

**SECTION 38 - SEWER AND STORM DRAIN CONSTRUCTION  
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## **SECTION 38 SEWER AND STORM DRAIN CONSTRUCTION**

### **38-1 GENERAL**

Sewer and storm drain construction shall conform to the details shown on the Plans and these Specifications. The Contractor shall furnish and install sanitary sewer and drain pipe of the materials shown or specified in the Contract. Where alternate pipe materials are listed in the Bid, the Contractor shall bid only one of the alternates shown. Substitution of alternate pipe material after bid is not permitted.

### **38-2 MATERIALS**

Sewer and storm drain pipe shall be of the type, class and size as shown or specified in the Contract, and shall conform to the requirements of Section 50, "Construction Materials", of these Specifications for each respective type and class of pipe.

### **38-3 EXCAVATION AND BEDDING**

Trench excavation and bedding for all sewer and storm drain pipe construction shall conform to Section 19, "Trench Excavation, Bedding and Backfill", of these Specifications.

The Contractor shall expose the end of existing pipe to be extended, for verification of alignment and elevation by the Agency, prior to trenching for any pipe that may be affected.

### **38-4 LAYING PIPE**

#### **38-4.01 Placement**

Pipe laying shall proceed after the trench for the pipe has been brought to the proper line and grade. Pipe laying shall proceed upgrade with the bell or groove end of the pipe placed upstream. Each section of pipe shall be laid true to line and grade and in such a manner as to form a watertight, concentric joint with the adjoining pipe. The interior of the pipe shall be cleared of all dirt and debris as the work progresses. Pipe shall not be laid when the condition of the trench or the weather is unsuitable, in the opinion of the Agency, because of water or mud that may interfere with proper jointing. All open ends of pipe and fittings shall be closed whenever the work is discontinued. For remedial maintenance or improvement projects in established areas, the Contractor shall coordinate the work so that storm drain systems are fully operational at the end of each Working Day. No runoff shall be allowed to flow uncontained through any trenches or excavations without approval of the Agency.

Where plain end vitrified clay pipe with the compression coupling is installed, the Contractor shall tighten the compression bands as pipe laying proceeds. The first length of pipe laid on any run, except where a connection is made to an existing line, shall be anchored securely to prevent movement when each succeeding length is pushed into place. After each compression band is tightened, the Contractor shall replace and tamp any bedding material that may have been displaced under the pipe, and particularly under the coupler, before proceeding with the initial backfill.

Circular reinforced concrete pipe with elliptical reinforcement shall be placed with the minor axis of the reinforcement in a vertical position.

#### **38-4.02 Lines and Grades**

All pipe shall be laid in strict conformity to the prescribed line and grade with grade bars set and each pipe length checked to the top grade line. Three consecutive points on the same grade of slope shall be used at all times to detect any variation from a straight grade. In case

any discrepancy exists, the work shall be stopped and the discrepancy immediately reported to the Agency. In addition, when requested by the Agency, a string line shall be used in the bottom of the trench to insure a straight grade and alignment of the pipe.

The Contractor may elect to furnish a laser beam system for grade and alignment control. Such laser beam shall have a minimum accuracy of  $\pm 0.01$  foot per one hundred feet (100') on line; and a minimum visible range of one thousand feet (1000'), and shall comply with OSHA requirements. The laser system shall have good visibility when used with suitable target material. The laser system shall be of the self-leveling type so that the laser beam is automatically compensated for small grade disturbances. The laser system shall also have an early warning system that warns when the laser is off grade.

**38-4.03 Grade Tolerance - Sewer**

Grade tolerance of the flow line of sewer pipe shall not exceed  $\pm 0.05$  feet. In addition, in any twenty-five-foot (25') length, the total variation (plus or minus) from flow line grade shall not exceed the following:

1. one-quarter of an inch (0.25") in four inch (4") or smaller pipe
2. three-quarters of an inch (0.75") in six- through twelve-inch (6"-12") pipe
3. one inch (1") in fifteen- through thirty-six-inch (15"-36") pipe.
4. Grade and total variation tolerance for pipe greater than thirty-six inches (36") shall be as required in the Special Provisions.

**38-4.04 Grade Tolerance – Storm Drain**

The elevation of the pipe invert for storm drain pipe shall not deviate from the design elevation by more than plus or minus two percent ( $\pm 2\%$ ) of the pipe size concerned, or one inch (1"), whichever is greater. The rate of deviation from grade or returning to grade shall be limited to one-sixteenth of an inch (1/16") per foot (1') of pipe.

**38-4.05 Existing Utilities and Facilities**

Mortar or brick plugs shall be installed in existing manholes as directed by the Agency in order to prevent surface water, ground water, and debris from entering existing sewer or storm drain systems during construction. Inflatable plugs will not be permitted. Care shall be exercised in installing plugs to avoid interrupting service to existing sewer or storm drain services. Plugs shall be removed upon completion of testing as provided in Section 38-10, "Testing of Pipe", in this Section of these Specifications.

The Contractor is responsible for avoiding all utility, service, or other conflicting lines that are not in direct physical conflict with the facility under construction. The Contractor may arrange with the owner of the utility to temporarily disconnect house service lines or other facilities along the line of work for the Contractor's convenience. The Contractor is responsible for all costs for disconnecting and restoring such utilities.

Utility or other lines which are in direct physical conflict with the structural section of the facility being constructed or appurtenant structures, and which cannot be avoided by rerouting the facility being constructed, or for which relocation is not provided in the Plans and Specifications, will be relocated by the owner of the utility prior to or during construction in accordance with Section 42, "Relocation and Maintenance of Utility Facilities", of these Specifications.

Should it become necessary to reroute the facility being constructed to avoid an existing utility or other obstruction and such rerouting is ordered by the Agency, compensation for the installation of such rerouted line shall be made at the unit price bid for the installation of said facility and no additional compensation will be made except as provided in Section 9, "Changes and Claims", of these Specifications. Reroute sewer service in accordance with Standard Drawing 7-13.

When indicated on the Plans or directed by the Agency, storm drain pipes and structures shall be abandoned in conformance with Section 15-1.04, "Abandonment of Pipes and Manholes", of these Specifications.

### 38-5 SEWER SERVICES

Construction of the cleanout to grade for all sewer services is required. Construction of the top one foot (1') of the cleanout riser may be delayed until installation of the building sewer at the option of the Contractor, except where the water main is to be installed at the back of the sidewalk (refer to Note 10, Standard Drawing 7-5). If construction of the top one foot (1') of the riser is delayed, the location of the service shall be accurately staked with a four-inch by four-inch (4"x4") post.

In addition, where curb and gutter exists, or is to be constructed concurrently with sewer facilities, the location of each sewer service shall be permanently indicated by inscribing the letter "S" two inches (2") in height in the curb directly above the line when the service is perpendicular to the street centerline. Otherwise, the "S" marks for skewed or angling services shall be placed at a right angle to the end of the service. When sewer services are installed in an existing street, the curb mark shall be placed at the time the service is installed to assure proper location.

In new subdivisions when the sewer services are installed before the curb is constructed, it is the Contractor's responsibility to establish the exact location of each sewer service and to furnish this information to the Agency.

In all alley improvements where a main is being replaced, all services to that main will be replaced and a clean-out installed as shown or specified in the Contract.

Service sewers shall be installed as detailed on Standard Drawing 7-5 and at the locations shown on the Plans. Unless otherwise specified, service sewers shall be four-inch (4") diameter in residential areas and six-inch (6") diameter in commercial and industrial areas and constructed to the property line or easement line. Except as otherwise specified herein, service sewers shall be of the same material as the lateral sewer to which it connects. In residential areas only the following exceptions are allowed:

- ABS-DWV (Schedule 40, ASTM D 2661) pipe may be connected to a VCP "T" or "Y" as shown on Standard Drawing 7-5.
- A regularly manufactured "T" or "Y" fitting of the same materials as the collector sewer shall be used in the collector sewer and shall be inclined upwards at a minimum angle of twenty-five degrees (25°) and a maximum of forty-five degrees (45°) from the horizontal. The ends of all service sewers shall be securely sealed by stoppers in such a manner that the stoppers can be removed for extending the line without damage to the pipe. Unless otherwise shown on the Plans, the depth of cover of the service sewer at the easement or property line shall be a minimum of four feet (4') and a maximum of five feet (5') below existing ground or edge of adjacent roadway, whichever is at the lower elevation, except that the minimum depth of cover shall be five feet-six inches (5'-6") and the maximum six feet (6') where a water main is to be installed at back of sidewalk as part of subdivision improvements. In such cases, as detailed in Standard Drawing 7-5, the service shall also be extended to the back of the 12.5 foot PUE or a minimum of ten feet (10'). The cleanout to grade, however, shall remain a maximum of two feet (2') behind the sidewalk, and a second cleanout installed at the end of the extension. Any elevation given shall be a maximum allowable elevation, and the minimum slope of the service shall be one-quarter inch per foot (1/4" per 1'). If the service is to be bored, the tolerance of the operation must be within these limits.

