

QUALITY CONTROL TESTING PROCEDURES

PART I: GENERAL

1.1 QUALIFICATION OF LABORATORY

- A. Meet laboratory requirements of ASTM E329 and applicable requirements of ASTM C1077, ASTM D3666, and ASTM D3740.
- B. Meet ISO/TEC Guide 17025 conditions for accreditation by the American Association for Laboratory Accreditation (A2LA) in specific fields of testing required in individual Technical Specification sections.
- C. If laboratory subcontracts are part of the testing services, such work shall be placed with a laboratory complying with the requirements of this Section.
- D. Testing requiring an Approved Independent Testing Laboratory shall be executed by a laboratory technician that is certified in the test being taken. At no time shall an uncertified technician be allowed to sample or test any material except under direct supervision of a qualified and certified technician. NO EXCEPTIONS.
- E. NICET and ACI are recognized certification companies for Laboratory Technicians.

1.2 SELECTION AND PAYMENT

- A. The City shall select, employ, and pay for services of an Independent Testing Laboratory to perform inspection and testing identified in Part III of individual Technical Specification sections.
- B. The Contractor may employ and pay for services of an independent testing laboratory or laboratories to perform inspection and testing identified in Part II of individual Technical Specification sections.
- C. Employment of a testing laboratory by the City shall not relieve the Contractor of its obligation to perform the Work in accordance with requirements of the Contract Documents.
- D. There shall be no separate payment of items under this Section. All testing, material, labor and equipment supplied by either the Approved Independent Testing Laboratory or the Contractor is incidental to the Work.
- E. Owners of private development projects, even in the event they are installing public infrastructure, shall contract with an Independent Testing Laboratory. The Independent Testing Laboratory shall not have any affiliation with the Owners, Contractors, Engineers or Architects on the project.

1.3 LABORATORY REPORTS

- A. Testing laboratory shall provide and distribute copies of laboratory reports to the distribution list the City’s Project Manager provides at the pre-construction conference.

- B. Laboratory shall notify the material supplier, the Contractor and the City's Project Manager of reports that indicate failing test results by no later than close of business on the working day following test completion and review.

14 LIMITS ON TESTING LABORATORY AUTHORITY

- A. Laboratory may not release, revoke, alter, or enlarge requirements of the Contract.
- B. Laboratory may not approve or accept any portion of the Work.
- C. Laboratory may not assume the Contractor duties
- D. Laboratory has no authority to stop the Work.

1.5 CONTRACTOR RESPONSIBILITIES

- A. Provide safe access to the Work and to manufacturer's facilities for the City's Project Manager and for testing laboratory personnel.
- B. Provide testing laboratory with a copy of the Construction Schedule and a copy of each update to Construction Schedule.
- C. Notify the City's Project Manager and testing laboratory a minimum of twenty-four hours (24 Hrs) previous to expected time for operations requiring inspection and testing services. When the Contractor fails to make timely prior notification, do not proceed with the operations requiring inspection and testing services.
- D. Notify Design Consultant twenty-four hours (24 Hrs) in advance when Technical Specification requires presence of Design Consultant for sampling or testing.
- E. Request and monitor testing as required to provide timely results and to avoid delays to the Work. Provide samples to laboratory in sufficient time to allow required test to be performed in accordance with specified test methods before intended use of the Product.
- F. Cooperate with laboratory personnel in collecting samples on site. Provide incidental labor and facilities for safe access to the Work to be tested, to obtain and handle samples at site or at source of Products to be tested, and to facilitate tests and inspections including storage and curing of test samples.
- G. Make arrangements with laboratory through the City's Project Manager. Payment for additional testing such as:
 - 1. Re-testing required for failed tests.
 - 2. Re-testing for nonconforming work.
 - 3. Additional sampling and tests requested beyond specified requirements.
 - 4. Insufficient notification of cancellation of scheduled tests of which are not performed.

1.6 REFERENCES

A2LA – The American Association for Laboratory Accreditation.
ASTM – American Society for Testing and Materials.
TCEQ – Texas Commission on Environmental Quality.
TDSHS – Texas Department of State Health Services.
TxDOT – Texas Department of Transportation
ISO/IES – International Organization for Standards.

PART II: PRODUCTS

- 2.1 The Contractor is to supply all equipment and labor needed to complete any testing.

PART III: EXECUTION

- 3.1 The Contractor shall notify the City's Project Manager a minimum of forty-eight hours (48 Hrs) in advance of any work which shall require testing. The City's Project Manager is there to observe test and verify compliance of specifications only. The City's Project Manager shall not help or assist in any way.

- 3.2 All testing requirements stated in this Section are minimal testing requirements. At the discretion of the City's Project Manager, more testing can be authorized. Additional testing may be requested by the Contractor at no additional cost to the City and with the approval of the City's Project Manager.

