

# SANITARY SEWER AND STORMWATER TECHNICAL SPECIFICATIONS

## 1. PIPE INSTALLATION

THIS SECTION COVERS FURNISHING ALL LABOR, SUPERVISION, MATERIALS AND EQUIPMENT AND PERFORMING ALL OPERATIONS NECESSARY TO FURNISH AND INSTALL THE PIPING AND FITTINGS. ALL PIPE AND FITTINGS, AND ACCESSORIES FURNISHED BY THE CONTRACTOR SHALL BE NEW MATERIAL FREE FROM RUST OR CORROSION. ALL PIPING AND FITTINGS SHALL BE CLEANED ON THE INSIDE WHEN INSTALLED AND THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO INSURE THAT THE LINES ARE KEPT FREE OF ANY FOREIGN MATTER AND DIRT UNTIL THE WORK IS COMPLETED. ALL PIPE SHALL BE CAREFULLY PLACED AND SUPPORTED AT THE PROPER LINES AND GRADES AS SHOWN ON THE DRAWINGS. PIPING RUNS SHOWN ON THE DRAWINGS SHALL BE FOLLOWED AS CLOSELY AS POSSIBLE EXCEPT FOR MINOR ADJUSTMENTS TO AVOID OTHER PIPING OR STRUCTURAL FEATURES. IF MAJOR RELOCATIONS ARE REQUIRED, THEY SHALL BE APPROVED BY THE CITY ENGINEER. THE BEDDING SHALL BE DEFINED AS THAT MATERIAL SUPPORTING, SURROUNDING AND EXTENDING TO ONE FOOT ABOVE THE TOP OF THE PIPE. IF SOFT, SPONGY, UNSTABLE OR SIMILAR OTHER MATERIAL IS ENCOUNTERED UPON WHICH THE BEDDING MATERIAL OR PIPE IS TO BE PLACED, THIS UNSUITABLE MATERIAL SHALL BE REMOVED TO A DEPTH ORDERED BY THE CITY ENGINEER AND REPLACED WITH BEDDING MATERIAL SUITABLY DENSIFIED. BEDDING MATERIAL SHALL FIRST BE PLACED SO THAT THE PIPE IS SUPPORTED FOR THE FULL LENGTH OF THE BARREL WITH FULL BEARING ON THE BOTTOM SEGMENT OF THE PIPE. HUNCHING OF THE PIPE SHALL NOT BE ALLOWED. PIPE WILL BE CAREFULLY INSPECTED IN THE FIELD BEFORE AND AFTER LAYING. IF ANY CAUSE FOR REJECTION IS DISCOVERED IN A PIPE AFTER IT HAS BEEN LAID, IT SHALL BE SUBJECT TO REJECTION. ANY CORRECTIVE WORK SHALL BE APPROVED BY THE CITY ENGINEER. PIPE SHALL BE LAID TRUE TO LINE AND GRADE WITH UNIFORM BEARING UNDER THE FULL LENGTH OF THE BARREL OF THE PIPE. SUITABLE EXCAVATION SHALL BE MADE TO RECEIVE



THE BELL OR COLLAR WHICH SHALL NOT BEAR UPON THE SUBGRADE OR BEDDING. ANY PIPE WHICH IS NOT IN TRUE ALIGNMENT OR SHOWS ANY UNDUE SETTLEMENT AFTER LAYING SHALL BE TAKEN UP AND RELAID AT THE CONTRACTOR'S EXPENSE. PIPE SHALL BE LAID UPGRADE WITH THE SOCKET ENDS OF THE PIPE UPGRADE UNLESS OTHERWISE AUTHORIZED BY THE ENGINEER. PIPE SECTIONS SHALL BE LAID AND JOINED IN SUCH A MANNER THAT THE OFFSET OF THE INSIDE OF THE PIPE AT ANY JOINT WILL BE HELD TO A MINIMUM AT THE INVERT. THE MAXIMUM HORIZONTAL OFFSET AT THE INVERT OF THE PIPE SHALL BE 1% OF THE INSIDE DIAMETER OF THE PIPE OR 0.02 FEET, WHICHEVER IS SMALLER. THE VERTICAL GRADE SHALL BE +/- 0.02 FEET OF THE DESIGN INVERT. IN JOINING SOCKET PIPE, THE SPIGOT OF EACH PIPE SHALL BE SO SEATED IN THE SOCKET OF THE ADJACENT PIPE AS TO GIVE A UNIFORM ANNULAR SPACE ALL AROUND THE PIPE IN THE SOCKET. UNAVOIDABLE OFFSETS SHALL BE DISTRIBUTED AROUND THE CIRCUMFERENCE OF THE PIPE IN SUCH A MANNER THAT THE MINIMUM OFFSET OCCURS AT THE INVERT. AT THE CLOSE OF WORK EACH DAY, OR WHENEVER THE WORK CEASES FOR ANY REASON, THE END OF THE PIPE SHALL BE SECURELY CLOSED.

## **2. SHORING AND SHEETING.**

THE CONTRACTOR SHALL DO SUCH TRENCH BRACING, SHEATHING, OR SHORING NECESSARY TO PERFORM AND PROTECT THE EXCAVATION AS REQUIRED FOR SAFETY AND CONFORMANCE TO GOVERNING LAWS. THE BRACING, SHEATHING, OR SHORING SHALL NOT BE REMOVED IN ONE OPERATION BUT SHALL BE DONE IN SUCCESSIVE STAGES TO PREVENT OVERLOADING OF THE PIPE DURING BACKFILLING OPERATIONS. ALL SHORING AND SHEETING DEEMED NECESSARY TO PROTECT THE EXCAVATION AND TO SAFEGUARD EMPLOYEES, SHALL BE INSTALLED.

