

4.6 SANITARY SEWER SYSTEM INSTALLATION

4.6.01 General Requirements

- A. The Contractor shall have a sufficient number of competent workers at the work site at all times to ensure that utility placement is completed in a timely, satisfactory manner.
- B. Take all precautions necessary to ensure that pipes, valves, fittings, manholes, 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 undamaged material.
- C. Keep pipes clean. Exercise care to keep foreign material and dirt from entering pipes during storage, handling and placing in trench. Close ends of in-place pipes at the end of any work period to prevent entry of animals and foreign material.
- D. Bed pipe as specified in Section 4.3 - Trenching & Backfilling.
- E. Do not lay pipe when weather or trench conditions are unsuitable.
- F. Separation of sanitary sewer lines and water lines shall be in accordance with Virginia Department of Health Regulations and these Standards.
- G. Encase sewer pipelines crossing under highways and railways in a steel casing pipe. The casing pipe shall be of the diameter and wall thickness indicated on the Standard Details. Installation of the steel casing pipe shall be by jacking, boring or open cut if permitted.
 - 1. Install casings at railroad crossings in accordance with the requirements of AREMA Standards for installation of pipelines carrying nonflammable substances under railway tracks.
 - 2. Install casings per the Standard Details or as otherwise required by the right-of-way owner.
 - 3. The Contractor is responsible for obtaining all required permits from the right-of-way owner prior to beginning work. Copies of the permits shall be submitted to the Department for approval.
 - 4. Casing ends shall be sealed to protect against foreign matter entering casing.
 - 5. Casing pipe shall meet the requirements of Section 5.2 of these Standards.

4.6.02 Gravity Sewer Pipe

- A. Lay gravity sewers 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.
- B. Commence laying gravity sewers at the lowest point on a section of line and lay pipe with the bell ends uphill.
- C. Pipe Joints: Preparatory to making pipe joints on gravity sewer lines, clean and dry all surfaces of joint pipe and jointing material. Use lubricants as recommended by the manufacturer. Place, fit, join, and adjust the jointing materials or factory fabricated joints as recommended by the manufacturer to obtain the degree of water tightness required. As soon as possible after the joint is made, place sufficient backfill material, as specified under Section 4.3 - Trenching & Backfilling, along each side of the pipe to resist forces that might tend to move the pipe offline and grade and sufficient backfill to prevent floating.
- D. Backfilling shall be performed as required by these Standards. Refer to Section 4.3 - Trenching & Backfilling. All sanitary sewer gravity mains buried underground shall have a detectable metallic tracer tape buried in the trench approximately 18 inches above the conduit but no less than 18 inches below grade.
- E. Backfill shall be placed over the pipe immediately after the pipe has been laid.
- F. Provide ductile iron pipe or C900 DR14 PVC pipe where cover over main line sewer pipe is less than 5.5 feet in public roads and 3.5 feet in easements.

4.6.03 Sewer Force Main

- A. Force mains shall be installed in accordance with the approved plan and profile drawings. Where no grades are shown on the drawings, force mains shall be installed with a minimum depth of cover of 42 inches over the top of the pipe.
- B. Where grades on the force main plans and profiles conflict with existing pipes or structures, then provide additional depth using a uniform vertical curve to provide proper clearance without the use of fittings. Provide allowance for expansion as directed by the Inspector.
- C. Lay force main pipe with bell ends facing the direction of laying. Where grade is 10 percent or greater, pipe shall be laid uphill with bell ends upgrade.
- D. All sanitary sewer force mains buried underground shall have a detectable metallic tracer tape buried in the trench approximately 18 inches above the conduit but no less than 18 inches below grade. The detectable tape shall comply with the product specifications as detailed in Section 5.2.