3.3 CONDUCTING TESTING

- A. The City's Project Manager shall be onsite for all testing procedures for the duration of the test and observe all procedures and document the adherence to the testing procedures as stated in this Section.
- B. Conform to laboratory sampling and testing methods specified in individual Technical Specification sections to the latest issues of ASTM standards, TxDOT methods, or other recognized test standards as approved by the City's Project Manager.
- C. Requirements of this Section shall also apply to those tests for approval of materials, for mix designs, and for quality control of materials as performed by employed testing laboratories.

3.4 BACKFILL

- A. Class I, II, and III backfill and Select fill lift placement shall not exceed six inches (6 In) to eight inches (8 In) of loose material. Clumps of material larger than six inches (6 In) in any direction shall not be allowed. Dry Density and Moisture content shall be determined by ASTM D698.
1. Frequency – One (1) test per lift per five hundred linear feet (500

- Lf), or fraction thereof if less than five hundred linear feet (500 Lf), of trench or between manholes, whichever is shorter. A minimum of three (3) density tests per lift per day shall be required.
2. Compaction in the ROW – Compaction shall be a minimum of ninety-five percent (95%) of dry density and moisture shall be at optimum plus or minus three percent ($\pm 3\%$).
 3. Compaction outside of the ROW – Compaction shall be a minimum of ninety percent (90%) of dry density and moisture shall be at optimum plus or minus three percent ($\pm 3\%$).
- B. Bank run sand shall be classified using ASTM D2487. Bank run sand lift placement shall not exceed twelve inches (12 In) of loose material.
1. Bank run sand shall have no more than two percent (2%) clay lumps or balls.
 2. Bank run sand shall have less than fifteen percent (15%) material passing through a No. 200 sieve as determined by ASTM D1140.
 3. Material passing No. 40 and have a Plasticity Index less than seven (7) as determined by ASTM D4318.
- C. Cement-Stabilized Sand shall be a minimum of one and one tenth (1.1) sacks of cement per one ton (1 Tn) of sand. Sand shall meet grading requirements for Fine Aggregates of ASTM C33. Cement-stabilized sand lift placement shall not exceed twelve inches (12 In) of loose material.
1. Sampling of cement-stabilized sand shall be either:
 - a. Three (3) samples taken from the truck, one (1) from each one-third (1/3) of the truck, beginning third (3rd), middle third (3rd) and last third (3rd), or;
 - b. One (1) sample shall be taken per one hundred fifty tons (150 Tn) or one (1 pD) production day, whichever is less.
 2. Mold four (4) specimens, per sample taken, in accordance with ASTM D558, Method A.
 3. Compaction shall be a minimum of ninety-five percent (95%) and moisture shall be at optimum plus or minus three percent ($\pm 3\%$), as determined by ASTM D558.
 4. Compressive strength of cement-stabilized sand shall be tested in accordance with ASTM D1163.
 - a. Two (2) specimens shall be tested at forty-eight hours (48 Hrs) plus or minus two hours (± 2 Hrs). Compressive strength shall be average of both specimens and shall be no less than one hundred pounds per square inch (100 psi), with no one (1) specimen compressive strength below seventy pounds per square inch (70 psi).
 - b. Two (2) specimens shall be tested at seven days (7 D) plus or minus four hours (± 4 Hrs). Compressive strength shall be average of both specimens and shall be equal

to or greater than one hundred pounds per square inch (100 psi), with no one (1) specimen compressive strength below one hundred pounds per square inch (100 psi).

3.5 CONCRETE

A. Concrete mix design.

1. Each Type of Concrete shall have one (1) mix design and shall be submitted so that the City's Project Manager can send to the Independent Testing Laboratory for review a minimum of seven days (7 D) before start of concrete placement. Concrete mix designs shall conform with requirements of ASTM C94.
2. Concrete Classification shall conform to TABLE 4.1 CONCRETE CLASSIFICATION MINIMUM SPECIFICATIONS in this Section. Coarse aggregate shall conform with ASTM C33 and as specified in TABLE 4.2 COARSE AGGREGATE GRADATION in this Section.
3. Fine aggregate shall conform with ASTM C33 and as specified in TABLE 4.3 FINE AGGREGATE GRADATION in this Section.
4. Mineral filler shall only be added with the approval of the Director of Community Development and shall not exceed fifteen percent (15%) of the fine aggregate weight and conforms to TABLE 4.4 MINERAL FILLERS in this Section.
5. Admixtures shall conform to the following:
 - a. Water reducers shall conform to ASTM C494, type A.
 - b. Water reducing retarders shall conform to ASTM C494, type D.
 - c. High range water reducers (superplasticizers) shall conform to ASTM C494, Types F and G.
6. Water shall be potable.
7. Air entrainment shall be in accordance with ASTM C260 and shall be four percent (4%) plus or minus one percent ($\pm 1\%$).