If the service sewer will have less than three feet (3') of cover as measured from the top of the finished subgrade, Class 200 cast or ductile iron pipe, or PVC (DR-14) pipe conforming to

the requirements of AWWA C900, or other high strength pipe approved by the Agency shall be used.

Service sewers entering a manhole shall be set to an invert to crown match with the outgoing pipe, or internal drops conforming to Standard Drawing 7-3, except at the ends of cul-de-sacs. Unless otherwise shown on or specified in the Contract, cleanouts shall be provided for all service sewers that do not require a manhole at property or easement line. The cleanout shall be installed three feet (3') maximum back of the sidewalk or easement line if the service is located within a side or back of lot easement. A concrete or PVC box shall be set to finish grade of the property. The cleanout and service shall be of like material and diameter, and shall be installed as shown on Standard Drawing 7-9 or 7-10, as required for the particular situation.

#### **38-5.01 Service Sewer Relocations and Reconnections**

Service sewer relocations and reconnections shall be constructed in conformance with these Specifications and as directed by the Agency. Ductile iron sewer pipe or PVC Pressure Class 200 (DR-14) pipe conforming to the requirements of AWWA C900 shall be used when the minimum depth of cover of the reconnected or relocated service sewer is three feet (3') or less from the top of the finished subgrade, or if located beneath the drain pipe and the clearance between the pipes is one-half foot (0.5') or less. Details for service sewer relocations and reconnections shall be as shown on Standard Drawing 7-13.

#### **38-5.02 Connections to Existing Sewers**

Where a new or relocated service sewer requires that a tap be made to an existing collector or trunk sewer, such tap will be made by the Agency. An application for such tap shall be made to the Agency, and the required fees paid, at least five (5) Working Days in advance of the date the tap is desired. All excavation, shoring and bracing is the responsibility of the Contractor and must be in conformance with all OSHA and other applicable safety standards. All shoring and bracing shall be in place before Agency personnel will install the tap. Installation of the service sewer shall be completed by the Contractor in accordance with these Specifications.

#### **38-5.03 Connections to Manholes**

Any service sewer entering a manhole shall be installed with the invert elevation of the service pipe matching the crown elevation of the exit sewer except when an internal drop connection is used. If the manhole at the end of a cul-de-sac is connected with a pre-cast base, the invert of any service stubs shall be a minimum of one inch (1") above the invert of the exit pipe. Internal drop connections shall have a minimum length of three feet (3') and be installed using a drop bowl in accordance with Standard Drawing 7-3.

### **38-6 STORM DRAIN INLET LATERALS**

Unless otherwise indicated on the Plans or in the Special Provisions, storm drain inlet laterals shall be a minimum of twelve inches (12") in diameter. Unless otherwise indicated in the Contract, materials for inlet laterals shall conform to requirements of Section 50, "Construction Materials", of these Specifications for each respective type and class of pipe.

Connections of laterals to manholes and inlets shall be water and soil tight, and shall conform to Section 39, "Manholes", and Section 27-13, "Drop Inlets and Catch Basins", of these Specifications.

All inlet laterals shall be inspected by lamping conforming to Section 38-10.05, "Lamping of Storm Drain Inlet Laterals", in this Section of these Specifications or TVI. When the radius or length of the lateral precludes the effective use of lamping methods, a TVI is required conforming to Section 38-10.04, "Television Inspection (TVI)", in this Section of these Specifications. Other proposed methods of inspection may be approved by the Agency.

### **38-7 PIPE JOINTS**

Joints in pipe shall conform to the requirements of Section 50, "Construction Materials", of these Specifications for the type of pipe being installed.

Care shall be used to prevent chipping or cracking of either end of the pipe during installation.

All joints for concrete pipe shall be rubber gasketed joints.

All joint surfaces shall be cleaned before joints are made.

### **38-8 PROTECTIVE COVERING**

#### **38-8.01 Sewer Pipe**

Unless otherwise specified in the Special Provisions, sewer laid in trenches at such an elevation that the top of the pipe bell is less than eighteen inches (18") below subgrade of the street, the pipe shall be covered with a protective covering as shown on the Plans. **Storm Drain Pipe**

Unless otherwise shown in the Contract, storm drain pipe laid in trenches at such an elevation that the top of the pipe bell has less than the minimum cover indicated in Table 38-1 shall be protected with a concrete cap, as shown on Detail 9-1D of Standard Drawing 9-1, "Storm Drain Pipe Bedding and Initial Backfill". The cover shall be measured from the top of a rigid pavement or the bottom of a flexible pavement. Unless otherwise shown in the Contract, the concrete used in making the cap shall be Class "B" concrete conforming to Section 50-5, "Portland Cement Concrete", of these Specifications.

**Table 38-1 Minimum Pipe-Pipe Cover Requirements**

<b>Pipe Material Type and Location</b>	<b>Minimum Cover Requirement</b>
High Density Polyethylene (HDPE) - non traffic areas	Twelve inches (12") - top of pipe to top of grade
High Density Polyethylene (HDPE) - for dia. to 36" in traffic areas	Twelve inches (12")
High Density Polyethylene (HDPE) - dia. 42" to 60" in traffic areas	Twenty-four inches (24")
Corrugated Metal	Span/8 but not less than 12 inches (12")
Spiral Rib - Steel	Span/3 but not less than twelve inches (12")
Spiral Rib - Aluminum with spans less than or equal to 72"	Span/2 but not less than twelve inches (12")
Spiral Rib - Aluminum with spans greater than 72"	Span/3 but not less than thirty inches (30")
Reinforced Concrete in unpaved areas and under flexible pavements	1/8 the diameter or rise (the greater of) but not less than twelve inches (12")
Reinforced Concrete under rigid pavements	A nine-inch (9") space between top of pipe and bottom of slab consisting of compacted granular fill shall be maintained at a minimum.
Cast-in-Place-Concrete-Pipes in paved areas	The Structural Section plus twenty-four inches (24")
Cast-in-Place-Concrete-Pipes in unpaved areas	Twenty-four inches (24")
Polyvinyl Chloride - C900 and C905	Twelve inches (12")
Polyvinyl Chloride - D2241 and D3034	Twenty-four inches (24")

Note: All depths shown are for a minimum trench width equal to the outside diameter of the pipe plus sixteen inches (16") measured at the top of the pipe.

**38-9 BACKFILLING PIPE TRENCHES**

Backfill of all sewer and storm drain pipes shall conform to the requirements in Section 19, "Trench Excavation, Bedding and Backfill", of these Specifications. Bedding and backfill for sanitary sewer pipes shall be in accordance with Standard Drawing 7-4 for sewer and Standard Drawing 9-1 for storm drain.

**38-10 TESTING OF PIPE**

Unless otherwise specified in the Contract, after laying, backfilling, and compacting of sewer and drain pipe, and before placing the aggregate base, the Contractor shall clean the pipe system, test for obstructions and leakage, and perform the television inspection (TVI).

Obstruction or leakage tests for storm drain shall be performed when required by the Contract or when visual inspection by television or lamping indicates that there may be obstructions or leaks in the pipe.



**38-10.01 Tests for Obstructions**

Unless otherwise shown or specified in the Contract, all sanitary sewer pipes shall be tested for obstructions and cleaned by balling and flushing or approved method in accordance with Section 43, "Cleaning Pipelines", of these Specifications. For balling and flushing an approved commercial sewer cleaning ball shall be used, which shall be controlled by a tag line or rope, or sewer rods, and permitted to move slowly through the pipe. Any obstructions or irregularities shall be removed or repaired by the Contractor. All testing, cleaning and repairing shall be done to the satisfaction of the Agency. The Contractor shall provide all necessary materials and utilities for the tests and shall dispose of all waste, including water, at the Contractor's expense. The water shall not be allowed to enter the existing sanitary sewer system.

