL REINFORCING ROD ENCASED IN CONCRETE TO PREVENT THE RIBS FROM BEING DAMAGED.
- 2.10.6 PIPE TO MANHOLE CONNECTION SHALL BE SEALED WITH A FLEXIBLE BOOT, GASKET, SLEEVE, OR AS DETAILED ON DRAWINGS AND MEET REQUIREMENTS OF ASTM C 802.
- 2.10.8 WHEN THE BOOT IS USED, THE PORT SHALL BE CORED TO THE SIZE, SHAPE, SURFACE FINISH AND LOCATION REQUIRED AND NOT CAST IN THE MANHOLE. ANGULAR ADJUSTMENTS THROUGH 20° SHALL BE ALLOWED. THE FLEXIBLE BOOT SHALL BE A 3/8-INCH THICK NEOPRENE COMPOUND MEETING ASTM C 443 SPECIFICATIONS. THE BOOT SHALL BE SECURED TO THE GRT WITH AN INTERNAL ALUMINUM EXPANDING BAND AND TO THE PIPE WITH A NONMAGNETIC CORROSION RESISTANT STEEL EXTERNAL BAND. BOOT SEAL SHALL BE "KOR-SEAL" AS MANUFACTURED BY NATIONAL POLLUTION CONTROL SYSTEMS, INC.
- 2.10.8.2 WHEN GASKET IS USED, THE GASKET SHALL BE A RUBBER PRESSED WEDGE GASKET CAST INTO THE MANHOLE WITH A MAXIMUM DEFLECTION OF 15° AS MANUFACTURED BY PRESS-SEAL GASKET CORPORATION.
- 2.10.8.3 WHEN SLEEVE IS USED, THE SLEEVE SHALL BE A FLEXIBLE RUBBER SLEEVE CAST INTO THE MANHOLE COMPLETE WITH STAINLESS STEEL STRAP AS MANUFACTURED BY INTERPACE CORPORATION.

- 2.11 PIPE TO SLEEVE SEALING SHALL BE GROUTING COMPOUND. GROUTING COMPOUND SHALL BE AS MANUFACTURED BY 3M COMPANY OR BE AN EQUIVALENT PRODUCT HAVING TENSILE STRENGTH OF 80 PSI AND ELONGATION PROPERTY OF 700% IN ACCORDANCE WITH ASTM D 3574 TEST E, AND LINEAR DIMENSION CHANGE SHALL NOT EXCEED 18% WHEN SUBJECT TO WET AND DRY CYCLES IN EQUILIBRIUM WITH ASTM D 756, PROCEDURE G AND ASTM D 1042.

3. EXECUTION

- 3.1 TAKE ALL PRECAUTIONS NECESSARY TO INSURE THAT PIPE, VALVES, FITTINGS, AND RELATED ITEMS ARE NOT DAMAGED IN UNLOADING, HANDLING, AND PLACING IN TRENCH. EXAMINE EACH PIECE OF MATERIAL JUST PRIOR TO INSTALLATION TO DETERMINE THAT NO DAMAGE HAS OCCURRED. REMOVE ANY DAMAGED MATERIAL FROM THE SITE AND REPLACE WITH UNDAAMAGED MATERIAL.

- 3.1.1 KEEP PIPE CLEAN. EXERCISE CARE TO KEEP FOREIGN MATERIAL AND DIRT FROM ENTERING PIPE DURING STORAGE, HANDLING, AND PLACING. CLOSE ENDS OF IN-PLACE PIPE AT THE END OF ANY WORK PERIOD TO PREVENT ENTRY OF ANIMALS AND FOREIGN MATERIAL.
- 3.1.2 BED PIPE AS DETAILED ON THE DRAWINGS, AND IN ACCORDANCE WITH THE MANUFACTURER'S WRITTEN RECOMMENDATIONS.
- 3.1.3 DO NOT LAY PIPE WHEN WEATHER OR TRENCH CONDITIONS ARE UNSUITABLE.