B. Form Inspection.

1. Concrete Form inspection – the City's Project Manager shall inspect the forms for uniformity and bracing.
2. All forms shall be cleaned free of all dried concrete, mud or any other deleterious material.
3. Non-petroleum based form oil may be used to coat the forms that will be in contact with concrete.
4. Wood forms shall be properly seasoned, of good quality and free of imperfections that may affect its strength or impair the finished surface of the concrete.

C. Reinforcing Bar Inspection.

1. The City's Project Manager shall inspect all reinforcing bar for conformity to CFTS Section 03200 – Reinforcing Steel.
2. Reinforcing bars shall be placed according to the Drawings, the

- City of Friendswood Standard Details and the City of Friendswood Technical Specifications.
- 3. The minimum size of reinforcing bar shall be #4 [one-half inch (1/2 In)] and the minimum spacing shall be sixteen inches (16 In) on center unless otherwise approved by the City's Project Manager.
 - 4. Reinforcing bars shall be one hundred percent (100%) tied at all ends, and fifty percent (50%) tied for the interior of the mat.
 - 5. Splices shall have a minimum of twenty-four inches (24 In) overlapping.
 - 6. Chairs are to be installed so that rebar is no closer from the top than one-third (1/3) of the depth of concrete being placed.
 - 7. Chairs shall be placed at every other bar and under the lowest rebar for support and placed in a checkerboard pattern.
- D. Placement of Concrete.
- 1. Independent Testing Laboratory shall be on site at all times. The City's Project Manager shall be on site as long as deemed necessary.
 - 2. Placement of concrete shall not be allowed when ambient temperature is below forty degrees Fahrenheit (40° F) or above ninety-five degrees Fahrenheit (95° F) and conform to TABLE 4.5 TEMPERATURE REQUIREMENTS FOR PLACEMENT in this Section.
 - 3. Materials shall not exceed eight percent (8%) moisture at the plant.
 - 4. Travel time from batch time at plant to dispersal shall not exceed ninety minutes (90 Min) and conforming to TABLE 4.6 TRANSPORTING TIME REQUIREMENTS.
 - 5. Time between trucks, end of last truck placement to beginning of next truck placement shall not exceed sixty minutes (60 Min); otherwise a construction joint shall be installed.
 - 6. Verify the mix design for each truck is the mix design being used.
 - 7. Verify tare weight to actual weights.
 - a. Actual weights shall be within plus or minus one percent ($\pm 1\%$) of the tare weight.
 - b. Admixtures shall be within plus or minus one gallon (± 1 Gal) of tare.
 - 8. Water tank on truck shall be full when arriving on site and shall have a readable and accurate measuring gauge attached to the tank.
 - 9. Minimum drum rotations shall be between fifty (50) and seventy (70) before and during transport.
 - 10. Minimum drum rotation shall be between seventy (70) and one hundred (100) arriving at the site and before discharge of concrete.
 - 11. Slump shall be from three inches (3 In) to five inches (5 In) unless

- plasticizers are introduced to concrete and otherwise approved by the City's Project Manager.
12. Concrete temperature shall not drop below fifty degrees Fahrenheit (50° F) or rise above ninety degrees Fahrenheit (90° F). If ice is added to the mixture as part of the water content, then concrete temperature shall be allowed to rise above ninety degrees Fahrenheit (90° F) but no higher than ninety-five (95) degrees F as conforming to TABLE 4.5 TEMPERATURE REQUIREMENTS FOR PLACEMENT and ASTM C1064.
 13. Slump tests shall be taken in conformance with ASTM C143 at every fifty cubic yards (50 Cy) of concrete. When ambient temperature is above ninety degrees Fahrenheit (90° F), then slump tests shall be taken on every thirty cubic yards (30 Cy) of concrete.
 14. Air entrainment above five percent (5%) and below seven percent (7%), as tested in conformance with ASTM C173 or ASTM C231, may be approved for placement at the discretion of the City's Project Manager, and only accepted after the concrete has passed the twenty-eight day (28 D) compressive strength requirements.
 15. Concrete that has air entrainment lower than two percent (2%) or higher than seven percent (7%), as tested in conformance with ASTM C173 or ASTM C231 shall be rejected and shall be remove concrete from site.
 16. One (1) set of four (4) concrete cylinders in conformance with ASTM C31 for compressive strength test shall be made for every one hundred cubic yards (100 Cy) or portion there of placed in the day. Concrete placements less than one hundred cubic yards (100 Cy) in a day shall be tested at the discretion of the City's Project Manager.
 17. Two (2) cylinders shall be tested in conformance of ASTM C39 at the age of seven days (7 D). The average of the two (2) tests shall be a minimum of seventy percent (70%) of designed twenty-eight day (28 D) strength.
 18. Two (2) cylinders shall be tested in conformance of ASTM C39 at the age of twenty-eight days (28 D). The average of the two (2) tests shall equal or exceed the design strength.
 19. No more that two gallons of water per cubic yard (2 Gal/Cy) shall be introduced into the truck at the job site. After addition of any water at the site, the truck drum shall make twenty-five (25) revolutions before placement can commence.
 20. Water added after sampling for testing shall void air entrainment, slump and compressive strength tests that may have been completed before the addition of water. New sample of concrete shall be taken and testing started over again. NO EXCEPTIONS. If after warning the Contractor the condition

continues to happen, and the practice continues, the Contractor shall be charged for failed tests.