Unless otherwise indicated in the Contract, balling and flushing or other approved methods for cleaning storm drains shall not be required unless visual inspection by television or lamping indicates obstructions in the line.

**38-10.02 Tests for Leakage**

All leakage tests shall be completed and approved at finished subgrade and prior to placing the aggregate base.

When leakage or infiltration exceeds the amount allowed by the Specifications, the Contractor shall locate the leaks and make necessary repairs or replacements in accordance with the Specifications to reduce the leakage or infiltration to the specified limits, at the Contractor's expense. Any individually detectable leaks shall be repaired, regardless of the results of the tests.

Leakage tests for storm drains shall be required when indicated in the Contract, when inferior materials or construction methods are used, or when visual inspection by television or lamping indicates a potential for leakage. All or any sections of sewer lines, including storm drains and force mains which the Agency may select, shall be tested by the Contractor by either of the following methods:

**38-10.02.A Air Test for Leakage - Sewer**

The air test for leakage for gravity sewer shall be in accordance with ASTM C 828. The installer may use this test as a presumptive test to determine the condition of the line prior to backfilling, however, only lines tested after backfilling to final grade will be considered for acceptance.

The Contractor shall furnish all necessary equipment and is responsible for conducting all low-pressure air tests. The Contractor shall perform any necessary repair work on pipeline segments that do not pass any or all of the tests, at no additional cost to the Agency. No sealant shall be used in any newly installed sewer line without the prior written approval of the Agency. Using sealant in a sewer line is not the equivalent of a sound sewer pipe. Proper structural repair work will be required by the Agency.

**38-10.02.A.(1) Procedure**

Air tests for leakage for sewers shall follow the procedures outlined in Sections 38-10.02.C.(1) through 38-10.02.C.(5)(d).

**38-10.02.A.(2) Test Time**

Table 38-2 shows the required test time, *T*, in minutes per one hundred feet of pipe for each nominal pipe size. Test times are for a 1.0-psi (7 kPa) pressure drop from 3.5 to 2.5 psi (24 to 17 kPa). The criteria in Table 38-2 were calculated using the following formulas:

Minimum test time (*T*) at a given allowable air loss (*Q*):

$$T = K \times D^2L / Q$$

Air loss (Q) with a timed (T) pressure drop:

$$Q = K \times D^2 L / T$$

Where:

*D* = nominal size, in. (mm),

*K* = 0.370 X 10<sup>-3</sup> for inch-pound units,

*K* = 0.564 X 10<sup>-7</sup> for S.I. units,

*L* = length of line of one pipe size, ft (m)

*Q* = air loss, ft<sup>3</sup>/min (m<sup>3</sup>/min), and

*T* = time for pressure to drop 1.0 psi (7 kPa), min./100'

**38-10.02.A.(3) Testing Sewer Collectors With Service Connections**

If service connections are included in the test, the lengths of the service connections may be ignored when computing required test times, unless otherwise specified in the Contract or directed by the Agency.

Should the section of line include more than one pipe size, determine the minimum test time for each size and add the test times to arrive at the total test time for the section.

**38-10.02.A.(4) Pipeline Acceptance Criteria**

If the test time shown in Table 38-2 elapses before the air pressure drops one pound per square inch (1 psi) gauge, the section undergoing the test shall be deemed to have passed the test and shall be presumed to be free of defects.

**38-10.02.A.(5) Determination Of Line Failure**

If the pressure drop is more than one pound per square inch (1 psi) gauge before the time shown in Table 38-2 has elapsed, the air loss rate is considered excessive and the section of pipe has failed the test.

**Table 38-2**

Nominal Pipe Size, D in. (mm)	Minimum Test Time, T (Min:sec/100 ft)	Allowable Air Loss, Q (ft <sup>3</sup> /min)
4 (100)	0:18	2.0
6 (150)	0:42	2.0
8 (205)	1:12	2.0
10 (255)	1:30	2.5
12 (305)	1:48	3.0
15 (380)	2:06	4.0
18 (455)	2:24	5.0
21 (535)	3:00	5.5
24 (610)	3:36	6.0
27 (685)	4:12	6.5
30 (760)	4:48	7.0
33 (840)	5:24	7.5
36 (915)	6:00	8.0
39 (990)	6:36	8.5

**38-10.02.B Hydrostatic Test for Leakage - Sewer**

A section of line shall be prepared for testing by plugging the upper side of the downstream manhole and all openings in the upstream manhole except the downstream opening. Care shall be exercised in installing plugs to avoid interrupting service to existing sewer or storm drain services. Where grades are slight, two (2) or more sections between manholes may be tested at once. Where grades are steep and excessive heads would result by testing from one manhole to another, test tees, the same size as the main, shall be installed at intermediate points so the maximum head on any section under test shall not exceed twelve feet (12').

A section of line prepared as above shall be tested by filling with water to an elevation five feet (5') above the top of pipe at the upstream end of the test section, or five feet (5') above the existing ground water elevation, whichever is greater. The water shall be introduced into the test section at least four (4) hours in advance of the test period to allow the pipe and joint material to become saturated with water. The water level should then again be brought to the five-foot (5') mark. At the beginning of the test, the elevation of the water in the upper manhole shall be carefully measured from a point on the manhole rim or test tee. After a period of four (4) hours, or less with the approval of the Agency, the water elevation shall be measured from the same point on the manhole rim and the loss of water during the test period calculated. If this calculation is difficult, enough water shall be measured into the upper manhole to restore the water to the level existing at the beginning of the test, and the amount added taken as the total leakage.

Unless otherwise specified in the Special Provisions, the allowable leakage in the test section shall not exceed fifty (50) gallons per mile per day per inch diameter of pipe tested at the five-foot (5') test head. If it is necessary or desirable to increase the test head above five feet (5'), the allowable leakage will be increased at the daily rate of fifty (50) gallons for each foot of increase in head.

Test sections showing leakage in excess of that allowed shall be repaired or reconstructed as necessary to reduce the leakage to that specified above.

Water used in testing shall be disposed as directed by Agency. No testing water shall be allowed to enter the existing sanitary sewer system.

**38-10.02.C Air Test for Leakage - Storm Drain**

Only lines tested after backfilling to final grade will be considered for acceptability. However, this test may also be used by the installer as a presumptive test to determine the condition of the line prior to backfilling.

The Contractor shall furnish all the necessary equipment and be responsible for conducting all low-pressure air tests. In addition, the Contractor is responsible for any necessary repair work on sections that do not pass the test. No sealant shall be used in any newly installed storm drain without the prior approval of the Agency. Using sealant in a storm drain is not the equivalent of a sound storm drain pipe. Proper structural repair work may be required by the Agency.

The Agency will witness all low-pressure air tests and verify the accuracy and acceptability of the equipment utilized.

**38-10.02.C.(1) Plug Restraint**

Restraints must be provided for plug to prevent blowouts of the plug. As an example of the hazard, a force of two hundred fifty (250) pounds is exerted on an eight-inch (8") plug by an internal pipe pressure of five pounds per square inch, gauge (5 psig), and a force of two thousand two hundred fifty (2,250) pounds is exerted on a twenty-four-inch (24") plug by an internal pressure of five pounds per square inch, gauge (5 psig). Sudden expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be very dangerous. For this reason, it is recommended that every plug be positively braced against the manhole walls, and that no one be allowed in the manhole adjoining a line being

tested so long as pressure is maintained in the line. It is further recommended that no internal pressure of more than nine pounds per square inch, gauge (9 psig) be permitted except for leak location equipment where the plugs are firmly tied together.

**38-10.02.C.(2) Relief Valve**

All pressurizing equipment used for low-pressure air testing shall include a regulator or relief valve set no higher than nine pounds per square inch, gauge (9 psig) to avoid over-pressurizing and displacing temporary or permanent plugs. As an added safety precaution, the pressure in the test section should be continuously monitored to make certain that it does not at any time exceed nine pounds per square inch, gauge (9 psig). (Note: It may be necessary to apply higher pressure at the control panel to overcome friction in the air supply hose during pressurization.)

**38-10.02.C.(3) Equipment**

**38-10.02.C.(3)(a) Plug Design**

Either mechanical or pneumatic plugs may be used. The Contractor shall internally restrain or externally brace the plugs to the manhole wall as a safety precaution throughout the test. Prior to any air pressure testing, all pipe plugs shall be checked with a soap solution to detect any air leakage. If any leaks are found, the air pressure shall be released, the leaks eliminated, and the test procedure started over again.