- E. Copper tracer wire shall be taped directly to the top of the pipe at maximum interval of 8 feet and within 12" on each side of all fittings, and be installed in a continuous traceable manner. The tracer wire shall be connected to any air-release valves (ARV) along the force main alignment. Appropriately sized lockable connectors shall be used wherever sections of tracer wire must be joined together. Tracer wire shall be adequately and securely connected to tracer wire access boxes in accordance with the manufacturer's specifications. Tracer wire access boxes are to be utilized and spaced no more than 1,000 feet apart, and at the receiving manhole. A concrete mow collar shall be installed at finished grade around all tracer wire access boxes. Tracer wire shall comply with the product specifications as detailed in Section 5.2.

4.6.04 Joining Pipe

- A. Mechanical joint pipe shall be installed as follows:
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 from the joint. Paint the bell and spigot with soap solution (half cup granulated soap dissolved in 1 gallon of water). Slip cast-iron gland on spigot end with lip extension of gland toward end of pipe. Paint rubber gasket with or dip into the soap solution and place on the spigot end with thick edge toward the gland.
 2. Push the spigot end forward to seat in the bell. Then carefully press the gasket into the bell so that it is located evenly around the joint. Move the gland into position, insert bolts, and make nuts finger tight. Tighten nuts as specified by the manufacturer.
 3. Use the tightening pattern specified by the manufacturer. If no specific pattern is specified, progressively tighten nuts on alternate sides of the gland until pressure on the gland is equally distributed.
 4. Permissible deflection in mechanical joint pipe shall not be greater than 1/2 of that listed in AWWA C600 or 1/2 the manufacturer's recommended deflection, whichever is less.
 5. There shall be no joint deflection of PVC pipe.
- B. Push-on joint pipe shall be installed as follows:
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 the gasket and the spigot end of the joining pipe.

2. Start spigot end of pipe into socket with care. The joint shall then be completed by forcing the plain end to the bottom of the socket with a forked tool or jack type device. Field cut pipe shall have the end filed to match the manufactured spigot end.
3. Permissible deflection in push-on joint pipe shall not be greater than 1/2 of that listed in AWWA C600 or 1/2 the manufacturer's recommended deflection, whichever is less.
4. There shall be no joint deflection of PVC pipe.

4.6.05 Thrust Restraint

- A. Provide concrete reaction anchors (thrust blocking) at all points of tie-in to existing pressure pipelines. Provide mechanical joint retainer glands at all fittings, valves, plugs, caps, and other changes in directions or dead ends of pressure pipelines. Joint restraints shall be installed upstream and downstream of each bend, valve, and fitting for the minimum distance determined by the Engineer. Restraint length calculations shall be provided on the drawings.
- B. Thrust blocks shall bear against undisturbed earth. They shall be of the size and shape indicated on the appropriate Standard Detail(s) unless specifically stated otherwise on the construction drawings.
- C. Use restrained joint pipe where indicated on the approved drawings.
- D. Use mechanical joint restraining glands for all mechanical joint pipe as indicated on the drawings to be restrained.
- E. All pressure pipe joints within the fence boundaries at pump stations shall be restrained.
- F. On sewer force mains, restraint calculations shall be provided on the drawings and length of restrained joints shall be indicated on the profiles.

4.6.06 Service Connections

- A. Service connections shall be installed in accordance with this Section of the Standards and the applicable Standard Detail(s).
- B. For new construction, place a main-sized wye fitting and 45-degree bend fitting of the required size wherever a service connection to the sewer line is to be constructed. The wye and bend shall be of the same material as the main. Lay pipe from the connection to the property line on a grade of not less than 1/4 inch per foot for 4-inch pipe or 1/8 inch per foot for 6-inch pipe. Install wye-fitting and cleanout stack at the property line, edge of easement, or as otherwise approved by the Department and shown on the Plans. Provide a short section of pipe with a

glue-on fitting on the back of the wye-fitting. Leave sufficient length of pipe to allow the cap to be cut off and the service line extended.