21. The City's Project Manager and the Independent Testing Laboratory Technicians have the authority to reject any concrete load not matching the City of Friendswood Technical Specifications.
22. Load tickets shall be marked rejected, state reason, along with date and time and be signed by the City's Project Manager or Independent Testing Laboratory Technician.

3.6 DETENTION POND

- A. Inspect for erosion around inflow/outflow areas and banks.
- B. Area surrounding all drainage ditches, retention and detention ponds shall have turf established at a minimum cover of ninety percent (90%) as required by CFTS Section 02900 – Turf Establishment.
- C. The drainage areas shall have either Galveston County Consolidated Drainage District (GCCDD) or Harris County Flood Control (HCFC) approval before requesting the City's Project Manager for inspection and approval. These inspection may be done simultaneously.

3.7 SANITARY SEWER MANHOLES

- A. Verify that all debris and water is removed from the interior of the manhole being tested and any grout has dried for a minimum of twenty-four hours (24 Hrs).
- B. Insert plugs in influent and effluent pipes. Plugs are to be installed a minimum of six inches (6 In) past the exterior wall of the manhole being tested.
- C. Inflate plugs to manufacturer's recommended air pressure.
- D. Inspect testing head. Verify that a gauge exists on the head and that all openings through the head are open, not sealed, with check ball valves.
- E. Install Vacuum testing head on ring of manhole. Testing head shall have a readable gauge that measures inches of mercury by inches.
- F. Begin evacuation of air from manhole. Turn pump off when the gauge reads ten inches of mercury (10 InHg).
- G. Softly tap gauge to ensure the gauge is not stuck.
- H. Hold vacuum for minimal time as required in TABLE 4.7 VACUUM TESTING TIME TABLE in this Section.
- I. After minimal time is complete, tap gauge twice. If the loss of mercury is one inch (1 In) or less the manhole is considered to have passed.

3.8 SANITARY SEWER FORCE MAINS

- A. Testing for High Density Polyethylene (HDPE) Pipe shall be in accordance with paragraph 3.11 of this Section.
- B. Hydrostatic Testing.
 1. Plug both ends of pipe to be tested.
 2. Provide a gauge with a range from zero pounds per square inch

- (0 psi) to three hundred pounds per square inch (300 psi), graduated in five pounds per square inch (5 psi) increments and is a minimum of three inches (3 In) in diameter. Provide a water tank and a water meter.
3. Fill pipe with water and pressure to either one hundred fifty (150 psi) or one and one-half (1.5) times the design pressure, whichever is greater.
 4. Hold pressure for minimum of four hours (4 Hrs).
 5. If pressure has held for four hours (4 Hrs), the pipe has passed.
 6. If pressure has lost pressure, calculate the maximum allowed loss of water using the following formula.

$$4L = \frac{(S)(D)(P_{0.5})}{133,200}$$

7. Pressure pipe back up to one hundred fifty (150 psi), and record number of gallons required to achieve pressure. If less than or equal to 4L, then pipe is considered to have passed.
- C. Pigging Test
1. Pigging test shall be conducted on force mains longer than two hundred feet (200 Ft).
 2. Pig shall be open-cell polyurethane with no abrasives or coatings.
 3. Pigs shall be capable of passing through reductions of up to sixty-five percent (65%) of nominal cross-section of pipe being tested.
 4. Pigs shall be capable of passing through all standard fittings.
 5. If pig passes through line being tested, the line is clear of obstructions and is considered to have passed.

3.9 SANITARY SEWER GRAVITY LINES

A. Low Pressure Air Test.

1. Low pressure air test shall conform to ASTM C828, ASTM C924 or ASTM F1417.
2. Clean both ends of pipe free of debris and water.
3. Install and inflate testing balls to manufacturer's recommended air pressure.
4. Pressure gravity sanitary sewer line to five pounds per square inch (5 psi) and hold for the minimum time as specified in TABLE 4.9 TIME ALLOWED FOR PRESSURE LOSS FROM 5.0 PSI TO 4.0 PSI in this Section.
5. For lengths longer than the minimum time multiply additional length by factor as specified in CFTS Section 02525 – Table 4.2 TIME ALLOWED FOR PRESSURE LOSS FROM 5.0 PSI TO 4.0 PSI.