**38-10.02.C.(3)(b) Singular Control Panel**

To facilitate test verification by the Agency, all air used shall pass through a single, above ground control panel.

**38-10.02.C.(3)(c) Equipment Controls**

The above ground air control equipment shall include a shut-off valve, pressure regulating valve, pressure relief valve, input pressure gauge and a continuous monitoring pressure gauge having a pressure range from zero (0) to at least ten (10) pounds per square inch (psi). The continuous monitoring gauge shall be no less than four inches (4") in diameter with minimum divisions of 0.10 psi and an accuracy of  $\pm 0.04$  psi.

**38-10.02.C.(3)(d) Separate Hoses**

Two separate hoses shall be used: (1) to connect the control panel to the sealed line for introducing low-pressure air, and (2) a separate hose connection for constant monitoring of air pressure build-up in the line. This requirement greatly diminishes any chance for over-pressurizing the line.

**38-10.02.C.(3)(e) Pneumatic Plugs**

If pneumatic plugs are utilized, a separate hose shall also be required to inflate the pneumatic plugs from the above ground control panel.

**38-10.02.C.(4) Line Preparation**

**38-10.02.C.(4)(a) Laterals, Stubs and Fittings**

During storm drain construction all laterals, stubs and fittings into the storm drain test section shall be properly capped or plugged so as not to allow for air loss that could cause an erroneous air test result. It may be necessary and is always advisable to restrain gasketed caps, plugs or short pipe lengths with bracing stakes, clamps and tie-rods or wire harnesses over the pipe bells.

**38-10.02.C.(4)(b) Pipe Wetting**

Air may pass through some porous pipe materials. If such materials are used, the pipe walls may be wetted to temporarily reduce the porosity of the material. Non-porous pipe materials need not be wetted.

**38-10.02.C.(5) Test Procedure**

**38-10.02.C.(5)(a) Plug Installation and Testing**

After a manhole-to-manhole reach of pipe has been backfilled to final grade, prepared for testing and the specified waiting period has elapsed, the plugs shall be placed in the line at each manhole and secured.

It is advisable to seal test all plugs before use. Seal testing may be accomplished by laying one length of pipe on the ground and sealing it at both ends with the plugs to be checked. The sealed pipe should be pressurized to nine pounds per square inch, gauge, (9 psig). The plugs shall hold against this pressure without bracing and without any movement of the plugs out of the pipe. No persons shall be allowed in the alignment of the pipe during plug testing.

It is advisable to plug the upstream end of the line first to prevent any upstream water from collecting in the test line. This is particularly important in high groundwater situations.

When plugs are being placed, the pipe adjacent to the manhole shall be visually inspected to detect any evidence of shear in the pipe due to differential settlement between the pipe and the manhole. A probable point of leakage is at the junction of the manhole and the pipe, and this fault may be covered by the pipe plug, and thus not revealed by the air test.

**38-10.02.C.(5)(b) Line Pressurization**

Low pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches four pounds per square inch, gauge, (4 psig) greater than the average back pressure of any groundwater above the pipe, but not greater than nine pounds per square inch, gauge, (9 psig). If groundwater is present, refer to Section 38-10.02.C.(6), "Determination of Ground Water Elevation and Air Pressure Adjustment", in this Section of these Specifications.

**38-10.02.C.(5)(c) Pressure Stabilization**

After a constant pressure of four pounds per square inch, gauge, (4.0 psig) greater than the average groundwater back pressure is reached, the air supply shall be throttled to maintain that internal pressure for at least two (2) minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall.

**38-10.02.C.(5)(d) Timing Pressure Loss**

When temperatures have been equalized and the pressure stabilized at four pounds per square inch, gauge, (4.0 psig) greater than the average groundwater back pressure, the air hose from the control panel to the air supply shall be shut off or disconnected. The continuous monitoring pressure gauge shall then be observed while the pressure is decreased to no less than three and one-half pounds per square inch, gauge (3.5 psig) greater than the average back pressure of any groundwater over the pipe. At a reading of three and one-half pounds per square inch, gauge (3.5 psig), or any convenient observed pressure reading between three and one-half pounds per square inch, gauge (3.5 psig) and four pounds per square inch, gauge, (4.0 psig) greater than the average groundwater back pressure, timing shall commence with a stopwatch or other timing device that is at least ninety-nine and eight-tenths percent (99.8%) accurate.

**38-10.02.C.(5)(e) Determination Of Line Acceptance**

If the time shown in Table 38-3 for the designated pipe size and length elapses before the air pressure drops one pound per square inch, gauge (1 psig); the section undergoing test shall have passed and shall be presumed to be free of defects. The test may be discontinued once the prescribed time has elapsed even though the one pound per square inch, gauge (1 psig) drop has not occurred.

**38-10.02.C.(5)(f) Determination Of Line Failure**

If the pressure drops one pound per square inch, gauge (1 psig) before the appropriate time shown in Table 38-3 has elapsed, the air loss rate is considered excessive and the section of pipe has failed the test.

**38-10.02.C.(5)(g) Line Repair Or Replacement**

If the section fails to meet these requirements, the Contractor shall, at his own expense, determine the source, or sources, of leakage, and repair or replace all defective materials and/or workmanship to the satisfaction of the Agency. The extent and type of repair that may be allowed, as well as results, shall be subject to the approval of the Agency. The completed pipe installation shall then be retested and required to meet the requirements of this test.

**38-10.02.C.(6) Determination Of Groundwater Elevation and Air Pressure Adjustment**

**38-10.02.C.(6)(a) Applicability**

The requirements of this Section shall only apply where groundwater is known to exist or is anticipated above the storm drain to be tested.

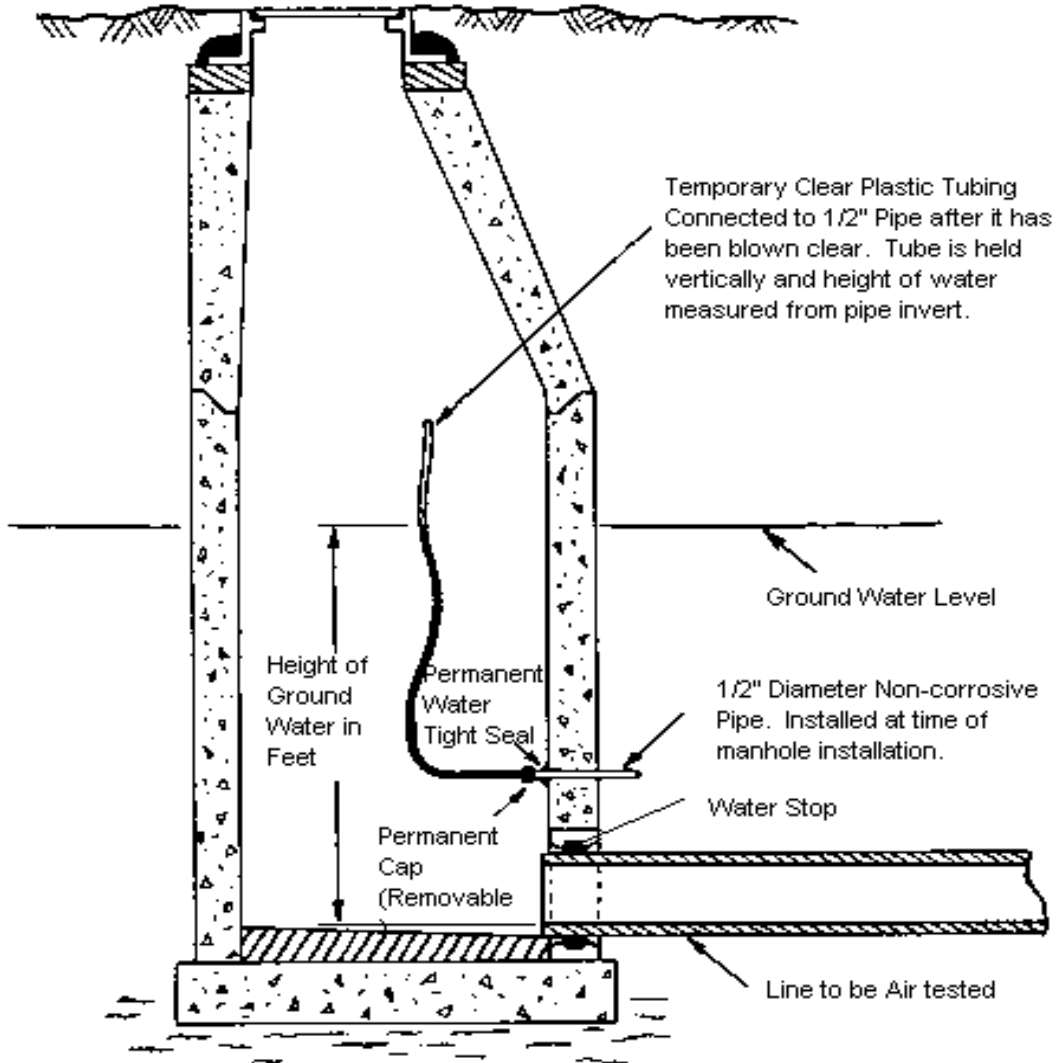
**38-10.02.C.(6)(b) Pipe Nipple Installation**