## **3. OPEN TRENCH**

EXCEPT WHERE OTHERWISE NOTED IN THE SPECIAL PROVISIONS, OR APPROVED IN WRITING BY THE CITY ENGINEER, THE MAXIMUM LENGTH OF OPEN TRENCH, WHERE THE CONSTRUCTION IS IN



ANY STAGE OF COMPLETION (EXCAVATION, PIPE LAYING OR BACKFILLING), SHALL NOT EXCEED 1,320 FEET IN THE AGGREGATE AREA OF A STREET AT ANY ONE LOCATION.

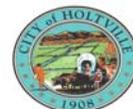
ANY EXCAVATED AREA SHALL BE CONSIDERED OPEN TRENCH UNTIL THE TRENCH BACKFILL HAS BEEN PLACED TO SUBBASE LEVEL, THE LEVEL OF THE BOTTOM OF THE CLASS 2 BASE. WITH THE APPROVAL OF THE CITY ENGINEER, PIPE LAYING MAY BE CARRIED ON AT MORE THAN ONE SEPARATE LOCATION, THE RESTRICTIONS ON OPEN TRENCH APPLYING TO EACH LOCATION. TRENCHES ACROSS STREETS SHALL BE COMPLETELY BACKFILLED AS SOON AS POSSIBLE AFTER PIPE LAYING.

SUBSTANTIAL STEEL PLATES WITH ADEQUATE TRENCH BRACING SHALL BE USED TO BRIDGE ACROSS TRENCHES AT STREET CROSSINGS WHERE TRENCH BACKFILL AND TEMPORARY PATCHES HAVE NOT BEEN COMPLETED DURING REGULAR WORK HOURS. SAFE AND CONVENIENT PASSAGE FOR PEDESTRIANS SHALL BE PROVIDED. THE CITY ENGINEER MAY DESIGNATE A PASSAGE TO BE PROVIDED AT ANY POINT HE DEEMS NECESSARY. ACCESS TO HOSPITALS, FIRE STATIONS, SCHOOLS, POST OFFICES, PUBLIC FACILITIES AND FIRE HYDRANTS MUST BE MAINTAINED AT ALL TIMES.

#### **4. PROTECTION OF EXISTING UTILITIES**

4.1 **UTILITIES:** UNLESS OTHERWISE ILLUSTRATED ON THE PLANS OR STATED IN THE SPECIFICATIONS, ALL UTILITIES, BOTH UNDERGROUND OR OVERHEAD, SHALL BE MAINTAINED IN CONTINUOUS SERVICE THROUGHOUT THE ENTIRE CONTRACT PERIOD. THE CONTRACTOR SHALL BE RESPONSIBLE AND LIABLE FOR ANY DAMAGES TO OR INTERRUPTION OF SERVICE CAUSED BY THE CONSTRUCTION.

IF THE CONTRACTOR DESIRES TO SIMPLIFY HIS OPERATION BY TEMPORARILY OR PERMANENTLY RELOCATING OR SHUTTING DOWN ANY UTILITY OR APPURTENANCE, HE SHALL MAKE THE NECESSARY ARRANGEMENTS AND AGREEMENTS WITH THE UTILITY PURVEYOR AND SHALL BE COMPLETELY RESPONSIBLE FOR ALL COSTS CONCERNED



WITH THE RELOCATION OR SHUTDOWN AND RECONSTRUCTION. ALL PROPERTY SHALL BE RECONSTRUCTED IN ITS ORIGINAL OR NEW LOCATION AS SOON AS POSSIBLE AND TO A CONDITION AT LEAST AS GOOD AS ITS PREVIOUS CONDITION. THIS CYCLE OF RELOCATION OR SHUTDOWN AND RECONSTRUCTION SHALL BE SUBJECT TO INSPECTION AND APPROVAL BY BOTH THE CITY ENGINEER AND THE UTILITY PURVEYOR.

THE CONTRACTOR SHALL BE ENTIRELY RESPONSIBLE FOR SAFEGUARDING AND MAINTAINING ALL CONFLICTING UTILITIES THAT ARE ILLUSTRATED ON THE PLANS. THIS INCLUDES OVERHEAD WIRES AND CABLES AND THEIR SUPPORTING POLES WHETHER THEY ARE INSIDE OR OUTSIDE OF THE OPEN TRENCH. IF, IN THE COURSE OF WORK, A CONFLICTING UTILITY LINE THAT WAS NOT ILLUSTRATED ON THE PLANS IS DISCOVERED, THE DEVELOPER SHALL EITHER NEGOTIATE WITH THE UTILITY PURVEYOR FOR RELOCATION, RELOCATE THE UTILITY OR CHANGE THE ALIGNMENT AND GRADE OF THE TRENCH.

- 4.2 **BUILDING, FOUNDATIONS AND STRUCTURES:** WHERE TRENCHES ARE LOCATED ADJACENT TO BUILDINGS, FOUNDATIONS, AND STRUCTURES, THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTION AGAINST DAMAGE TO THEM. THE CONTRACTOR SHALL BE LIABLE FOR ANY DAMAGE CAUSED BY THE CONSTRUCTION. EXCEPT WHERE AUTHORIZED IN THE SPECIAL PROVISIONS OR IN WRITING BY THE CITY ENGINEER, WATER SETTLING OF BACKFILL MATERIAL IN TRENCHES ADJACENT TO STRUCTURES WILL NOT BE PERMITTED.
- 4.3 **ELECTRONIC, TELEPHONIC, TELEGRAPHIC, ELECTRICAL, OIL AND GAS LINES:** THESE UNDERGROUND FACILITIES SHALL BE ADEQUATELY SUPPORTED BY THE CONTRACTOR. SUPPORT FOR PLASTIC PIPE SHALL BE CONTINUOUS ALONG THE BOTTOM OF THE PIPE. SUPPORT FOR METAL PIPE AND ELECTRICAL CONDUIT MAY BE CONTINUOUS OR NYLON WEBBING MAY BE USED FOR SUSPENSION AT NO GREATER THAN TEN FOOT (10') INTERVALS.