6. If test pressure drops below four pounds per square inch (4 psi) before the minimal testing time has been achieved then the test is considered to have failed. The Contractor shall make repairs as necessary and schedule a retest.
- B. TV INSPECTION
1. One week (1 Wk) prior to mandrel test, sewer lines shall be cleaned and a TV inspection completed on each line, from upstream to downstream end.
- C. MANDREL TEST
1. Mandrel testing shall conform to ASTM D3034.
 2. No mandrel test shall be performed until after the gravity sanitary sewer has been installed for a minimum of thirty days (30 D).
 3. Install mandrel pull string from manhole to manhole. Pull string shall not exceed three-eighths inch (3/8 In) thick nylon rope for pulling the mandrel.
 4. Inspect mandrel size using proving ring provided. Proving ring shall fit snug over the mandrel. Verify that the mandrel is the correct size for the pipe being tested.
 5. Once the mandrel is placed in the upstream pipe, slowly pull mandrel to the next manhole. Mandrel shall be pulled in the manhole by one (1) person. Mechanical equipment shall not be allowed to pull the mandrel through the pipe.
 6. When mandrel reaches next manhole, mandrel shall be lifted and shown to the City's Project Manager. Mandrel shall never be pulled straight through a manhole, no exceptions.
 7. If mandrel gets stuck in the pipe being tested, remove the mandrel and correct defects to the pipe and retest.
- D. SMOKE TEST
1. Smoke test shall only be used on existing sanitary sewers that have been repaired or rehabilitated.
 2. Only test from one (1) manhole to one (1) manhole section at a time.
 3. Residents shall be notified no fewer than two days (2 D) and no more than seven days (7 D) before smoke testing is scheduled to take place.
 4. Public Works, Police Department, Fire Department and Notification Contacts shall be notified twenty-four hours (24 Hrs) prior to actual smoke testing.
 5. Isolate section gravity sanitary sewer line to be tested at each manhole.
 6. Introduce smoke into one (1) or both manholes. Operate smoke generator for a minimum of five minutes (5 Min).
 7. Inspect all service line connections at the gravity sanitary sewer main for leaks. Repair and retest all leaks.
 8. Visually inspect each house on the line being tested. Look for smoke coming through the plumbing vent stack on each house.

9. Any house that does not have smoke coming through the plumbing vent stack shall be checked for proper connection to the gravity sanitary sewer line being tested. Method of checking for proper connection shall be to introduce dye into the service line system at a point on landowner's property, and visually watch for dye to exit into downstream manhole. If no dye is seen, repair and retest service connection.

3.10 SUBGRADE

A. Lime Determination and Atterberg Limits

1. Have Independent Testing Laboratory obtain a representative sample of material.
2. Conform to ASTM D4318 to determine Liquid Limit, Plastic Limit and Plasticity Index.
3. Conform to ASTM D698 for Lime Determination. Minimum Lime content shall be no less than six percent (6%).
4. Make Lime Determination for soil to bring soil to a PI of no more than fifteen (15).

B. Lime Solids Test

1. Lime Solids test shall conform to TxDOT Tex-600-J.
2. Take sample from back of distributor truck.
3. Weigh and calculate samples for Dry Solids as specified in TxDOT Tex-600-J.

C. Gradation Test

1. Immediately after the re-mix of the lime-stabilized subgrade and before lime-stabilized subgrade is compacted, conform to TxDOT Tex-101-E, Part III dry method requirements for testing subgrade using sieve analysis.
2. Three (3) random samples shall be taken and tested for every six hundred linear foot (600 Lf) of roadway section or portion thereof for day's production.
3. Locations of the sample areas shall be determined by the City's Project Manager and shall vary from left, center and middle of roadway being tested.
4. Samples shall be a representative sampling of the lime-stabilized subgrade.
5. All three (3) samples must pass sieve analysis. If any one sample fails then the Contractor shall rework the roadway section tested and have it retested at no cost to the City.
6. Immediately after the roadway section has passed the sieve analysis, the Contractor shall commence to compaction of subgrade.

D. Compaction

1. Notify the City's Project Manager a minimum of forty-eight hours (48 Hrs) before testing for compaction.
2. The City's Project Manager shall identify the locations for all

- density testing.
 3. Compaction shall be a minimum of ninety-five (95%) of dry density and moisture shall be at optimum plus or minus three percent ($\pm 3\%$).
 4. There shall be only two (2) tests performed in any one (1) hole at one (1) time to achieve density readings. Moving the Nuclear Density Gauge around more than this shall fail the whole work area being tested.
 5. Three (3) density tests per lane shall be performed on every two hundred linear feet (200 Lf) of roadway.
 6. After one inch (1 In) or more of documented rainfall, subgrade shall be retested and shall conform to 3.9.D.3 and 3.9.D.4.
 7. After one inch (1 In) or more of rain, every five hundred feet (500 Ft) per lane of roadway shall be tested.
 8. Stipulations in 3.9.D.6 and 3.9.D.7 shall be reinstated after each additional one inch (1 In) of rainfall until paving has been placed.
- E. In-place Depth Test
1. Contractor shall notify the City's Project Manager a minimum of forty-eight hours (48 Hrs) prior to the start of testing.
 2. In place depth test for lime-stabilization shall conform to TxDOT Tex-140-E.
 3. Tests shall be taken in hand excavated holes only. NO EXCEPTIONS.
 4. Three (3) samples shall be taken for each one thousand foot (1000 Ft) section of subgrade place per lane.
 5. Depth shall be based on the average of all three (3) samples from the section being tested.
 6. Failing sections shall be remixed and recompact with correct amount of subgrade in place.