- C. On new construction in subdivisions, clean-out stacks shall extend 36" above existing grade with a glue-on cap installed over the end of the stack. The height of the stack shall be adjusted, and cleanout cap installed when final grading of the yard is complete. See Standard Detail SEW-01b for more information.
- D. For connection to an existing sewer mains 12 inches and smaller, use a compression type wye cast iron saddle at the connection point. Make connections of this type by machine tapping or cutting the pipe and ensure watertight connection. On pipe larger than 12 inches, a straight cast iron saddle may be used.
- E. Service connections at manholes shall be ductile iron or C900, DR-14, PVC pipe. The invert in of the service connection shall be set so that elevation of the crown of the service connection matches that of the outgoing pipe.
- F. Determine the depth of service connections by the deepest of the following:
 - 1. Provide minimum 5 feet of cover at the edge of the road paving or the curb-line.
 - 2. Provide minimum 36 inches of cover at the bottom of ditches.
 - 3. Provide minimum 5 feet of cover at the property line when elevation is higher than the edge of pavement or top of curb.
 - 4. On residential connections where the above conditions cannot be met using a 4-inch pipe at 1/4 inch per foot slope, the line may be changed to a 6-inch pipe at 1/8 inch per foot.
 - 5. Where depth of cover must be less than 36 inches, the 6-inch service line shall be ductile iron encased in concrete. Depth of cover less than 24 inches shall not be permitted.
 - 6. If a building's lowest finished floor with plumbing fixtures cannot be served by gravity sewer, an ejector pump or grinder pump may be used with prior approval of the Director. Appropriate building permit(s) must be obtained from the Building Inspections Department prior to installation of an individual sewage pump.
- G. Provide ductile iron pipe or C900, DR-14, PVC pipe where cover over service connections is less than 5.5 feet in public right of way and 3.5 feet in easements.

4.6.07 Manhole Connections

- A. Connection to an Existing Manhole: A flexible pipe-to-manhole connector shall be used in the connection of the sewer pipe to an existing manhole.
 - 1. The flexible connector shall be installed by coring the manhole wall to the appropriate size. Acceptable connectors are listed in Section 5 of these Standards. Cored holes shall be sized, and connectors installed, in strict accordance with the manufacturer's recommendations.
 - 2. The connection shall be installed in the manhole wall by activating the expanding mechanism in strict accordance with the recommendation of the connection manufacturer.
 - 3. The connector shall be of a size specifically designed for the pipe material and size being utilized for the manhole connection.
 - 4. This provision shall apply to both gravity sewer lines and service connections.

4.6.08 Testing Gravity Sewer Lines and Manholes

- A. All gauges used for testing shall be calibrated, liquid-filled, gauges with a minimum of a 4-½-inch dial and a mirrored back.
- B. Sanitary sewer lines 24 inches in diameter and smaller shall be tested after backfill using a low-pressure air test in accordance with ASTM C828. Sewer lines larger than 24 inches in diameter and manholes shall be tested by infiltration or exfiltration as hereinafter detailed. All sewer manholes shall be tested by a vacuum test in the presence of the County Inspector. Tests shall be conducted on complete runs of pipe from manhole to manhole. The Contractor shall provide all labor, materials, tools, and equipment necessary to perform the tests. All equipment and methods used shall be acceptable to the Inspector.
- C. Testing of Gravity Sewer Pipes
 - 1. Testing: All structures required to be watertight, and all piping and appurtenances, shall be tested for leakage by the Contractor in accordance with the requirements in these Standards, and in the presence of the Inspector.
 - 2. Gravity sewer pipes testing shall be done by air pressure test as specified herein.
 - 3. Air Test: The Contractor shall plug the pipe and shall conduct a low-pressure air test to determine the acceptability of the completed work. The Contractor shall furnish all men, materials, and supplies necessary to assist

in the conducting of this test. This air test shall conform to UNI-BB-6-79 or latest revision.