- 3.2 LAY GRAVITY SEWERS SO AS TO MAINTAIN A TRUE ALIGNMENT AND GRADE AS INDICATED ON DRAWINGS. AFTER COMPLETION, THE PIPE SHALL EXHIBIT A FULL CIRCLE OF LIGHT WHEN LIGHTED AT ONE MANHOLE AND VIEWED FROM THE NEXT.
- 3.2.1 COMMENCE LAYING GRAVITY SEWERS AT THE LOWEST POINT ON A SECTION OF LINE AND LAY PIPE WITH THE BELL ENDS UPHILL.
- 3.2.2 PIPE JOINT: PREPARATORY TO MAKING PIPE JOINTS ON GRAVITY SEWER LINES CLEAN AND DRY ALL SURFACES OF JOINT PIPE AND JOINTING MATERIAL. USE LUBRICANTS, PRIMERS, ADHESIVES, AND SIMILAR MATERIALS AS RECOMMENDED BY THE MANUFACTURERS. PLACE FIT JOINTS BETWEEN MATERIALS OR FACTORY FABRICATED JOINTS AS RECOMMENDED BY MANUFACTURER TO OBTAIN THE DEGREE OF WATERTIGHTNESS REQUIRED, AS SOON AS POSSIBLE AFTER THE JOINT IS MADE, PLACE SUFFICIENT BACKFILL MATERIAL ALONG EACH SIDE OF PIPE TO RESIST FORCES THAT MIGHT TEND TO MOVE PIPE OFF LINE AND GRADE.
- 3.2.3 BACKFILL AS INDICATED ON THE DRAWINGS. PLACE BACKFILL OVER THE PIPE IMMEDIATELY AFTER THE PIPE HAS BEEN PLACED AND SHALL BE INTEGRAL.

- 3.3 LAY PRESSURE PIPING WITH BELL ENDS FACING THE DIRECTION OF LAYING. WHERE GRADE IS 10 PERCENT OR GREATER, PIPE SHALL BE LAID UPHILL WITH BELL ENDS UPGRADE. LAY PRESSURE PIPING WITH A MINIMUM COVER OF 42 INCHES UNLESS OTHERWISE INDICATED.

3.4 JOIN MECHANICAL JOINT PIPE AS FOLLOWS:

- 3.4.1 THOROUGHLY CLEAN INSIDE OF THE BELL AND 8 INCHES OF THE OUTSIDE OF THE SPIGOT END OF THE JOINING PIPE TO REMOVE OIL, GRIT, EXCESS COATING, AND OTHER FOREIGN MATTER. FLEX RUBBER GASKET AND INSERT IN THE GASKET RECESS OF THE BELL SOCKET. APPLY A THIN FILM OF GASKET LUBRICANT SUPPLIED BY PIPE MANUFACTURER TO EITHER THE GASKET OR THE SPIGOT END OF THE JOINING PIPE.
- 3.4.2 START SPIGOT END OF PIPE INTO SOCKET WITH CARE. THE JOINT SHALL THEN BE COMPLETED BY FORCING THE PLAN END TO THE BOTTOM OF THE SOCKET WITH A FORKED TOOL OR JACK TYPE DEVICE. FIELD CUT PIPE SHALL HAVE THE END CUT TO MATCH THE MANUFACTURED SPIGOT END.
- 3.4.3 JOINT RESTRAINED PUSH-ON JOINTS AS RECOMMENDED IN WRITING BY THE MANUFACTURER.
- 3.4.4 PERMISSIBLE DEFLECTION OF PUSH-ON JOINT PIPE SHALL NOT BE GREATER THAN LISTED IN AWWA C600.
- 3.4.5 PERMISSIBLE DEFLECTION IN RESTRAINED PUSH-ON JOINT PIPE SHALL BE AS RECOMMENDED IN WRITING BY THE MANUFACTURER.

- 3.6 JOINT RESTRAINED PUSH-ON JOINT DUCTILE IRON PIPE AS RECOMMENDED IN WRITING BY THE MANUFACTURER. PERMISSIBLE DEFLECTION IN RESTRAINED JOINT PIPE SHALL BE AS RECOMMENDED IN WRITING BY THE MANUFACTURER.
- 3.7 JOIN POLYVINYL CHLORIDE (PVC) PIPE USING RUBBER RING GASKETS IN BELL JOINTS AS RECOMMENDED IN WRITING BY THE MANUFACTURER. JOIN AND ASSEMBLE SOLUTION WELDED PVC PIPE JOINTS IN ACCORDANCE WITH THE REQUIREMENTS OF ASTM D 2855.
- 3.8 WELDED, SOLDERED, OR BRAZED JOINTS BETWEEN SECTIONS OF COPPER PIPE AND BETWEEN PIPE AND FITTINGS SHALL BE IN COMPLIANCE WITH ANSI B31.1. MAKE JOINTS IN PIPING SYSTEM TIGHT AND LEAKPROOF AGAINST THE DESIGN

- PRESSURE. PEENING OF WELDED JOINTS TO CORRECT LEAKS WILL NOT BE PERMITTED. BRAZED OR SOLDERED JOINTS THAT LEAK SHALL BE DISASSEMBLED, CLEANED, AND MADE AGAIN.

- 3.9 JOIN PIPE OF DIFFERENT MATERIALS BY USING FERROCO COUPLINGS IN ACCORDANCE WITH THE MANUFACTURER'S WRITTEN RECOMMENDATIONS.