During manhole installation, a one-half inch (1/2") diameter threaded pipe nipple shall be installed through the manhole wall directly on top of one (1) of the storm drain pipes entering the manhole. The threaded end of the nipple shall extend no more than two inches (2") on the inside of the manhole. The total length of the nipple shall exceed the manhole wall thickness by no less than four inches (4"). The pipe nipple shall be non-corrosive and resistant to chemicals common in domestic sewage. Special attention shall be given to providing a permanent, watertight seal around the pipe nipple at the manhole wall. The pipe nipple shall be sealed with a threaded one-half inch (1/2") cap. Not every manhole need have a pipe nipple. A few key manhole locations should be sufficient to establish a groundwater profile for the test area. The Agency will assist the Contractor in selecting appropriate manholes for pipe nipple installation.

**38-10.02.C.(6)(c) Groundwater Elevation**

Immediately before air testing, the groundwater level shall be determined by removing the threaded cap(s) from the nipple(s) nearest the section to be tested, blowing air through the pipe nipple(s) to remove any obstructions, and then connecting clear plastic tube(s) to the pipe nipple(s). Each plastic tube shall be held vertically to allow groundwater to rise in it. After the water level in the tube has stopped rising, a measurement of the height in feet of water over the invert of the storm drain pipe shall be taken. (See Figure 38A below.) If the section to be tested is not immediately adjacent to an installed pipe nipple, the groundwater height shall be estimated based upon nearby height readings and the pipe's invert elevation.

**FIGURE 38A**  
**MANHOLE CROSS-SECTIONAL VIEW OF THE PROPER METHOD FOR DETERMINING GROUND WATER HEIGHT**



**38-10.02.C.(6)(d) Air Pressure Adjustment**

The air pressure correction, which must be added to the three and one-half pounds per square inch, gauge (3.5 psig) normal test starting pressure, shall be calculated as follows:

$$(Average\ vertical\ height,\ in\ feet,\ of\ groundwater\ above\ the\ invert\ of\ the\ storm\ drain\ pipe\ to\ be\ tested) \div 2.31$$

The result gives the air pressure correction in pounds per square inch to be added. (For example, if the average vertical height of groundwater above the pipe invert is 2.8 feet, the additional air pressure required is 2.8 divided by 2.31, or 1.2 psig. This requires a minimum starting pressure of 3.5 plus 1.2, or 4.7 psig.). The allowable pressure drop of one pound per square inch, gauge (1.0 psig) and the times in Table 38-3 are not affected and shall remain the same.

**38-10.02.C.(6)(e) Maximum Test Pressure**

In no case should the starting test pressure exceed nine pounds per square inch, gauge (9 psig). If the average vertical height of groundwater above the pipe invert is more than twelve and seven tenths feet (12.7'), the section so submerged may be tested using nine pounds per square inch, gauge (9 psig) as the starting test pressure. The nine pounds per square inch, gauge (9 psig) limit is intended to further ensure worker safety and falls within the range of the pressure monitoring gauges normally used.

**38-10.02.C.(6)(f) Re-sealing Of Pipe Nipples**

After the groundwater height has been determined, each pipe nipple shall be recapped and sealed to prevent any future infiltration.

**38-10.02.C.(7) Test Times**

**38-10.02.C.(7)(a) Test Time Criteria**

The test time criteria requires that no test section shall be accepted if it loses more than 0.0015 cubic feet per minute per square foot of internal pipe surface area for any portion containing less than six hundred twenty-five (625) square feet internal pipe surface area. The total leakage from any test section shall not exceed 0.9375 cubic feet per minute.

**38-10.02.C.(7)(b) Test Time Calculation**

All test times shall be calculated using the following equation:

$$T = 0.085(DK/Q)$$

Where:

- T = Shortest time, in seconds, allowed for the air pressure to drop 1.0 psig,
- K = 0.000419 DL, but not less than 1.0,
- Q = 0.0015 cubic feet/minute/ square feet of internal surface,
- D = Nominal pipe diameter in inches, and
- L = Length of pipe being tested in feet.

For more efficient testing of long test sections and/or sections of larger diameter pipes, a timed pressure drop of one-half pound per square inch, gauge (0.5 psig) may be used in lieu of the one pound per square inch, gauge (1.0 psig) timed pressure drop. If a one-half pound per square inch, gauge (0.5 psig) pressure drop is used, the appropriate required test times shall be exactly half as long as those obtained using the equation for T cited above.



**38-10.02.C.(7)(c) Testing Main Storm Drains With Lateral Connectors**

It is often convenient to include connected lateral storm drains when testing storm drain mains having lateral connectors. If lateral storm drains are included in the test, their lengths may generally be ignored for computing required test times. This can be done because in practice, ignoring the branch or lateral storm drains will normally increase the severity of the air test whenever the tested surface area is less than six hundred twenty-five (625) square feet so that the total rate of rejection may only be increased about two percent (2%). If the total tested surface area is greater than six hundred twenty-five (625) square feet, ignoring the lateral storm drains will only slightly decrease the severity of the test.

In the event a test section, having a total internal surface area less than six hundred twenty-five (625) square feet, fails to pass the air test when lateral storm drains have been ignored; the test time shall be recomputed to include all lateral storm drains using the following formula:

$$T = \frac{0.085 [D_1L_1 + D_2L_2 + \dots + D_nL_n](K / Q)}{D_1L_1 + D_2L_2 + \dots + D_nL_n}$$

Where:

T = Shortest time, in seconds, allowed for the air pressure to drop 1.0 psig,

K = 0.000419 (D<sub>1</sub>L<sub>1</sub> + D<sub>2</sub>L<sub>2</sub> + ... + D<sub>n</sub>L<sub>n</sub>), but not less than 1.0,

Q = 0.0015 cu.ft./min./sq.ft. of internal surface,

D<sub>1</sub>, D<sub>2</sub>, etc. = Nominal diameters of the different size pipes being tested, and

L<sub>1</sub>, L<sub>2</sub>, etc. = Respective lengths of the different size pipes being tested.

If the recomputed test time is short enough to allow the section tested to pass, then the section shall be presumed to be free of defects and comply with this Specification.

**38-10.02.C.(7)(d) Specified Time Table**

To facilitate the proper use of this recommended practice for air testing, Table 38-3 is provided, which contains the specified minimum times required for a one pound per square inch, gauge (1 psig) pressure drop from a starting pressure of at least three and one-half pounds per square inch, gauge (3.5 psig) greater than the average back pressure of any groundwater above the pipe's invert. The table also includes easy-to-use formulas for calculating required test times for various pipe sizes and odd lengths. All costs for this work are to be included in the prices paid for the items involved.

**TABLE 38-3  
MINIMUM SPECIFIED TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE INDICATED  
FOR Q = 0.0015**

Pipe Dia. (in.)	Minimum Time (min)	Length For Minimum Time (ft)	Time For Longer- Length (sec)	Specified Time For Length (L) Shown (min: sec)							
				100	150	200	250	300	350	400	450
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

**38-10.02.D Hydrostatic Test for Leakage – Storm Drain**

If, in the opinion of the Inspector, excessive groundwater is encountered in the construction of a section of the storm drain, the exfiltration test for leakage shall not be used.

The end of the storm drain at the upper structure shall be closed sufficiently to prevent the entrance of water, and pumping of groundwater shall be discontinued for at least three (3) Calendar Days, after which the section shall be tested for infiltration.

The infiltration into each individual reach of storm drain between adjoining manholes shall not exceed five hundred (500) gallons per inch of internal diameter per mile per day.

The allowable infiltration for any portion of the storm drain system shall be measured by a weir or current meter placed in the appropriate manhole.