THE CONTRACTOR SHALL AVOID DAMAGING THE PLASTIC PIPE, PIPE WAYS OR CONDUITS DURING TRENCH BACKFILLING AND DURING FOUNDATION AND BEDDING PLACEMENT.

**5. COMPACTION METHODS:**

BACKFILL MATERIAL SHALL BE COMPACTED WITH HAND AND/OR MECHANICAL WORK METHODS USING EQUIPMENT SUCH AS ROLLER, PNEUMATIC TAMPS, AND HYDRO-HAMMERS OR OTHER APPROVED DEVICES WHICH SECURE UNIFORM AND REQUIRED DENSITY WITHOUT INJURY TO THE PIPE OR RELATED STRUCTURES.

WATER CONSOLIDATION BY JETTING OR FLOODING IS NOT ACCEPTABLE AS A SOIL CONSOLIDATION METHOD UNLESS AUTHORIZED IN THE TECHNICAL SPECIFICATION OR APPROVED BY THE CITY ENGINEER.

**6. RIGHTS-OF-WAY BELONGING TO OTHERS:**

WHERE THE PERMIT OF A GOVERNING AGENCY SETS FORTH REQUIREMENTS FOR COMPACTION MORE STRINGENT THAN THOSE STATED HEREIN, THE CONTRACTOR SHALL ADHERE TO THE MORE STRINGENT REQUIREMENTS.

**7. SANITARY SEWER GRAVITY MAIN**

THE SANITARY SEWER GRAVITY PIPE MATERIAL FOR DIAMETER SIZES 4 INCHES THROUGH 48 INCHES SHALL MEET ALL REQUIREMENTS OF ASTM D-3034 AND ASTM F-679 (ANNEX) IN ACCORDANCE WITH ASTM D1784. THE PIPE SHALL BE JOINED WITH AN INTEGRAL BELL TO UTILIZE THE GASKET FOR SEALING. ALL GASKETS SHALL MEET THE REQUIREMENTS OF ASTM F-477. THE PIPE SHALL BE MADE OF P.V.C. PLASTIC HAVING A CELL CLASSIFICATION OF 12454-B OR 12454-C OR 13364-B WITH A MINIMUM TENSILE MODULES OF 500,000 PSI AS DEFINED IN ASTM D-1784. CLEAN REWORK MATERIAL MAY BE USED AS LONG AS THE PIPE PRODUCED MEETS ALL OF THE REQUIREMENTS OF THIS SPECIFICATION. THE PVC SANITARY SEWER PIPE SHALL BE INSTALLED ACCORDING TO THE REQUIREMENTS OF ASTM D2321,



UNI-BELL UNI-PUB 6 AND THE REQUIREMENTS OF THE MANUFACTURER. THE PIPELINE DIAMETER SIZE SHALL BE AS INDICATED ON THE PLANS. THE PIPE LENGTHS SHALL MEASURE 20 FEET IN HORIZONTAL LENGTH.

**8. DEFLECTION TESTING FOR SANITARY SEWER PIPELINE**

THE CONTRACTOR SHALL PERFORM DEFLECTION TESTING FOR 100% OF THE SEWER LINES TO ENSURE THAT THE INSTALLATION MEETS OR EXCEEDS THE MANUFACTURE'S RECOMMENDATIONS.

THE CONTRACTOR SHALL PERFORM DEFLECTION TESTING ON THE SYSTEM AS DIRECTED BY THE CITY ENGINEER. THE DEFLECTION TESTING SHALL BE ACCOMPLISHED BY MANDRELING THE PIPELINE. ANY PART OF THE INSTALLATION, WHICH SHOWS DEFLECTION IN EXCESS OF 5% OF THE AVERAGE INSIDE DIAMETER PER ASTM D-3034 FOR PVC PIPE, SHALL BE CORRECTED.

AFTER ACCEPTANCE BUT PRIOR TO THE TERMINATION OF THE WARRANTY PERIOD, THE CITY OF HOLTVILLE MAY TEST THE LONG-TERM DEFLECTION OF THE SEWER. IF THE CITY OF HOLTVILLE DETERMINES THAT THE DEFLECTION HAS EXCEEDED 7 ½% OF THE AVERAGE INSIDE DIAMETER, THAT PORTION OF THE INSTALLATION SHALL BE CORRECTED BY THE CONTRACTOR AT NO COST TO THE CITY OF HOLTVILLE.

**9. LEAK TESTING FOR SANITARY SEWER PIPELINE**

THE CONTRACTOR SHALL LEAK TEST 100 % OF THE SEWER LINE INSTALLED. THE LEAK TESTING SHALL BE ACCOMPLISHED AFTER THE DEFLECTION TESTING OF THE SANITARY SEWER PIPELINE IS COMPLETED.

SEWER LINES SHALL BE SUBJECT TO ACCEPTANCE TESTING AFTER BACKFILLING HAS BEEN COMPLETED BUT PRIOR TO THE PLACEMENT OF THE FINISH SURFACE MATERIAL, (CLASS 2 BASE, A.C. PAVEMENT AND P.C.C. CONCRETE).



THE COST OF REPAIRS OR CORRECTIONS NECESSARY TO CONFORM TO THE TESTING REQUIREMENTS WILL BE BORNE BY THE CONTRACTOR AT NO COST TO THE CITY OF HOLTVILLE.