4. The air testing equipment shall be Air-Lock, as manufactured by Cherne Industrial, Inc., or approved equal. All air used shall pass through a single control panel. Individual air hoses shall be used from control panel to pneumatic plugs; from control panel to sealed line for introducing low pressure air; and from sealed line to control panel for continually monitoring the air pressure rise in the sealed line.
5. Test Method: The pneumatic plugs used in the test shall have a sealing length equal to or greater than the diameter of the pipe tested. Plugs shall resist internal test pressures without requiring external bracing or blocking. Plugs shall be tested prior to installation in the pipe run. A joint of pipe shall be sealed at both ends with the plugs which are to be used in the sewer test. Air shall be introduced into the plugs to 25 psi. The sealed pipe shall then be pressurized to 9 psi. The plugs shall withstand this pressure without bracing or movement. The tested line segment shall be plugged and pressurized to 4.0 psi greater than the ground water back pressure but not to exceed 9 psi. The line shall be allowed to stabilize for 2 minutes after pressurization. After the pressure has stabilized, the air pressure shall be decreased slowly to 3.5 psi greater than ground water back pressure and the timing of the test shall commence. The time for the pressure to drop 1 psi from 3.5 psi shall be recorded. The minimum acceptable time durations are shown on Table I. If the elapsed time to drop 1 psi is less than that shown on Table I, then the air loss shall be deemed excessive and the section of pipe has failed the test.
6. Sewer lines shall be prepared for the test as follows: Flush and clean the sewer line prior to testing. Plug all pipe outlets using approved pneumatic plugs with a sealing length equal to or greater than the diameter of the line being tested to resist the test pressure. Give special attention to laterals.
7. Ground Water Determination: Install a ½-inch capped galvanized pipe nipple, approximately 12 inches long, through the manhole on top of the lowest sewer line in the manhole. Immediately prior to the line acceptance test, the ground water elevation shall be determined by removing the pipe cap and blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic hose to the pipe nipple. The hose shall be held vertically and a measurement of the height in feet of water over the invert of the pipe shall be taken after the water has stopped rising in the plastic hose.
8. Procedures: Determine the test duration for the section under test by computation from the applicable formulas shown in ASTM C828. The pressure-holding time is based on an average holding pressure of 3.0 psi gauge or a drop from 3.5 psi to 2.5 psi gauge.

TABLE I**SPECIFICATION TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED Q=.0015****PART 1A**

Pipe Diameter (in.)	Minimum Time (min:sec)	Length for Minimum Time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)			
				100'	150'	200'	250'
4	3:46	597	.380 L	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12

PART 1B

Pipe Diameter (in.)	Minimum Time (min:sec)	Length for Minimum Time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)			
				300'	350'	400'	450'
4	3:46	597	.380 L	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	106:57	124:38	142:26	160:15
33	31:10	72	25.852 L	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	153:50	179:29	205:07	230:46

9. Add air until the internal air pressure of the sewer line is raised to approximately 4.0 psi gauge. After an internal pressure of approximately 4.0 psig is obtained, allow time for the air pressure to stabilize. The pressure will normally show some drop until the temperature of the air in the test section stabilizes.
10. When the pressure has stabilized and is at or above the starting test pressure of 3.5 psi gauge, commence the test. Before starting the test, the pressure may be allowed to drop to 3.5 psig. Record the drop in pressure for the test period. If the pressure has dropped more than 1.0 psi gauge during the test period, the line shall be presumed to have failed. The test may be discontinued when the prescribed test time has been completed even though the 1.0 psig drop has not occurred.
11. The test procedure may be used as a presumptive test which enables the installer to determine the acceptability of the line prior to backfill and subsequent construction activities.
12. If the pipe to be tested is submerged in ground water, the test pressure shall be increased by 1.0 psi for every 2.31 feet the ground water level is above the invert of the sewer, to a maximum of 9 psi.
13. Safety: The air test may be dangerous if, because of lack of understanding or carelessness, a line is improperly prepared.

a. It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. In as much as 250 pounds of force (lb-f) is exerted on an 8-inch plug by an internal pipe pressure of 5 psi, a sudden expulsion of a poorly installed plug, or of a plug that is partially deflated before the pipe pressure is released, can be extremely dangerous.

b. As a safety precaution, pressurized equipment shall include a regulator or relief valve set slightly over the test pressure to avoid over-pressurizing and damaging an otherwise acceptable line.

c. No one shall be allowed in manholes during testing.