3.11 WATER LINES

- A. Bacteriological Test (BAC-T)
1. The Contractor shall notify the City's Project Manager at least forty-eight hours (48 Hrs) in advance of testing. All testing shall conform to TCEQ and TDSHS. NO EXCEPTIONS.
 2. The City's testing collection times shall be at 10:00 a.m. on Tuesdays and Thursdays only. NO EXCEPTIONS.
 3. Water line shall have been thoroughly flushed prior to and at least on the day of the scheduled testing.
 4. The City's Public Works Department personnel shall open the valves and collect the samples.
 5. There shall be one (1) BAC-T taking for every one thousand linear feet (1000 Lf) of pipe installed. Any linear footage, no matter the amount, over one thousand linear feet (1000 Lf) shall require another BAC-T for that portion.
 6. The City's Project Manager shall identify and mark the locations

- of the BAC-T's to be taken.
7. Maximum testing length shall be no more than four thousand linear feet (4000 Lf) at one (1) given testing day.
 8. Optimum chlorine content for testing shall be from **two-tenths parts per million (0.2 ppm) free chlorine or five-tenths parts per million (0.5 ppm) total chlorine** and no more than **three and nine-tenths parts per million (3.9 ppm) free or total chlorine**. Water lines having chlorine **levels greater than three and nine-tenths parts per million (3.9 ppm) free or total chlorine** shall not be tested and shall be flushed until the chlorine is in the acceptable range.
 9. If the water lines have not been isolated for testing purposes, then all tests taken shall come back negative. One (1) positive test on non-isolated lines is a failure of the whole line being tested and BAC-T's for the entire line shall be retaken.
 10. After two (2) failed BAC-T's the Contractor shall re-chlorinate and flush the failing water line.
 11. The Contractor may, upon the approval of the City's Project Manager, take samples and use an alternate lab provided that the following conditions are met:
 - a. Project Manger shall be present at all times during the testing process.
 - b. The alternate lab shall be qualified and recognized under TCEQ and TDSHS rules and regulations.
 - c. Laboratory shall send a representative of their company to pick up samples. The Contractor shall not transport the samples to the laboratory. Chain of custody shall be maintained by the laboratory's personnel.
 - d. Copies of all reports shall be sent immediately from the lab to the City's Project Manager.
- B. Testing for High Density Polyethylene (HDPE) Pipe shall be in accordance with paragraph 3.11 of this Section.
- C. Hydrostatic Test of Water Lines
1. The Contractor shall notify the Project Manger a minimum of forty-eight hours (48 Hrs) before testing.
 2. Hydrostatic Testing shall conform to American Water Works Associations' Manual M-23, latest revision.
 3. The Contractor shall supply all pumps, gauges, meters and other equipment necessary to perform the test procedures. Testing gauge shall measure pressure in five pounds per square inch (5 psi) increments.
 4. One (1) test shall be taken for every one thousand linear feet (1000 Lf) of water line.
 5. Fill the auxiliary tank full of water and using the pressure pump, pressurize the water line to one hundred fifty pounds per square inch (150 psi). [Dedicated Fire Lines shall be pressurized to two

- hundred pounds per square inch (200 psi)].
6. After gauge achieves one hundred pounds per square inch (150 psi), close valves and stop pump.
7. Softly tap the glass of the gauge. Start time of the test.
8. Test time shall be no less than a minimum of four hours (4 Hrs). [Dedicated Fire Lines shall be tested for no less than a minimum of two hours (2 Hrs)].
9. At the end of the test period, softly tap pressure gauge, if needle does not move then the line is considered to have passed.
10. Fill line back up with water and use the following water to calculate minimum allowed loss as calculated using the formula below:
$$L = \frac{4NDP^{1/2}}{7400}$$
11. If amount of gallons lost is less than that calculated, then the test is considered to have passed.

3.12 Hydrostatic Testing of High Density Polyethylene (HDPE) Pipe in Pressurized Systems.

A. Restraint.

1. All valves, tees elbows and dresser couplings shall be restrained with stainless steel all thread.
2. Test gauge shall be installed at the lowest point in the test section.