(A) LOW PRESSURE AIR TEST:

TESTING WILL BE ACCOMPLISHED BY THE MEANS OF "LOW PRESSURE AIR TESTING." TESTS MAY BE CONDUCTED BY THE CONTRACTOR OR AN INDEPENDENT TESTING FIRM. HOWEVER, ACCEPTANCE TESTS SHALL BE MADE ONLY IN THE PRESENCE OF THE CITY ENGINEER.

TEST PROCEDURE:

1. BEFORE TESTING, THE PIPE SHALL BE THOROUGHLY CLEANED.
2. THE CONTRACTOR SHALL SEAL OFF THE SECTION OF PIPE TO BE TESTED AT EACH MANHOLE CONNECTION. TEST PLUGS MUST BE SECURELY BRACED WITHIN THE MANHOLES.
3. A MINIMUM OF TWO CONNECTION HOSES TO LINK THE AIR INLET TEST PLUG WITH AN ABOVE GROUND TEST MONITORING PANEL MUST BE PROVIDED.
  - A. ONE HOSE IS TO INDUCE AIR THROUGH THE TEST PLUG AND INTO THE TEST CHAMBER.
  - B. THE SECOND HOSE IS FOR THE PURPOSE OF MONITORING THE TEST PRESSURE FROM WITHIN THE ENCLOSED PIPE.
4. UNDER NO CIRCUMSTANCES ARE WORKERS TO BE ALLOWED IN THE CONNECTING MANHOLES WHILE A PRESSURE TEST IS BEING CONDUCTED.
5. ADD AIR SLOWLY INTO THE TEST SECTION. AFTER AN INTERNAL PRESSURE OF 4.0 PSI IS OBTAINED, ALLOW INTERNAL AIR TEMPERATURE TO STABILIZE.



6. AFTER STABILIZATION PERIOD, ADJUST THE INTERNAL AIR PRESSURE TO 3.5 PSI, DISCONNECT THE AIR SUPPLY AND BEGIN TIMING THE TEST.
7. REFER TO SANITARY SEWER AIR TEST TABLE TO DETERMINE THE LENGTH OF TIME (MINUTES) THE PIPELINE SECTION BEING TESTED MUST SUSTAIN AIR PRESSURE WHILE NOT LOSING IN EXCESS OF 1 PSI AS MONITORED BY THE TEST GAUGE. IF THE SECTION OF PIPELINE TO BE TESTED INCLUDES MORE THAN ONE PIPE SIZE, CALCULATE THE TEST TIME FOR EACH SIZE AND ADD THE TEST TIMES TO ARRIVE AT THE TOTAL TEST TIME FOR THE SECTION.
8. SECTIONS SO DETERMINED TO HAVE LOST 1 PSI OR LESS DURING THE TEST PERIOD WILL HAVE PASSED THE LEAKAGE TEST. THOSE SECTIONS LOSING IN EXCESS OF 1 PSI DURING THE TEST PERIOD WILL HAVE FAILED THE LEAKAGE TEST.
9. APPROPRIATE REPAIRS MUST THEN BE COMPLETED AND THE LINE RE-TESTED FOR ACCEPTANCE.

<b>SANITARY SEWER AIR TEST TABLE</b>			
MINIMUM TEST TIME FOR VARIOUS PIPE SIZES*			
NOMINAL PIPE SIZE, IN.	T (TIME), MIN/100 FT.	NOMINAL PIPE SIZE, IN.	T (TIME), MIN/100 FT.
3	0.2	21	3.0
4	0.3	24	3.6
6	0.7	27	4.2
8	1.2	30	4.8
10	1.5	33	5.4
12	1.8	36	6.0
15	2.1	39	6.6
18	2.4	42	7.3

\* THE TIME HAS BEEN ESTABLISHED USING THE FORMULAS CONTAINED IN ASTM C-828, APPENDIX.



(B) HYDROSTATIC TEST:

EXFILTRATION TESTING (WATER):

SANITARY SEWER TESTING BY MEANS OF EXFILTRATION SHOULD ONLY BE CONSIDERED WHEN LOW PRESSURE AIR TESTING CANNOT BE USED AND ONLY WITH THE APPROVAL OF THE CITY ENGINEER.

TESTING PROCEDURE:

1. THE CONTRACTOR SHALL FURNISH ALL EQUIPMENT FOR TESTING.
2. SEAL OFF THE DOWNSTREAM END OF THE LINE AND FILL WITH WATER TO A MINIMUM HEAD OF FOUR FEET (4') IN A STAND PIPE AT THE HIGH END.
3. A PERIOD OF AT LEAST ONE (1) HOUR WILL BE ALLOWED FOR ABSORPTION TIME BEFORE MAKING THE TEST.
4. A SUITABLE METER OR METHOD OF MEASURING THE QUANTITY OF WATER USED IS NECESSARY.
5. THE ALLOWABLE WATER LOSS FOR SANITARY SEWERS SHALL NOT EXCEED 0.158 GALLONS PER HOUR PER 100 FEET OF PIPE PER INCH OF DIAMETER OF PIPE UNDER A MINIMUM TEST HEAD OF FOUR FEET (4') ABOVE THE TOP OF THE PIPE AT THE UPPER END.

**10. LEAK TESTING FOR SANITARY SEWER AND STORMWATER MANHOLES**

THE CONTRACTOR SHALL LEAK TEST 100% OF THE SANITARY SEWER AND STORMWATER MANHOLES INSTALLED FOR THIS PROJECT.



THE CONTRACTOR SHALL TEST ALL MANHOLES USING THE FOLLOWING TEST PROCEDURE:

THE CONTRACTOR SHALL FILL THE MANHOLE WITH WATER AND ALLOW THE INTERIOR SURFACES OF THE MANHOLE TO SOAK FOR FOUR (4) HOURS. THE LEAK TEST SHALL THEN COMMENCE. WATER TIGHTNESS TESTING BY SHALL CONSIST OF FILLING THE MANHOLE WITH WATER TO AN ESTABLISHED LEVEL. THE CONTRACTOR SHALL ENSURE THAT THE DROP IN WATER LEVEL DOES NOT EXCEED 0.001 OF THE TOTAL MANHOLE VOLUME IN ONE (1) HOUR.