**38-10.02.D.(1) Water Exfiltration Test**

The allowable water exfiltration for any length of the storm drain pipe between manholes shall be measured and shall not exceed five hundred (500) gallons per inch of internal pipe diameter per mile of pipe per day. The maximum testing pressure at any joint shall be five pounds per square inch (5 psi) or eleven and one-half feet (11.5') of head. If it is not possible to test the pipe to five pounds per square inch (5 psi), the system shall be tested to the surface of the lowest manhole or inlet rim in the section tested. In lieu of water exfiltration testing, the Contractor may perform air testing as described below.

The Contractor is responsible for providing all equipment, materials, water and labor for performing infiltration and exfiltration tests and making measurements. Payment for these items will be included in the bid items for pipes and manholes. All tests shall be made in the presence of the Inspector.

**38-10.03 Tests for Deflection**

**38-10.03.A Sewer**

Unless otherwise shown or specified in these Specifications or in the Contract, where PVC, ABS, or HDPE pipe are installed as sewer a deflection test shall be made by the Contractor upon completion and acceptance by the Agency of all backfill operations and prior to the placement of the aggregate base, if any. Deflection testing shall be conducted no sooner than thirty (30) Calendar Days following completion and acceptance of all backfill operations, unless otherwise approved by the Agency.

The deflection testing will be witnessed by the Agency and shall be conducted by the Contractor at the Contractor's expense. One-hundred percent (100%) of all mainline PVC, ABS, or HDPE sewer installed shall be deflection tested for excessive vertical deflection using a pre-sized, rigid mandrel or "Go-No-Go" device approved by the Agency. The mandrel size shall be clearly labeled and shall be sized so as to provide a diameter of at least ninety-seven percent (97%) of the base internal diameter as specified in ASTM Designations: D 3034 or D 2680 for PVC, and ABS or AASHTO Designations: M294 or MP7-97 Type S or Type D for HDPE. The mandrel shall be drawn through the pipe using only the force that can be exerted by one man on the end of a rope, using no mechanical advantage. Under no conditions shall the mandrel device be attached to the cleaning ball.

The Contractor shall remove, replace, and retest any pipe section through which the mandrel is unable to pass. The use of any rerounding device or similar method to correct or reduce over deflection will not be permitted. Re-tests for deflections shall be made at the Contractor's expense.

### **38-10.03.B Storm Drain**

When indicated in the Contract, or when inferior products or construction methods are used or visual inspection by television or lamping indicates a potential for excessive deflection, the following test method shall be used:

Where PVC or HDPE pipe are installed as drain pipe, a deflection test shall be made by the Contractor upon completion and acceptance of all backfill operations and prior to placement of the finished surface, if any. Deflection testing shall be conducted no sooner than thirty (30) Calendar Days following completion and acceptance of all backfill operations, unless otherwise approved by the Agency.

The deflection testing shall be witnessed by the Inspector and shall be conducted by the Contractor at the Contractor's expense. Unless otherwise shown on the Plans or in the Special Provisions, one-hundred percent (100%) of all mainline PVC and HDPE drain pipe installed shall be deflection tested for excessive vertical deflection using a pre-sized, rigid mandrel or "Go-No-Go" device approved by the Agency. The mandrel size shall be clearly labeled and shall be sized so as to provide a diameter of at least 92.5% of the "Base Internal Diameter" per ASTM D 3034 for PVC and ASTM F 894 for HDPE. Base inside diameters for larger diameters of PVC pipe may be found in ASTM F 679.

The Contractor shall remove, replace, and retest any pipe section through which the mandrel is unable to pass. The use of any rerounding device or similar method to correct or reduce over deflection will not be permitted. Re-tests for deflections shall be made at the Contractor's expense.

### **38-10.04 Television Inspection (TVI)**

A closed circuit television inspection (TVI) shall be conducted prior to new sewer or storm drain pipeline acceptance and prior to and after completion of pipeline rehabilitation projects. The TVI shall document and verify:

1. The overall condition of the pipeline,
2. The location of service taps,
3. Line and grade,
4. Cleanliness, and
5. That post-installation inspection per the Contract has taken place.

In addition, TVI documentation shall indicate:

1. Consistent use of standard forms and codes
2. Uniform compliance with setup and inspection procedures
3. Quality pictures and audible records
4. Suitable camera speed, lighting, and panning
5. Accuracy when recording file names and electronic data.

The TVI shall be documented in an electronic report (TVI Report) and digital video recording as specified herein. Contractors shall comply with the County of Sacramento Department of Water Quality Television Inspection Manual Draft 2001, or most current edition (Television Inspection Manual), available at the Water Quality Department Customer Service office at 10545 Armstrong Ave., Suite 101, Mather, CA. 95655, phone (916) 876-6100. The Television Inspection Manual contains the requirements for collection and documentation of TVI data. It is the Contractor's responsibility to verify that electronic documentation is in the latest, most up-to-date format required by the Agency. TVI of new construction shall be performed after all required testing specified in the Contract and/or this Section is satisfactorily completed. The cleaning of sanitary sewers or storm drains shall be performed prior to the TVI in a separate operation, unless otherwise specified. Unless otherwise shown or specified in the Contract, the Contractor shall perform a TVI on all sewers between manholes or manhole to flusher branch/stub or to existing manholes, as necessary, to video a complete segment, all storm drains between manholes or to existing manholes, as necessary, to video a complete segment,

and all storm drain inlet laterals where the radius of the pipe alignment or the length of the pipe precludes the use of the methods in Section 38-10.05, "Lamping of Storm Drain Inlet Laterals".

**38-10.04.A Safety**

Safety and traffic control procedures shall be maintained at all times in accordance with the requirements of Sections 6-11, "General Safety Requirements"; 6-12, "Public Convenience and Safety"; 6-13, "Public Safety and Traffic Control"; and 10-10, "Confined Space Entry", of these Specifications, and any other applicable procedures or requirements.

The TVI shall be conducted from above ground. Prior to opening a manhole cover or a confined space area, a gas monitor shall be used to detect the oxygen level, presence of explosive or flammable gases, vapors, or mist in excess of 10% of the (LEL/LFL), and toxic gases in excess of the permissible exposure levels (Hydrogen Sulfide, Carbon Monoxide.)

Manhole entry, if required, shall be conducted in strict accordance with permit required confined space entry regulations as specified in Section 10-10, "Confined Space Entry", of these Specifications.

**38-10.04.B Sample Video and TVI Report Submittal**

Prior to any TVI, the Contractor shall submit a sample video and TVI Report to the Agency for review in accordance with Section 5-8, "Contractor's Submittals", of these Specifications. The sample video and TVI Report shall represent the quality of video inspection and electronic data to be provided by the Contractor in compliance with the Contract.

**38-10.04.C TVI Equipment Submittal**

TVI equipment shall include video cameras, a color monitor, digital recording equipment, sound and voice recording capabilities, gauging tool, cables, power sources, and all equipment necessary to perform a TVI in accordance with this Section and the Contract. The Contractor shall submit a complete list of equipment and operational information to be used for TVI's-, in accordance with Section 5-8, "Contractor's Submittals", of these Specifications.

**38-10.04.C.(1) Camera**

The camera shall be a pan and tilt camera system with pipe grade verification system (inclinometer), and shall be specifically designed and constructed for sewer and storm drain environments. The camera shall include: a solid state color TV camera with a panning and rotational camera head, remote adjustable optical focus and automatic light compensation iris with remote override, camera controller with remote focus, iris and auto centering control and camera lighting system.

There shall be no geometrical distortion of the image. The camera and monitor shall be able to produce a minimum 460 lines of horizontal resolution and 400 lines of vertical resolution. Focal distance shall be adjustable through a range of one inch (1") to infinity. The camera shall be mounted on skids or a tractor suitably sized for each pipe diameter to be inspected. The camera shall move through the pipeline in a downstream direction whenever possible at a maximum uniform rate of thirty feet per minute (30 fpm). Maximum allowable error for all the TV footage counters shall not exceed 0.5% (6 inches per 100 feet.)

**38-10.04.C.(2) Inclinometer System and Data Output**

The inclinometer shall detect and record variations in pipe grade angle and distance from true horizontal. The inclinometer shall be capable of detecting pipe grade variations of  $\pm 5$  degrees from true horizontal ( $\pm 8.7\%$  grade) with a maximum error of  $\pm 0.1$  degree with readings taken at minimum intervals of two feet. The inclinometer shall include a vertical sensing, single axis, precision sensor mounted internally to the camera and shall be a capacitive or fluid based type or equivalent as determined by the Agency. Inclinometer data shall be capable of being displayed in both numerical and graphical formats that can be printed or exported to an external database. Inclinometers with external electronic modules towed behind the camera will not be

allowed.