B. Pipe filling:

1. Quantity of liquid needed to fill the internal volume of the pipe test section shall be estimated using the following formula:

$$V_{GAL} = 0.04 \times ID_{IN}^2 \times L_{FT}$$

where:

- a. V_{GAL} = pipe section volume in U.S. gallons
- b. ID_{IN} = pipe inside diameter in inches
- c. L_{FT} = test section length in feet
2. An appropriate excess quantity of liquid, up to forty percent (40%), may be needed to account for pipe expansion and possibility of leakage.
3. Fill test section of pipe slowly, allowing all air to be purged from the pipe.
4. Allow the test section and the test liquid to equalize in temperature.

C. Initial Expansion Phase.

1. Expansion Phase can take up to, but shall be no longer than, four hours (4 H).
2. Slowly pressurize the test section to test pressure, one hundred-fifty pounds per square inch (150 PSI), and maintain for three hours (3 H). During the initial expansion phase the polyethylene pipe will expand slightly. Additional test liquid will be required to

01080-14

- maintain test pressure.
- D. Testing Phase
 - 1. Immediately following the initial expansion phase, monitor the amount of liquid required to maintain test pressure (150 psi) for one hour (1 H).
 - 2. If the amount of liquid does not exceed the amount listed in TABLE 4.10 MAKE-UP WATER ALLOWANCE, then no leakage is detected and the test section a passing test is indicated.
 - 3. Should the test fail and retesting become necessary, depressurize test section in accordance with paragraph 3.11.E.
 - a. Do not attempt to correct faults or leaks until after test section is completely depressurized.
 - b. A minimum relaxation period of eight hours (8 H) shall be observed before re-pressurization. After relaxation period, retest starting with the initial expansion phase.
 - E. Post Test Procedures.
 - 1. At the conclusion of the test, test section shall be depressurized by a controlled release of the test fluid. The potential of a pressure surge is avoided by a controlled release.

PART IV: TABLES

4.1 CONCRETE CLASSIFICATION MINIMUM SPECIFICATIONS

CONCRETE CLASSIFICATION MINIMUM SPECIFICATIONS					
Class of Concrete	Sacks of Cement per Cubic Yard Minimum	Minimum Compressive Strength at 28 Days	Maximum Cement to Water Ratio	Coarse Aggregate Grade Number	Slump
A	5.0	3000	6.25	2 – 3	3 – 5*
B	6.0	3600	6.00	1,2,3,4,5	4
C	4.0	2000	8.00	2,3,4,5,6,7	5
D	6.0	3000	6.00	2,3,4,5	5
E	6.0	As specified	5.50	3,4,5,6	5
F	8.75	5500	3.6	6	5

***When ASTM C494, Type F or Type G admixture is used to increase workability, this range may be 6 to 9.**

4.2 COARSE AGGREGATE GRADATION

COARSE AGGREGATE GRADATION CHART										
Aggregate Grade No.	Nominal Size Inches	Percent Retained on Each Sieve								
		2-1/2 In.	2 In.	1-1/2 In.	1 In.	3/4 In.	1/2 In.	3/8 In.	No. 4	No. 8
1	2	0	0-20	15-50		60-80			95-100	
2 (467)*	1-1/2		0	0-5		30-65		70-90	95-100	
3	1-1/2		0	0-5		10-40	40-75		95-100	
4 (57)*	1			0	0-5		40-75		90-100	95-100
5 (67)*	3/4				0	0-10		45-80	90-100	95-100
6 (7)*	1/2					0	0-10	30-60	85-100	95-100
7	3/8						0	5-30	75-100	
8	3/8						0	0-5	35-80	90-100

*** Numbers in parenthesis indicate that the gradations conform to Corresponding ASTM gradation in ASTM C33.**

4.3 FINE AGGREGATE GRADATION

FINE AGGREGATE GRADATION CHART								
Aggregate Grade No.	Percent Retained on Each Sieve							
	3/8 In.	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
1	0	0-5	0-20	15-50	35-75	65-90	90-100	97-100

4.4 MINERAL FILLERS

MINERAL FILLER GRADATION CHART		
Percent Retained on Each Sieve		
No. 20	No. 30	No. 100
0 %	0 to 5 %	0 to 30 %

4.5 TEMPERATURE REQUIREMENTS FOR PLACEMENT

PLACEMENT TEMPERATURE REQUIREMENTS	
AMBIENT TEMPERATURE¹	
Minimum temperature to start placing concrete	35° and rising
Minimum temperature to stop placing concrete	40° and falling
Maximum temperature for placing concrete without ice	90°
Maximum temperature for placing concrete with ice	100°
CONCRETE TEMPERATURE	
Minimum concrete temperature	50°
Maximum concrete temperature without ice	90°
Maximum concrete temperature with ice	95°
MINIMUM CURING TIMES WHEN PLACED CONCRETE HAS BEEN EXPOSED TO FREEZING TEMPERATURES	
From 50° to 70°, minimum days	5
70° and above, minimum days	3
¹ Ambient temperature is to be taken as specified in paragraph 3.3.F.1 of this section.	