**11. ADDITIONAL TESTING**

THE CITY OF HOLTVILLE RESERVES THE RIGHT TO VISUALLY INSPECT THE INTERIOR OF THE SEWER LINE USING A TELEVISION CAMERA. ANY DEFECTS IN THE PIPE OR CONSTRUCTION METHODS REVEALED SHALL BE CORRECTED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE CITY OF HOLTVILLE.

THE CONTRACTOR SHALL NOT PAY FOR T.V. INSPECTIONS COMPLETED BY THE CITY OF HOLTVILLE. ANY ADDITIONAL INSPECTION(S) OR CORRECTIVE WORK REQUIRED, DUE TO PIPE DEFICIENCIES IDENTIFIED BY THE T.V. INSPECTION, SHALL BE PAID FOR BY THE CONTRACTOR.

**12. SEWER LATERALS**

THE CONTRACTOR SHALL INSTALL 4-INCH DIAMETER SDR 35 PVC SANITARY SEWER LATERALS EXTENDING FROM THE SANITARY SEWER MAIN TO THE PROPERTY LINE AS ILLUSTRATED ON THE PLANS. ALL FITTINGS SHALL BE COMPOSED OF SDR 35 PVC MATERIAL WITH O-RING GASKETS. A 2-INCH HIGH LETTER "L" SHALL BE STAMPED IN THE P.C.C. CURB FACE AT THE LOCATION OF EACH SANITARY SEWER LATERAL. THE SANITARY SEWER LATERAL PIPE ZONE SHALL CONSIST OF 2 INCHES OF GRANULAR SAND PLACED BELOW THE SANITARY SEWER LATERAL AND 1 FOOT OF SAND PLACED ABOVE THE SANITARY SEWER LATERAL



PIPELINE. THE GRANULAR SAND SHALL BE COMPACTED TO 95 PERCENT OF MAXIMUM DENSITY PER ASTM D1557.

### **13. CONCRETE**

THE PORTLAND CONCRETE CEMENT FOR THE MANHOLE BASES, MANHOLE GRADE RINGS AND ALL OTHER CONCRETE INFRASTRUCTURE SHALL BE TYPE "V" AND CONTAIN A MINIMUM OF 6-1/2 SACKS OF CEMENT PER CUBIC YARD AND ATTAIN 4,500 PSI COMPRESSIVE STRENGTH AFTER 28 DAYS OF CURING. CONCRETE SLUMP SHALL NOT EXCEED 4.5 INCHES. THE CITY ENGINEER SHALL BE PROVIDED WITH A COPY OF THE CONCRETE VENDOR'S DELIVERY SLIP. ONE (1) SLIP SHALL BE PROVIDED FOR EACH CONCRETE DELIVERY TRUCK. ONE (1) SET OF CONCRETE CYLINDERS SHALL BE OBTAINED FOR EVERY SIX (6) MANHOLE BASES CONSTRUCTED AT A PROJECT SITE. IT SHALL NOT BE REQUIRED TO OBTAIN AND TEST CONCRETE CYLINDERS ON PROJECTS WITH LESS THAN SIX (6) MANHOLE BASES. A SET OF CYLINDERS SHALL BE DEFINED AS THREE (3) CYLINDERS. ONE (1) CYLINDER SHALL BE TESTED 7 DAYS AFTER CONCRETE PLACEMENT. THE SECOND CYLINDER SHALL BE TESTED 28 DAYS AFTER CONCRETE PLACEMENT. THE THIRD CYLINDER SHALL BE HELD IN RESERVE AND TESTED AT THE DIRECTION OF THE CITY ENGINEER.

### **14. SANITARY SEWER MANHOLES COATING**

INSTALL A LOW TEMPERATURE 100 PERCENT SOLIDS ACRYLATED EPOXY PRIMER SYSTEM DESIGNED TO PROVIDE POSITIVE CURE DOWN TO 20 DEGREES FAHRENHEIT AND EXTREMELY RAPID ROOM TEMPERATURE CURE. THE SOLIDS ACRYLATED EPOXY IS TO BE APPLIED AS A PRIMER MATERIAL TO THE INTERIOR OF THE MANHOLE SURFACES. APPLY THE POLYURETHANE SYSTEM OVER THE PRIMER SYSTEM WITHIN SURFACE INTERIOR OF THE P.C.C. MANHOLE PER THE MANUFACTURER'S RECOMMENDATIONS. THE INTERIOR SURFACE OF THE P.C.C. MANHOLE SHALL BE PRIMED WITH A 1 TO 3 MIL. THICKNESS OF 100 PERCENT SOLIDS ACRYLATED EPOXY PRIMER SYSTEM TO THE ABRASIVE GRIT BLASTED RING AND TO ALL CONCRETE SURFACES, INCLUDING INTO THE INVERT DOWN TO THE LOW FLOW WATER LINE. ALLOW



THE PRIMER TO TACK UP (STICK TO THE TOUCH). A 125 MIL THICKNESS POLYURETHANE COATING SYSTEM SHALL BE APPLIED TO THE PRIMER AND ALL INTERIOR SURFACES OF THE P.C.C. MANHOLE AFTER THE PRIMER HAS ATTAINED THE REQUIRED CONSISTENCY.