14. Table: The air test table above has been prepared utilizing applicable formulas from ASTM C828-76T. It is based on an allowable air loss of 0.0015 cubic foot per minute per square foot of internal pipe surface, a maximum air loss per test section of 3.5 cubic feet per minute and a minimum significant air loss per test section of 1.0 cubic foot per minute. It applies when testing one pipe diameter only and for convenience ignores the volume of sewer laterals, which in most instances create only insignificant differences in test time.

4.6.09 Manhole Negative Air Pressure (Vacuum) Test

A. Vacuum Test shall be in accordance with ASTM C1244.

1. All lift holes and any pipes entering the manhole are to be plugged. A vacuum will be drawn and the vacuum drop over a specified time period is used to determine the acceptability of the manhole.
2. The values recorded are applicable only to the manhole being tested and at the time of testing.

B. Preparation of the Manhole.

1. All lift holes shall be permanently plugged.
2. All pipes entering the manhole shall be temporarily plugged, taking care to securely brace the pipes and plugs to prevent them from being drawn into the manhole.

C. Procedure

1. The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations.
2. A vacuum of 10 inches of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump

shut off. The time shall be measured for the vacuum to drop to 9 inches of mercury.

3. The manhole shall pass if the time for the vacuum reading to drop from 10 inches of mercury to 9 inches of mercury meets or exceeds the values indicated in Table 2.
4. If a manhole fails its initial test, necessary repairs shall be made by an approved method. The manhole shall then be retested until a satisfactory test is obtained.

**TABLE 2
MINIMUM TEST TIMES FOR MANHOLES LESS THAN 8 FEET IN DEPTH.**

	Diameter (inches)		
Depth (feet)	48	60	72
	Time (seconds)		
8	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	67
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97

5. For manholes more than 8 feet in depth, or larger than 72 inches in diameter, refer to ASTM C1244.
- D. Test for leakage of gravity sewers using either the infiltration or exfiltration test. Allowable leakage shall be 100 gallons per inch of pipe diameter per mile per 24 hours up to a maximum of 2400 gallons per mile per 24 hours.

1. Use infiltration test when ground water is at 4 feet or more above pipe crown along the length of line to be tested. Plug the pipe at the upper manhole. Install suitable measuring device at the next lowest manhole. Measure the amount of water flowing through the outlet after flow has been stabilized.
2. Ground water determination: Use same procedure as “low pressure air test” above.
3. Use exfiltration test when ground water is less than 4 feet above the pipe crown. Plug the pipe at the lower manhole. Fill the line and manhole to 4 feet above pipe crown or top of manhole whichever is less. Let the water stand until pipe as reached maximum absorption and until all trapped air has escaped, 4 hours minimum. After maximum absorption is reached, refill manhole to original level. After 30 minutes, record difference in level and convert to gallons. Subtract manhole loss to obtain pipeline loss. Manhole loss is found by plugging inlet and outlet and filling manhole with water to 4 feet above pipe crown or top of manhole whichever is less. Let water stand one hour to reach maximum absorption. Refill to original level. After 30 minutes, check difference in level and convert to gallons. Manhole leakage shall not exceed ½ gallon per hour.

4.6.10 Force Main Testing

- A. The Contractor shall supply the pumps, water, calibrated gauges and meters, and all the necessary apparatus for performing the test.
- B. Prior to performing any test, the Contractor must contact the Inspector to schedule a date and time for the test. All tests must be performed in the presence of the Inspector.
- C. Hydrostatic pressure test: After the line has been backfilled and at least seven days after the last concrete anchor block was poured, a hydrostatic pressure test shall be performed. Carefully fill the system with 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 1.5 times the working pressure or 150 psi, whichever is greater. Measure the pressure at the lowest point in system with the gauge compensated for elevation. Maintain the pressure for at least two hours. If pressure cannot be maintained, determine the cause, repair and repeat the test until successful.
- D. Leak Test: A leakage test shall be conducted concurrently with the pressure test. Leakage shall be determined with a calibrated test meter, furnished by the Contractor. Leakage is defined as the quantity of water required to maintain a pressure with 5 psi of the specific test pressure, after air has been expelled and the pipe filled with water. Leakage shall not exceed the amount calculated by the following formula.