3.10 SET VALVES AND VALVE BOXES AS FOLLOWS:

- 3.10.1 EQUIP ALL UNDERGROUND VALVE OPERATORS WITH VALVE BOXES. SET BOX IN ALIGNMENT WITH VALVE STEM CENTERED ON VALVE NUT. SET VALVE BOX TO PREVENT TRANSMITTING SHOCK OR STRESS TO THE VALVE. SET BOX COVER FLUSH WITH THE FINISHED GROUND SURFACE OR PAVEMENT.

- 3.11 INSTALL COMBINATION AIR VALVES AT LOCATIONS INDICATED ON THE DRAWINGS AND AT ALL HIGH POINTS ON PRESSURE PIPING IN ACCORDANCE WITH THE MANUFACTURER'S WRITTEN RECOMMENDATIONS. INSTALL BALL VALVE BETWEEN PIPING AND AIR VALVE. USE TAP, TAPPING SADDLE, TEE, OR OTHER FITTINGS AS REQUIRED FOR COMPLETE AND OPERABLE INSTALLATION.

- 3.12 CONSTRUCT MANHOLES USING PRECAST REINFORCED CONCRETE MANHOLE SECTIONS EXCEPT AS OTHERWISE NOTED. INSTALL MANHOLE FRAMES AND COVERS AND MANHOLE STEPS USING MATERIALS SPECIFIED UNDER PRODUCTS.

- 3.13 CONSTRUCT MANHOLE CHANNEL WITH SMOOTH SEMICIRCULAR BOTTOMS MATCHING INSIDE DIAMETERS OF THE CONNECTING SEWERS. CHANGE DIRECTIONS OF FLOW WITH A SMOOTH CURVE OF AS LARGE A RADIUS AS THE MANHOLE SIZE WILL PERMIT. CHANGE SIZE AND GRADE OF CHANNELS GRADUALLY AND EVENLY. CHANNELS MAY BE FORMED DIRECTLY IN THE CONCRETE MANHOLE BOTTOM, MADE OF CHANNEL PILE, LAID IN CONCRETE, OR CONSTRUCTED BY LAYING FULL SECTION SEWER PIPE THROUGH THE MANHOLE AND BREAKING OUT THE TOP HALF WHEN THE SURROUNDING CONCRETE HAS HARDENED. MANHOLE FLOORS OUTSIDE THE CHANNELS SHALL BE SMOOTH AND SHALL HAVE SLOPE BETWEEN 2 AND 4 INCHES PER FOOT TOWARD THE CHANNELS.

- 3.14 CONSTRUCT CONCRETE CAP OR CRADLE IN ACCORDANCE WITH THE LATEST EDITION OF THE VDOT ROAD AND BRIDGE STANDARDS AT LOCATIONS WHERE THE VERTICAL SEPARATION BETWEEN THE NEW SANITARY SEWER AND ADJACENT UTILITIES IS LESS THAN 18 INCHES.

- 3.15 ENCASE SANITARY SEWER/FORCE MAIN PIPING CROSSING UNDER HIGHWAYS IN A LARGER PIPE OR CONDUIT CALLED A CASING PIPE. THE CASING PIPE SHALL BE OF THE DIAMETER AND WALL THICKNESS INDICATED ON DRAWINGS. JOINTING OF STEEL CASING PIPE SHALL MEET REQUIREMENTS OF AWWA C208 "STANDARD FOR FIELD WELDING OF STEEL WATER PIPE JOINTS." INSTALL CASING PIPE BY JACKING OR BORING.

- 3.15.1 INSTALLATION UNDER HIGHWAYS SHALL MEET REQUIREMENTS OF VDOT ROAD AND BRIDGE SPECIFICATIONS, PROVIDE END SEALS ON CASING PIPE ENDS TO PROTECT AGAINST FOREIGN MATTER. NOTIFY VDOT PRIOR TO BEGINNING WORK.

- 3.15.2 THE CONTRACTOR SHALL DETERMINE FOR HIMSELF THE EXISTING CONDITIONS BOTH ABOVE AND BELOW GROUND AND SHALL PHYSICALLY VERIFY THE LOCATION AND ELEVATION OF THE EXISTING UTILITIES, WHETHER INDICATED OR NOT, PRIOR TO STARTING CONSTRUCTION. THE CONTRACTOR SHALL CONTACT MISS UTILITY AND RESPECTIVE UTILITY OWNERS FOR EXACT LOCATIONS PRIOR TO ANY CASING INSTALLATION NEAR UTILITIES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR INSTALLING THE CASING PIPE AND THE CARRIER PIPE TO THE REQUIRED LINES AND GRADES.