PRIOR TO THE APPLICATION OF THE 100% SOLIDS ACRYLATED EPOXY PRIMER AND POLYURETHANE PROTECTIVE LINING, THE MANHOLE SHALL BE THOROUGHLY CLEANED BY HIGH WATER PRESSURE BLAST AT PRESSURES OF 34.5 MPA (5,000 PSI) MINIMUM TO 68.9 MPA (10,000 PSI) MAXIMUM. DEBRIS FROM CLEANING SHALL NOT BE ALLOWED TO ENTER THE SEWER SYSTEM. THE CONTRACTOR SHALL PROVIDE THE NECESSARY DEBRIS CONTAINMENT DEVICES WHILE MAINTAINING SEWER FLOW. THE CONTRACTOR SHALL REMOVE AND DISPOSE OF ALL DEBRIS COLLECTED FROM THE CLEANING OPERATION PER 500-1.4 OF THE GREENBOOK SPECIFICATIONS.

THE CURED POLYURETHANE LINING SHALL BE SPARK TESTED FOR PINHOLES WITH A SPARK TESTER SET AT 15,000 VOLTS MINIMUM. ALL PINHOLES SHALL BE REPAIRED AS SPECIFIED IN THE GREENBOOK SPECIFICATION 500-2.4.9.

ALL PINHOLES IN THE PROTECTIVE LINING SHALL BE MARKED OFF ON SURFACE AREAS CONTAINING PINHOLES TO A POINT 150MM (6 INCHES) BEYOND ALL PINHOLES, PRIMED WITH EPOXY, AND RE-COATED WITH POLYURETHANE TO A MINIMUM ADDITIONAL THICKNESS OF 762NM (30 MILS). BLISTERS, UNCURED LINING AND SURFACE IMPERFECTIONS SHALL BE COMPLETELY REMOVED AND THE AREAS RE-COATED WITH EPOXY PRIMER AND POLYURETHANE LINING TO A POINT 150MM (6 INCHES) BEYOND THE REPAIR AREAS AT A MINIMUM THICKNESS OF 2540NM (100 MILS).

THE EPOXY PRIMER AND POLYURETHANE LINING SHALL MEET OR EXCEED THE REQUIREMENTS SPECIFIED IN GREENBOOK SPECIFICATIONS 303-2 AND GREENBOOK TABLE 500-2.4.10(A) AS FOLLOWS:



**TABLE 500-2.4.10(A)**

	POLYURETHANE	EPOXY
TENSILE STRENGTH ASTM D 638, TYPE 1V, MPA (PSI)	13.8(2,000)	41.4(6,000)
ELONGATION AT BREAK, % ASTM D 638, TYPE IV	50	5
WEAR RESISTANCE, MG. WT. LOSS TABER ABRASION, S-17	60	100
HARDNESS, SHORE D, DUROMETER ASTM D 2240	55	75
TEAR RESISTANCE, KG/MM (PPI) ASTM D 903	2.7(150)	N/A
PEEL STRENGTH, CONCRETE, G/MM (PLI) ASTM D 903	125 (7)1	125 (7)1
ADHESIVE STRENGTH, KPA (PSI) ASTM C 190 (MODIFIED BRIQUET)	2760 (400)1	2760 (400)1

TEST RESULTS SHALL BE VERIFIED ON A PER JOB BASIS OR AS REQUIRED BY THE CITY ENGINEER.

THE COATING SYSTEM SHALL BE A ZEBRON NUMBER 386 OR AN APPROVED EQUAL. THE COATING SYSTEM SHALL BE APPLIED PER THE MANUFACTURER'S RECOMMENDATIONS.

**15. SANITARY SEWER AND STORMWATER FORCEMAIN**

THIS SPECIFICATION DESIGNATES GENERAL REQUIREMENTS FOR UNPLASTICIZED POLYVINYL CHLORIDE (PVC) PLASTIC CLASS WATER PIPE WITH INTEGRAL BELL AND SPIGOT JOINTS FOR THE CONVEYANCE OF WATER. PIPE SHALL MEET THE REQUIREMENTS OF AWWA C900 OR AWWA C905 "POLYVINYL CHLORIDE (PVC) WATER DISTRIBUTION".



ALL PIPE SHALL BE SUITABLE FOR USE AS PRESSURE CONDUIT. PROVISIONS MUST BE MADE FOR EXPANSION AND CONTRACTION AT EACH JOINT WITH AN ELASTOMERIC RING. THE BELL SHALL CONSIST OF AN INTEGRAL WALL SECTION WITH A FACTORY INSTALLED, SOLID CROSS SECTION ELASTOMERIC RING WHICH MEETS THE REQUIREMENTS OF ASTM F-477. THE BELL SECTION SHALL BE DESIGNED TO BE AT LEAST AS HYDROSTATICALLY STRONG AS THE PIPE WALL AND MEET THE REQUIREMENTS OF AWWA C900 OR AWWA C905. SIZES AND DIMENSIONS SHALL BE AS SHOWN IN THIS SPECIFICATION. JOINT DESIGN MEETS QUALIFICATION REQUIREMENTS OF ASTM F3139. EACH PIPE SHALL BE TESTED TO FOUR TIMES THE PRESSURE CLASS OF THE PIPE FOR A MINIMUM OF 5 SECONDS. THE INTEGRAL BELL SHALL BE TESTED WITH THE PIPE. STANDARD LAYING LENGTHS SHALL BE 20 FEET ( $\pm 1''$ ) FOR ALL SIZES.

THE PIPE STIFFNESS USING  $F/\Delta Y$  FOR PVC CLASS WATER PIPE IS CONTAINED IN THE TABLE BELOW:

CLASS	DR	$F\Delta y$ (psi)
100	25	129
150	18	364
200	14	815

PIPE SHALL WITHSTAND, WITHOUT FAILURE AT 73°F, AN IMPACT OF A FALLING MISSILE, TUP C, AT THE FOLLOWING LEVELS. (PER ASTM D 2444.)