The inclinometer data submitted shall allow easy identification of any high and/or low sections throughout a segment, correlated with the proper footage, that vary in distance from the design grade by more than the maximum allowed in Section 38-4.03, "Grade Tolerance – Sewer", of these Specifications.

#### **38-10.04.C.(3) Computer System**

The computer system shall be capable of digitally recording an MPEG file, a JPEG file, use Agency-defined codes, compile data in a standard database format, and print TVI Reports and graphics in accordance with these Specifications and the Contract. The system shall also be capable of recording, storing, and playing video and images of defects and other related significant visual information using Agency-defined codes.

The electronic data shall be in a standard database format and shall use Agency-defined field names, field types and information as referenced in the Television Inspection Manual. The Contractor may submit the TVI report on either a compact disc (CD) or digital video disc (DVD) in MPEG-1 or MPEG-2 format, or as specified by the Agency. The CD/DVD shall be in a format that is readable by the Agency's current computer system. A list of the Agency's current CD/DVD readers is available at the Water Quality Department Customer Service office at 10545 Armstrong Ave., Suite 101, Mather, CA. 95655, phone (916) 876-6100. The CD/DVD shall be of such quality that all videos, graphics, and reports are high-resolution. The disc(s) shall be presented in a hard plastic protective case. The computer system shall be able to produce tabular and graphical inclination data in an intuitive and useful format, as determined by the Agency, for sag identification. All tabular and graphical reports shall be recorded and printed in color to match the Agency's defect severity codes.

#### **38-10.04.C.(4) Lighting**

Illumination sensitivity shall be 3 lux or less. During inspection, lighting intensity shall be adjusted to minimize glare. Lighting and picture quality shall be adjusted to provide a clear, in-focus picture of the entire periphery of the pipeline for all conditions encountered. Lighting shall be adjusted according to the size of the pipe.

#### **38-10.04.D Procedure**

Mainlines shall be televised from upstream manholes to downstream manholes whenever possible, except for flusher branches/stub lines/drain inlets. All lines televised against the flow direction shall be noted "Reverse Set-up" on the TVI Report. The recording shall begin at the street surface. Manhole barrels, drop inlets, and service taps shall be videoed from the center of the manhole (footage counter set at 0.0). The focal point of the camera shall be the point to which all footages are measured.

The Contractor shall verify footage counter accuracy prior to the start of the TVI and calibrate the counter every two weeks during the TVI. The camera set point (footage counter set point) shall be from the center of the manhole to the focal point in the direction of camera travel. The camera shall travel at a maximum speed of thirty feet per minute (30 fpm) with slow downs at joints. The camera shall stop at all service connections, significant observations, and possible defects, and the picture shall be clear and bright enough to allow for clear identification of any defects. The footage counter shall appear on the screen at all times. Agency-defined codes shall be placed at each of the following observation points and the camera shall stop, pan, and tilt at each of the following:

- Inside each service connection (tap)
- Inside each drain lateral connection
- Joint separation
- Offset joints
- Alignment problems and elbows
- Cracked or damaged pipe, including lined or point repaired pipe
- Debris in the line

Identifiable sags or high points in the line  
Root intrusion  
In-flow or infiltration  
Grease  
Corrosion

**38-10.04.D.(1) Scheduling a TVI**

The Contractor shall coordinate with an Agency Inspector to be on site and witness the entire TVI. If an Agency Inspector is not available, the Contractor may perform the TVI without an Agency Inspector and submit two copies of the TVI Report, unless otherwise directed by the Agency, to the Agency for review as specified in Section 38-10.06.

For new construction, the TVI may proceed only after compaction of street subgrade and prior to placement of the AB roadbase. Prior to any TVI, the following items must be completed:

1. All underground facilities, utility piping, conduits, and access structures are installed, backfilled, and trench backfill compacted.
2. Final air test has been completed and accepted.
3. The pipelines have been sufficiently cleaned to allow for a good TVI.

**38-10.04.D.(2) Manhole Numbers**

The Agency has assigned or will assign numbers to each manhole and drain inlet, which will be shown on an overall plan, and the televised segments shall be tied to these assigned numbers. Manhole numbers will not be assigned until the facilities are in the ground. For new construction, the Contractor shall submit one set of drawings, including the plan and profile sheets, reflecting the actual installation to the appropriate office as follows:

Sanitary Sewer manhole numbers can be obtained at the Water Quality Department Customer Service Counter at 10545 Armstrong Ave., Suite 101, Mather, CA 95655, phone (916) 876-6100.

Storm Drain manhole/inlet numbers can be obtained at the Water Resources Drainage Operations and Maintenance Office at 3847 Branch Center Road, Trailer No. 4, Sacramento, CA 95827, phone (916) 875-7159.

Private systems will not be assigned manhole numbers or be reviewed for electronic compliance by the Agency.

**38-10.04.D.(3) Initial Screen Text**

Reference the Television Inspection Manual.

**38-10.04.D.(4) Audio Information**

Reference the Television Inspection Manual.

**38-10.04.D.(5) Running Screen Text**

Reference the Television Inspection Manual.

**38-10.04.D.(6) CD/DVD Labels**

Reference the Television Inspection Manual.

Each CD/DVD shall contain a label with the catalog number as follows:

*“(plan number)-TV (disk number) of (total number of disks)”* (example, for plan number 2-707, first disk of four disks, the catalog number would be “2-707-TV 1 of 4”, etc.)

The plan and manhole numbers will be assigned at the same time and are to be recorded on the same plan sheet.

**38-10.04.E Pre- and Post Rehabilitation TVI**

**38-10.04.E.(1) Pre-Rehabilitation TVI**

A pre-rehabilitation TVI shall document a minimum of 75% of the pipe wall and all “significant observations” to provide a clear record of the pipe condition prior to rehabilitation.

“Significant observations”, includes, but is not limited to: taps, blockages, medium to large cracks, medium to large roots, medium to heavy grease, medium to large offsets, inflow or infiltration, changes of material, and any significant structural decay. The TVI shall be done from center of manhole to center of manhole.

If the camera cannot pass through the entire section of pipeline (blockage, etc.), the Contractor shall reset the equipment at the downstream manhole and attempt to inspect the section of pipe from the opposite direction. If the camera again fails to pass through the blocked section, the video inspection shall be temporarily suspended and the Agency notified. The Contractor shall clear the obstruction as directed by the Agency, and then resume the inspection.

**38-10.04.E.(2) Pre-lining Video**

A TVI shall be performed which documents 100% of the pipe wall and focusing on conditions that may prevent a successful lining of the pipe, including sources of possible inflow and infiltration. Each service connection shall be panned and viewed in detail. Prior to performing a pre-lining TVI, the Contractor shall:

1. Remove all sand, debris, grease and roots from the line,
2. Install and monitor a plug at the upstream location, or construct a bypass to ensure that no upstream flow is present at the time of inspection. Extreme care shall be taken to avoid flooding any upstream property. In case of any overflow, the Contractor shall immediately notify the Agency. The Contractor is financially responsible for all costs incurred due to the overflow, including any fines.

**38-10.04.E.(3) Post Rehabilitation TVI**

A TVI shall be performed to document that if the rehabilitation was performed per the Contract, and all live laterals and service connections have been re-established “The TVI shall show a clear view of a minimum of seventy-five percent (75%) of the pipe wall. The camera shall stop at all significant observations to ensure a clear and complete view of the pipe condition. Each significant observation shall be documented by coded text and voice recording to the video. The observations shall also be noted on the TVI Report for each segment. A video capture picture (JPEG) shall be taken of every significant observation, which shall be described as large, heavy or severe. If there is movement (inflow and/or infiltration) or the camera needs to be moved or panning is required to capture the observation, a video clip shall also be taken. The screen text shall not obscure the critical portions of the video clips or captured images. Each service connection shall be panned and viewed in detail and an inclinometer survey shall be performed. If an obstruction (debris, collapse, etc.) is encountered during the TVI, the Contractor shall remove the obstruction or repair the pipe (at the Contractor’s cost) prior to final TVI.