- 3.15.3 THE CARRIER PIPE SHALL BE ELEVATED AND RESTRAINED WITHIN THE CASING PIPE BY THE USE OF CASING PLACEMENT DEVICES AS SPECIFIED FOR CASING SPACERS SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S WRITTEN RECOMMENDATIONS.

- 3.16 FOR BURIED PRESSURE PIPING, PROVIDE REACTION ANCHORS OF CONCRETE BLOCKING, RETAINER GLAND TYPE DEVICES, RESTRAINING DEVICES, OR RESTRAINED JOINT TYPE PIPE AT ALL CHANGES IN DIRECTION OF PRESSURE PIPING. AT DEAD ENDS, AND AS SHOWN ON THE DRAWINGS.

- 3.16.1 CONCRETE REACTION ANCHORS SHALL BEAR AGAINST UNDISTURBED EARTH AND SHALL BE OF THE SIZE AND SHAPE SHOWN ON THE DRAWINGS.
- 3.16.2 RESTRAIN ALL JOINTS WITH RETAINER GLAND/DEVICES IN ACCORDANCE WITH THE WRITTEN RECOMMENDATIONS OF THE RETAINER GLAND/DEVICE MANUFACTURER. ALL PIPE JOINTS SHALL BE RESTRAINED WITH RETAINER GLAND/DEVICES A MINIMUM OF 60 FEET EACH SIDE OF A FITTING OR VALVE.
- 3.16.3 WHERE RETAINER GLAND/DEVICES ARE USED, EXTREME CARE SHALL BE TAKEN SO THAT EACH SET SCREW IS TIGHTENED AS RECOMMENDED BY THE MANUFACTURER BEFORE THE PIPE IS BACKFILLED AND TESTED.

- 3.17 INSTALL DETECTABLE TAPE IN TRENCH ABOVE ALL PIPE PER THE MANUFACTURER'S WRITTEN RECOMMENDATIONS.

3.18 PRESSURE PIPE TESTS SHALL BE AS FOLLOWS:

- 3.18.1 SUPPLY THE PUMPS, POTABLE WATER, CALIBRATED GAUGES AND METERS, AND ALL THE NECESSARY APPARATUS.
- 3.18.2 HYDROSTATIC PRESSURE TEST: AFTER THE LINE HAS BEEN BACKFILLED, A HYDROSTATIC PRESSURE TEST SHALL BE PERFORMED USING POTABLE WATER. CAREFULLY FILL THE SYSTEM WITH POTABLE WATER AT A VELOCITY OF APPROXIMATELY 1 FOOT PER SECOND WHILE NECESSARY MEASURES ARE TAKEN TO ELIMINATE ALL AIR. AFTER THE SYSTEM HAS BEEN FILLED, RAISE THE PRESSURE BY PUMP TO A MINIMUM OF 150 PSI, OR 1.5 TIMES THE WORKING PRESSURE, WHICHEVER IS GREATER. MEASURE PRESSURE AT LOWEST POINT IN THE SYSTEM WITH GAUGE COMPENSATED FOR ELEVATION. MAINTAIN THIS PRESSURE FOR AT LEAST 1 HOUR. IF PRESSURE CANNOT BE MAINTAINED, DETERMINE THE CAUSE, REPAIR AND REPEAT THE TEST UNTIL SUCCESSFUL.
- 3.18.3 FOLLOWING THE HYDROSTATIC PRESSURE TEST, SUBJECT THE SYSTEM TO A LEAKAGE TEST. USE CALIBRATED METER TO DETERMINE LEAKAGE. LEAKAGE SHALL BE DEFINED AS THE QUANTITY OF POTABLE WATER THAT MAY BE SUPPLIED INTO THE PIPE TO MAINTAIN WORKING PRESSURE. AFTER ALL AIR IN THE PIPE LINE HAS BEEN EXPELLED AND THE PIPE HAS BEEN FILLED WITH POTABLE WATER, DURATION OF LEAKAGE TEST SHALL BE 2 HOURS. LEAKAGE SHALL NOT EXCEED THE QUANTITY DETERMINED BY THE FORMULA, FIND AND REPAIR THE LEAKS AND REPEAT THE TEST UNTIL SUCCESSFUL. THE FORMULA IS AS FOLLOWS:

$$L = SD \cdot P / \pi \cdot 32.00$$

WHERE:
 L = ALLOWABLE LEAKAGE IN GALLONS/HOUR
 S = LENGTHS OF PIPE LINED IN FEET
 D = NOMINAL DIAMETER OF THE PIPE IN INCHES
 P = AVERAGE TEST PRESSURE DURING LEAKAGE TEST IN PSIG