$L = S * D * P_{0.5} / 13200$ Where:

L is the allowable leakage, in gallons per hour;

S is the length of pipeline tested, in feet;

D is the nominal diameter of the pipe, in inches; and

P is the average test pressure during the leakage test in pounds per square inch gauge.

- E. All visible leaks shall be repaired regardless of the amount of leakage.

4.6.11 CCTV Inspection

- A. Immediately prior to applying for acceptance by the County, the Contractor must clean all gravity sewer lines and perform video inspection via CCTV. Video Inspections of sewer systems shall be carried out in compliance with the NASSCO PACP reporting format and coding standards, and the requirements of these Standards.
- B. The following items shall be submitted to the Department for review:
 - 1. A letter of CCTV completion, signed by the person(s) who performed the CCTV Inspection.
 - 2. Complete documentation of the CCTV inspection in digital form, on a CD/DVD, memory stick, or other method suitable to the Department.
- C. For new installations, the Contractor shall, following construction, conduct a final video inspection of all gravity pipes and a visual inspection of all manholes and wet wells. Copies of reports of this inspection shall be submitted to the Inspector for approval.
- D. The Contractor shall be responsible for all traffic control required during the inspections. This shall include flagging, all applicable signage, and/or detours as designated by the more stringent authority in the design plans, the Goochland County Standards and Specifications, and the VDOT MUTCD design manual (latest editions of all.)
- E. After cleaning, all pipe sections shall be visually inspected by means of closed-circuit television camera. The inspection will be done one section at a time, from manhole to manhole. Any flow in the section being inspected will be suitably controlled as needed. All CCTV inspections shall be performed in accordance with NASSCO PACP standards including the specific date and time of inspection.
- F. The television camera used for the inspection shall be one specifically designed and constructed for such inspection. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The camera, television monitor, and other

components of the video system shall be capable of producing picture quality to the satisfaction of the Inspector.

- G. The camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewer's condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line. If, during the inspection operation, the television camera will not pass through the entire pipe section, the Contractor shall set up his equipment so that the inspection can be performed from the opposite manhole. If, again, the camera fails to pass through the entire pipe section, the inspection shall be considered failed. Additional repairs, cleaning, and inspection will be required.
- H. The camera shall be stopped at each joint and lateral connection, and the head rotated to show a 360-degree picture.
- I. When manually operated winches are used to pull the television camera through the line, telephones or other suitable means of communication shall be set up between the two manholes of the section being inspected to ensure good communications among members of the crew.
- J. The importance of accurate distance measurements is emphasized. Measurement for location of defects shall be made above ground by means of a meter device. Marking on the cable, or any other method which requires interpolation for depth of manhole, will not be allowed. Accuracy of the distance meter shall be checked by use of a walking meter, roll-a-tape, or other suitable device, and the accuracy shall be satisfactory to the Inspector. Documentation of CCTV Inspection results shall be as follows:
 - 1. Television Inspection Logs: Electronic media location records shall be kept by the Contractor and will clearly show the location, by distance in 1/10 of a foot from the manhole wall, in relation to an adjacent manhole of each infiltration point observed during inspection. In addition, other points of significance such as locations of building sewers, unusual conditions, roots, storm sewer connections, cracks, fractures, broken pipe, debris, the presence of scale and corrosion, and other discernible features, as defined in the PACP defect codes, will be recorded on electronic media and a copy of such records will be supplied to the Inspector.
 - 2. Digital photographs of the pipe condition and all defects shall be taken by the Contractor. Photographs shall be located by distance in 1/10 of a foot from the wall of an adjacent manhole.

- K. Electronic media recordings: The purpose of electronic media recording shall be to supply a visual and audio record of problem areas of the lines for review by the Department. Upon completion of the CCTV inspection, an original electronic media recording of conditions and defects will be delivered to the Inspector.

- L. All CCTV Inspections shall be performed by CCTV personnel who are trained and certified in the use of NASSCO's Pipeline Assessment and Certification Program (PACP)©.

END OF SECTION 4.6