**38-10.04.E.(4) Pre- and Post Rehabilitation TVI Report and Video**

The Contractor shall provide the Agency with a TVI Report, clearly labeled as “Pre-Rehabilitation TVI ” or “Post Rehabilitation TVI”, as appropriate (each type of report shall be presented on a separate CD/DVD). The report shall be prepared in accordance with the Television Inspection Manual and shall contain, at a minimum:

1. A summary list of all pipeline segments inspected (i.e. manhole to manhole, stub, flusher branch or drain inlet).
2. A title page (header information) for each segment
3. A schematic plot of each segment showing observation codes and footages
4. MPEG video of each segment.
5. JPEG pictures of major defects for each segment.
6. An inclinometer survey of each segment.



7. A list of “significant observations”, using codes from the Television Inspection Manual

The TVI Report shall be indexed and coded (per the Television Inspection Manual) for easy location of each segment, video clip, captured image, and inclinometer survey. Videos and captured images shall be clear and sharp. Voice recordings –shall be clear, complete, and distinct. A vocal description shall be recorded at the beginning of each inspection while the “Initial Screen Text” is displayed. A voice recording shall also be performed during each observation and at the conclusion of each inspection. Poor picture quality, extended periods of inactivity, inappropriate language or idle chatter are not acceptable and will be grounds for rejection by the Agency.

The TVI Report will become the property of the Agency upon completion of the televised inspection. The TVI Report shall be given to the Agency Inspector by the Contractor upon completion of televising and evaluation or as requested by the Inspector.

**38-10.04.F New Construction Sewer and Storm Drain TVI**

A TVI shall be performed to document that the the new system was installed per the Contract. The TVI shall be performed after all testing has been completed to the satisfaction of the Agency, and before placement of AB road base. Prior to the TVI, the pipeline, including all appurtenances, shall be sufficiently cleaned, as directed by the Agency, to allow for complete visual inspection of the pipe.

Prior to performing the TVI, the Contractor shall introduce enough water in the pipe segment(s) to fill all low sections and flow through the downstream manhole. A  $\frac{3}{4}$ ” target shall be used, unless otherwise specified or directed by the Agency. If any section of the pipe segment appears to be dry, additional water shall be introduced as described above. An Agency Inspector shall verify the adequacy of water and target size before any TVI is performed. The TVI shall begin within thirty (30) minutes of introducing water into the pipe segment, unless otherwise directed by the Agency.

**38-10.04.F.(1) New Construction TVI Report and Video**

Upon completion of the TVI, the Contractor shall provide the Agency with a final TVI Report prepared in accordance with the Television Inspection Manual. The report is to include only data from pipe segments meeting all acceptance criteria. The final TVI Report shall be submitted to the Agency within five (5) Working Days of the pipe installation being found to be in compliance with these Specifications and the Contract documents.

The final TVI Report shall include, at a minimum:

1. A title page (header information) for each segment.
2. A schematic plot of each segment showing observation codes and footages.
3. MPEG video of each segment.
4. Inclinometer survey data for each segment.
5. A map of the pipeline which shows manhole numbers
6. A completed TVI Form or written certification (per Section 7-11, “Proof of Compliance with the Contract”, of these Specifications) that the installation meets the acceptance criteria of these Specifications and the Contract documents.
7. Printed records or reports as detailed elsewhere in these Specifications or as directed by Agency.

Poor picture quality, extended periods of inactivity, inappropriate language or idle chatter are not acceptable and will be grounds for rejection by the Agency.

The final TVI Report will become the property of the Agency upon acceptance.

**38-10.04.G Non-Conforming TVI**

If the quality of the TVI Report and/or video recording are not in compliance with these Specifications and the Contract, the pipeline shall be re-inspected (TVI) or the TVI Report revised at the Contractor's expense.

**38-10.05 Lamping of Storm Drain Inlet Laterals**

Each storm drain inlet lateral shall be inspected for obstructions, cracks, grade consistency, joint continuity, alignment, and other defects by lamping. If the radius of the alignment or the length of the lateral precludes the effective use of lamping, a TVI is required conforming to Section 38-10.04, "Television Inspection (TVI)".

Lamping shall be accomplished by using an appropriate bright light source and a mirror. After the manhole lid is removed, the light source shall be directed onto a mirror that is held at the end of the lateral within the manhole or inlet at an angle that allows the Contractor to see the length of the pipe. The mirror may be mounted on a pole to avoid entering the inlet or manhole to carry out this procedure. The light source and mirror shall be rotated to inspect the entire inside circumference of the pipe for its entire length. Defects detectable by lamping include offset joints, poor grade, poor alignment, excessive deflection, obstructions, and other irregularities.

A record of each lateral shall be made by the Contractor. The record shall include the following information:

- Date
- Name
- Company Name
- Inlet Type
- Inlet Location
- Manhole Type
- Manhole Location
- Lateral Diameter
- Lateral Material
- Lateral Length
- Description of defects (pass or fail)
- Corrective action (if needed)
- Follow up inspection results (if corrective action required)

Any defects or obstructions detected by lamping shall be corrected at the Contractor's expense.

**38-10.06 Pipeline and Electronic Data Acceptance Criteria**

Unless otherwise specified in the Contract, all new sewer and storm drain pipelines shall be inspected in accordance with the requirements of Section 38-10.4, "Television Inspection (TVI)". The final TVI Report shall be delivered to the Agency no later than five (5) Working Days after completion of the TVI. The TVI Report will become the property of the Agency upon acceptance. The Agency will review the TVI Report within ten (10) Working Days and will notify the Contractor whether or not the report is acceptable and, if so, whether or not the review revealed a satisfactory installation or deficiencies. The following types of deficiencies shall be corrected by the Contractor at no cost to the Agency:

1. Joint separation equal to or greater than one-half inch (1/2").
2. Offset mainline joints equal to or greater than one-half the pipe wall thickness.
3. Joint deflection of more than seventy-five percent (75%) of manufacturer's recommended maximum.
4. Cracked or damaged pipe, including liner pipe.
5. Debris in the line.

6. Identifiable sags or high points (i.e. out of tolerance grades per Sections 38-4.03 and 38-4.04).
7. Offset service joints (ABS to clay) equal to or greater than one pipe wall thickness of the ABS.
8. Non-compliance with any other requirements of these Specifications or the Contract Documents.

The Contractor will be notified in writing of any deficiencies. The Contractor may request to review the TVI Report and/or video with the Agency. Deficiencies in electronic data shall be corrected and re-submitted to the Agency within ten (10) Working Days, and shall reflect current coding and labeling procedures as referenced in the most current edition of the Television Inspection Manual.

Upon completion of all required corrective actions, the sewer or storm drain shall be cleaned and re-inspected (TVI) in accordance with this Section 38-10.04. This process shall be repeated until an Agency review of the final TVI Report indicates that the pipe installation, cleaning, and electronic data meet all requirements of these Specifications and the Contract.

### **38-11 RESTORATION OF SURFACES**

Restoration of existing paved surfaces shall conform to Section 14, "Restoration of Surfaces", of these Specifications.

### **38-12 MEASUREMENT AND PAYMENT**

The quantity of sewer and storm drain construction of the sizes, grades, and types of pipes listed in the Contract is the slope length designated by the Agency, measured along the centerline of the pipe from manhole to manhole, and includes the straight run of all wyes and tees where used. The length is measured from the inside face of the structures and does not include the inside diameter of manholes and other structures. The prices paid per linear foot for the sizes, grades, and types of pipes listed in the Contract include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in sewer and storm drain construction, complete in place, including furnishing pipe, excavation and backfill, removing obstructions, removing and replacing utilities, bedding, placing and jointing the pipe, testing pipe lines, connecting to existing manholes or pipes, as shown or specified in the Contract, in these Specifications, and as directed by the Agency. Full compensation for wye or tee fittings placed in a main sewer or storm drain in connection with sewer or storm drain services is included in the price paid per linear foot for the main sewer or storm drain pipe and no additional compensation will be paid.

The quantity of sewer or storm drain services of the sizes, grades, and types of pipes listed in the Contract will be measured by the unit constructed in place. The unit prices paid for the sewer or storm drain services of the respective sizes, grades, and types of pipes listed in the Contract include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in furnishing and placing all service pipe from the wye or the fitting in the main sewer or storm drain to the property line, complete in place, including furnishing and placing other necessary bends and stoppers to construct the service, as shown or specified in the Contract, as specified in these Specifications, and directed by the Agency.

The cost of each TVI and inspection shall be all-inclusive and shall be included in the price paid per linear foot of pipe, or as specified in the Contract.