PIPE SIZE (IN.)	IMPACT (FT./LBS.)
4	100
6	100
8	100
10	120
12	120

THERE SHALL BE NO VISIBLE EVIDENCE OF SHATTERING OR SPLITTING WHEN THE ENERGY IS IMPOSED.



RANDOMLY SELECTED SAMPLES TESTED IN ACCORDANCE WITH ASTM D 1599 SHALL WITHSTAND, WITHOUT FAILURE, PRESSURES LISTED BELOW WHEN APPLIED IN 60-70 SECONDS.

CLASS	MINIMUM BURST PRESSURE AT 73°F (PSI)
100	535
150	755
200	985

SANITARY SEWER AND STORMWATER FORCEMAINS SHALL CONFORM WITH THE SPECIFICATIONS FOR AWWA C-900, CLASS 150 FOR DIAMETER SIZES 4 INCHES THROUGH 12 INCHES AND AWWA C905 DR25 FOR DIAMETER SIZES 14 INCHES OR GREATER.

**16. DUCTILE IRON FITTINGS**

FITTINGS FOR THE SANITARY SEWER FORCEMAINS SHALL BE COMPOSED OF DUCTILE IRON. THE DUCTILE IRON MECHANICAL JOINT FITTINGS SHALL CONFORM TO AWWA C153. THE DUCTILE IRON FLANGED FITTINGS SHALL CONFORM TO AWWA C110. THE FITTINGS SHALL BE CEMENT MORTAR LINED IN ACCORDANCE WITH ANSI/AWWA C-104/A21.4, STANDARD FOR CEMENT MORTAR LINING FOR DUCTILE IRON AND GRAY IRON PIPE FITTINGS FOR WATER, LATEST REVISION. THE PRESSURE RATING FOR 3 INCH – 24 INCH DIAMETER SIZES SHALL BE 350 PSI. THE PRESSURE RATING FOR 30 INCH – 48 INCH DIAMETER SIZES SHALL BE 250 PSI. THE INTERIOR AND EXTERIOR SURFACES OF THE DUCTILE IRON FITTINGS SHALL BE FUSION BONDED EPOXY LINED AND COATED.

**17. DUCTILE IRON PIPE FOR SANITARY SEWER FORCEMAIN OR GRAVITY SANITARY SEWER PIPELINE**

DUCTILE IRON PIPE SHALL BE CLASS 350 FOR DIAMETER SIZES 4 INCHES THROUGH 12 INCHES AND CLASS 250 FOR DIAMETER SIZES 14 INCHES AND GREATER. THE DUCTILE IRON PIPE MATERIAL SHALL CONFORM WITH ANSI/AWWA C110/A21.10.



FLANGED PIPE SHALL CONFORM TO ANSI/AWWA C115/A21.15. MECHANICAL JOINT PIPE SHALL CONFORM TO ANSI/AWWA C111/A21.11. FASTITE JOINTS SHALL CONFORM WITH ANSI/AWWA C111/A21.11. THE DUCTILE IRON PIPE SHALL BE COATED WITH A 401 PROTECTO LINING SYSTEM OR AN APPROVED EQUAL. DUCTILE IRON PIPELINE SHALL BE WRAPPED WITH A POLYETHYLENE WRAP. DUCTILE IRON PIPELINE SHALL BE BACKFILLED WITH GRANULAR SAND PER THE PIPE TRENCH STANDARD DETAIL.

**18. HARDWARE FOR SANITARY SEWER FORCEMAIN**

ALL NUTS, BOLTS AND MISCELLANEOUS HARDWARE UTILIZED FOR THIS PROJECT SHALL BE COMPOSED OF 304 STAINLESS STEEL UNLESS OTHERWISE NOTED ON THE PLANS. AN ANTI-SEIZE MATERIAL SHALL BE APPLIED TO THE STAINLESS STEEL HARDWARE. A TRIPAC, OR AN APPROVED EQUAL, BLUE FLUOROPOLYMER COATING FOR STEEL AND DUCTILE IRON HARDWARE SHALL BE APPROVED AT THE DISCRETION OF THE CITY ENGINEER.

**19. GRAVITY STORM WATER PIPELINE**

GRAVITY STORMWATER PIPELINE SHALL CONSIST OF HIGH DENSITY POLYETHYLENE (HDPE). THE MINIMUM DIAMETER STORM WATER PIPELINE SHALL BE 12 INCHES IN DIAMETER. THE PIPE SHALL POSSES A SMOOTH INTERIOR AND ANNULAR EXTERIOR CORRUGATIONS. THE STORM WATER PIPELINES SHALL RANGE FROM 12 INCHES IN DIAMETER TO 60 INCHES IN DIAMETER. THE HDPE MATERIAL COMPOSING THE STORM WATER PIPELINE SHALL CONFORM WITH AASHTO M294, TYPE S. THE MANNING'S "N" VALUE FOR USE IN DESIGN SHALL BE BETWEEN 0.010 TO 0.012. PIPE JOINTS SHALL MEET THE REQUIREMENTS OF AASHTO M294.

THE 12- THROUGH 60-INCH (300 TO 1500 MM) STORMWATER PIPELINE SHALL BE WATERTIGHT ACCORDING TO THE REQUIREMENTS OF ASTM D3212. GASKETS SHALL BE MADE OF POLYISOPRENE MEETING THE REQUIREMENTS OF ASTM F477 WITH THE ADDITION THAT THE GASKETS SHALL NOT HAVE ANY



VISIBLE CRACKING WHEN TESTED ACCORDING TO ASTM D1149 AFTER 72 HOUR EXPOSURE IN 50 PPHM OZONE AT 104°F (40°C). GASKETS SHALL BE INSTALLED BY THE PIPE MANUFACTURER AND COVERED WITH A REMOVABLE WRAP TO ENSURE THE GASKET IS FREE FROM DEBRIS. THE 12- THROUGH 30-INCH (300 TO 750 MM) BELLS SHALL INCLUDE A REINFORCING RIB AT THE FLARE O.D. TO ASSURE MEETING ROUNDNESS TOLERANCES AND ENHANCE PROPER JOINT ASSEMBLY. A JOINT LUBRICANT AVAILABLE FROM THE MANUFACTURER SHALL BE USED ON THE GASKET AND BELL DURING ASSEMBLY.