4.6 TRANSPORTING TIME REQUIREMENTS

TRANSPORTING TIME REQUIREMENTS FOR PLACEMENT		
Ambient Temperature	Maximum Time (No Retarding Agent) in Minutes	Maximum Time (With Retarding Agent) in Minutes ¹
Non-Agitated Concrete		
Above 80° F	15	30
80° F and Below	30	45
Agitated Concrete		
Above 90° F	45	75
75° F to 90° F	60	90
75° F and Below	90	120
NOTE: Time interval shall be from the addition of cement to the batch to start of placement of concrete in the forms. ¹ Normal Dosage of retarder.		

4.7 TIME ALLOWED FOR PRESSURE LOSS FROM 5.0 PSI TO 4.0 PSI

Pipe Dia. In.	Min. Time mm:ss	Length for Min. Time	Time for Longer Length	Specification Time for Length (L) shown in MM:SS				
				100'	150'	200'	250'	300'
6	5:40	398	0.8548	5:40	5:40	5:40	5:40	5:40
8	7:33	298	1.5196	7:33	7:33	7:33	7:33	7:36
10	9:27	239	2.3743	9:27	9:27	9:27	9:54	11:52
12	11:20	199	3.4190	11:20	11:20	11:20	14:15	17:06
15	14:10	159	5.3423	14:10	14:10	17:48	22:16	26:43
18	17:00	133	7.6928	17:00	19:14	25:39	32:03	38:28
21	19:50	114	10.4708	19:50	26:11	34:54	43:38	52:21
24	22:40	99	13.6762	22:48	34:11	45:35	56:59	68:23
27	25:30	88	17.3089	28:51	43:16	57:42	72:07	86:33
30	28:20	80	21.3690	35:37	53:25	71:14	89:02	106:51
33	31:10	72	25.8565	43:06	64:38	86:11	107:44	129:17

Pipe Dia. In.	Min. Time mm:ss	Length for Min. Time	Time for Longer Length	Specification Time for Length (L) shown in MM:SS					
				350'	400'	450'	500'	550'	600'
6	5:40	398	0.8548	5:40	5:42	6:25	7:07	7:50	8:33
8	7:33	298	1.5196	8:52	10:08	11:24	12:08	13:56	15:12
10	9:27	239	2.3743	13:51	15:50	17:48	19:47	21:46	23:45
12	11:20	199	3.4190	19:57	22:48	25:39	28:30	31:20	34:11
15	14:10	159	5.3423	31:10	35:37	40:04	44:31	48:58	53:25
18	17:00	133	7.6928	44:52	51:17	57:42	64:06	70:31	76:56
21	19:50	114	10.4708	61:05	69:48	78:32	87:15	95:59	104:42
24	22:40	99	13.6762	79:47	91:10	102:34	113:58	125:22	136:46
27	25:30	88	17.3089	100:58	115:24	129:49	144:14	158:40	173:05
30	28:20	80	21.3690	124:39	142:28	160:16	178:05	195:53	213:41
33	31:10	72	25.8565	150:50	172:23	193:55	215:28	237:01	258:34

4.8 – VACUUM TESTING TIME TABLE

TIME ALLOWED FOR VACUUM LOSS FROM 10.0 Hg TO 9.0 Hg			
	TIME IN SECONDS BY DIAMETER OF MANHOLES		
Manhole Depth in Feet	48” Diameter	60” Diameter	72” Diameter
8’ and less	14	18	23
10	17	23	28
12	21	28	34
14	25	32	40
16	28	37	45
18	23	41	51
20	35	46	57
22	39	51	62
24	42	55	68
26	46	60	74
28	49	64	80
30	53	69	85

4.9 MINIMUM TESTING TIMES FOR LOW PRESSURE AIR TEST

Pipe Diameter (Inches)	Minimum Time (seconds)	Length of Pipe for Minimum Time (feet)	Time for Longer Length (seconds)
6	340	398	0.855 (L)
8	454	298	1.520 (L)
10	567	239	2.374 (L)
12	680	199	3.419 (L)
15	850	159	5.342 (L)
18	1020	133	7.693 (L)
21	1190	114	10.471 (L)
24	1360	99	13.676 (L)
27	1530	88	17.309 (L)
30	1700	80	21.369 (L)
33	1870	72	258.856 (L)

4.10 MAKE-UP WATER ALLOWANCE

Nominal Pipe Size (Inches)	Allowable Gallons per 100 Feet of Pipe	Nominal Pipe Size (Inches)	Allowable Gallons per 100 Feet of Pipe
1-1/4	0.06	12	1.1
1-1/2	0.07	14	1.4
2	0.07	16	1.7
3	0.10	18	2.0
4	0.13	20	2.8
5	0.21	22	3.5
6	0.3	24	4.5
8	0.5	26	5.0
10	0.8	28	5.5

END OF SECTION