THE 24- THROUGH 60-INCH (600 TO 1500 MM) DIAMETER STORMWATER PIPELINE SHALL HAVE A REINFORCED BELL & SPIGOT INCLUDING A BELL TOLERANCE DEVICE. THE BELL TOLERANCE DEVICE SHALL BE INSTALLED BY THE MANUFACTURER AND COVERED WITH A PROTECTIVE WRAP. THE GASKET CORRUGATION SHALL BE REINFORCED WITH A CLOSED CELL STRUCTURAL FOAM CORE.

TO ASSURE WATERTIGHT FIELD PERFORMANCE VERIFICATION SHALL BE ACCOMPLISHED USING ASTM F 1417 OR ASTM C 969 TEST PROCEDURES. APPROPRIATE SAFETY PRECAUTIONS MUST BE USED WHEN FIELD TESTING ANY PIPE MATERIAL. THE COSTS TO COMPLETE THE WATERTIGHT FIELD PERFORMANCE SHALL BE BORNE BY THE CONTRACTOR.

FITTINGS SHALL CONFORM TO AASHTO M294. FABRICATED FITTINGS SHALL BE WELDED AT ALL ACCESSIBLE INTERIOR AND EXTERIOR JUNCTIONS.

THE PIPE AND FITTING MATERIAL SHALL BE HIGH-DENSITY POLYETHYLENE MEETING ASTM D3350 MINIMUM CELL CLASSIFICATION 335400C. THE PIPE MATERIAL SHALL BE A SLOW CRACK RESISTANT MATERIAL EVALUATED USING THE NOTCHED CONSTANT LIGAMENT-STRESS (NCLS) TEST. AVERAGE NCLS TEST SPECIMENS MUST EXCEED 24 HOURS WITH NO TEST RESULT LESS THAN 17 HOURS. THE CLOSED CELL STRUCTURAL FOAM CORE MUST HAVE A FREE RISE DENSITY NO LESS THAN 3 LBS/FT<sup>3</sup> AND COMPRESSIVE STRENGTH NO LESS THAN 20 LBS/IN<sup>2</sup>.



AS REQUESTED, ALL CORRUGATED POLYETHYLENE PIPE MEETING OR EXCEEDING AASHTO M294 SHALL ONLY BE PROVIDED BY MANUFACTURERS LISTED BY THE PLASTICS PIPE INSTITUTE (PPI) AS HAVING MET THE REQUIREMENTS OF THE PPI SPONSORED THIRD-PARTY CERTIFICATION PROGRAM. ALL AASHTO M294 PIPE SHALL BE CLEARLY MARKED WITH A CERTIFICATION PROGRAM MARK OR LOGO REPRESENTING THE SUPPLIED PIPE IS IN COMPLIANCE WITH ALL APPLICABLE STANDARDS.

INSTALLATION SHALL BE IN ACCORDANCE WITH THE HOLTVILLE STANDARD DETAILS AND ASTM D2321, WITH THE EXCEPTION THAT MINIMUM COVER IN TRAFFIC BEARING AREAS FOR 12- THROUGH 48-INCH (300 TO 1200 MM) DIAMETERS SHALL BE 3 FOOT. THE MORE STRINGENT REQUIREMENTS SHALL COMPLY IF THE DETAILS AND SPECIFICATIONS CONFLICT. BACKFILL REQUIREMENTS SHALL COMPLY WITH THE HOLTVILLE STANDARD DETAILS.

**PIPE DIMENSIONS**

		NOMINAL DIAMETER, IN (MM)								
PIPE I.D. IN (MM)	12 (300)	15 (375)	18 (450)	24 (600)	30 (760)	36 (900)	42 (1050)	48 (1200)	60 (1500)	
PIPE O.D. IN (MM)	14.2 (361)	17.7 (450)	21.5 (546)	28.4 (721)	36.0 (914)	41.4 (1052)	48.0 (1219)	55.0 (1397)	67.3 (1709)	
FLARE O.D. IN (MM)	15.4 (391)	19.6 (498)	23.9 (607)	N/A	N/A	N/A	N/A	N/A	N/A	
PITCH IN (MM)	2.0 (51)	2.4 (61)	3.0 (76)	4.0 (102)	4.0 (102)	4.6 (117)	5.8 (147)	5.8 (147)	7.8 (198)	
APPROX. WEIGHT LB/FT. (KG/M)	3.5 (5.2)	5 (7.4)	7 (10.4)	11 (16.4)	17 (25.3)	20 (29.8)	25 (37.2)	30 (44.6)	43 (64)	



## **20. ROUND ROCK**

ROUND ROCK SHALL BE PLACED BENEATH THE GRAVITY SANITARY SEWER PIPELINE AND STORMWATER PIPELINE AS ILLUSTRATED BY THE STANDARD DETAILS. ROUND ROCK SHALL BE PLACED BENEATH THE STORMWATER AND WASTEWATER PIPELINE IF THE PIPE BEDDING IS UNSTABLE. ROUND ROCK SHALL CONSIST OF 1" X NO. 4 ROUND ROCK WITH NO MORE THAN 20 PERCENT OF THE MATERIAL PASSING THE NUMBER 4 SIEVE. ROCK WITH SHARP EDGES SHALL NOT BE ALLOWED.

**END OF SECTION**

