SECTION 01400

UNIT PRICE DESCRIPTION

PART I: GENERAL

1.1 MEASUREMENT AND PAYMENT

A. It is the intent of the Contractor that the aggregate amount of the unit prices, times and unit of work actually installed, shall cover all work required by the Contract Documents, in place, complete, and ready for use.

B. Prices in the Contract Documents include all compensation for full completion of all work items in place, including providing all labor, materials, tools, equipment, services, supplies, incidental, and all necessary operations.

C. Work considered incidentals to the various pay items are as follows. No separate payment for this work will be made:

1. Delivery, Storage and Handling.

2. Work to protect items to remain by installation of temporary construction, including posting of warning signs, placement of protective fencing, barriers, barricades and covers, and restoration of damaged items to remain.

3. Work necessary to haul materials from original positions to points of disposition, including excavation of earth materials and utilization in construction or other disposition.

4. Work necessary to provide proper drainage during construction, including maintaining sections, existing ditches, channels, culverts, and sewers and including temporary construction and maintenance of ditches and drainage ways.

5. Clearing and Grubbing the removal and disposal of all above and below ground obstructions within the construction area.

6. Any work required to provide tree protection, maintenance and evaluation. Tree protection applies to all work items in the proposal.

7. All work associated with coordination of adjustment and locations of existing private utilities.

8. All traffic control and devices needed to assure proper traffic control.

D. Method of measurement and basis of payment for unit price work items shall be as stipulated in following paragraphs. "Supplemental materials" are to be used for material installed at locations other than indicated in the Drawings. The installation of supplemental materials shall be approved by the Project Manager.

1.2 UNIT PRICE BID ITEM DECRIPTIONS

{INSERT UNIT PRICE DESCRIPTIONS}

END OF SECTION

SECTION 01420

REFERENCE STANDARDS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

A. General quality assurance as related to Reference Standards and a list of references.

1.2 QUALITY ASSURANCE

A. For products or workmanship specified by association, trade or Federal Standards, comply with requirement of the standard, except when more rigid requirements are specified or are required by applicable code.

B. Conform to reference standard by date of issue current on the date as stated in the General Conditions.

C. Request clarification from the Project manager before proceeding should specified reference standards conflict with the Contract Documents.

1.3 SCHEDULE OF REFERENCES

AASHTO American Society of State Highway and Transportation Officials
444 North Capitol Street NW, Suite 249
Washington, DC 20001-1512
TEL: (202) 624-5800
FAX: (202) 624-5806
WEB: www.transportation.org

ACI American Concrete Institute
38800 Country Club Drive
Farmington Hills, MI 48331-34396
TEL: (248) 848-3700
FAX: (248) 848-3701
WEB: www.concrete.org

AGC Associated General Contractors of America
2300 Wilson Boulevard, Suite 400
Alexandria, VA 22201-5426
TEL: (703) 548-3118
FAX: (703) 548-3119
WEB: www.acg.org

AI Asphalt Institute
2696 Research Park Drive
P. O. Box 14052
Lexington, KY 40511-8480
TEL: (859) 288-4960
FAX: (859) 288-4999
WEB: www.asphaltinstitute.org

AITC American Institute of Timber Construction
7012 S. Revere Parkway, Suite 140
Englewood, CA 80112-6769
TEL: (303) 792-9559
FAX: (303) 792-0669
WEB: www.aitc-glulam.org

AISC American Institute of Steel Construction
One East Wacker Drive, Suite 700
Chicago, IL 60601-1802
TEL: (312) 670-2400
FAX: (312) 670-5403
WEB: www.aisc.org

AISI American Iron and Steel Institute
1140 Connecticut Avenue NW, Suite 705
Washington, DC 20036-4011
TEL: (202) 452-7100
WEB: www.steel.org

ASME American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016-5990
TEL: (973) 882-1170
FAX: (973) 882-1717
WEB: www.asme.org

ANSI American National Standards Institute
1819 L Street NW
Sixth Floor
Washington, DC 20036-3807
TEL: (202) 293-8020
FAX: (202) 293-9287
WEB: www.ansi.org

APA American Plywood Association
7011 S. 19th Street
Tacoma, WA 98466-5333
TEL: (253) 620-7400
FAX: (253) 565-7265
WEB: www.apawood.org

API American Petroleum Institute
1220 L Street, NW
Washington, DC 20005-4070
TEL: (202) 682-8000
WEB: www.api.org

AREMA American Railway Engineering and Maintenance-of-Way Association
10003 Derekwood Lane, Suite 210
Lanham, MD 20706-4875
TEL: (301) 459-3200
FAX: (301) 459-8077
WEB: www.arema.org

ASTM American Society for Testing and Materials
100 Barr Harbor Drive
West Conshoshocken, PA 19428-2959
TEL: (610) 832-9500
WEB: www.astm.org

AWPA American Wood Protection Association
P.O. Box 361784
Birmingham, AL 35236-1784
TEL: (205) 733-4077
FAX: (205) 733-4075
WEB: www.awpa.com

AWS American Welding Society
550 NW LeJeune Road
Miami, FL 33126-5649
TEL: (305) 443-9353
WEB: www.aws.org

AWWA American Water Works Association
6666 W Quincy Avenue
Denver, CO 80235-3098
TEL: (303) 794-7711
FAX: (303) 794-0804
WEB: www.awwa.org

CFTS City of Friendswood Technical Specifications
City Hall – Community Development Department
910 S. Friendswood Drive
Friendswood, TX 77546-4856
TEL: (281) 996-3201
FAX: (281) 996-3260
WEB: www.ci.friendswood.tx.us

CLFMI Chain Link Fence Manufacturers Institute
10015 Old Columbia Road, Suite B-215
Columbia, MD 21046-1865
TEL: (301) 596-2583
FAX: (301) 596-2594
WEB: www.arcat.com

CRSI Concrete Reinforcing Steel Institute
933 North Plum Grove Road
Schaumburg, IL 60173-4758
TEL: (847) 517-1200
FAX: (847) 517-1206
WEB: www.crsi.org

EJMA Expansion Joint Manufacturers Association
25 North Broadway
Tarrytown, NY 10591-3221
FAX: (914) 332-1541
WEB: www.ejma.org

FS Federal Standardization Documents
General Services Administration
Specifications Unit (WFSIS)
7th and D Streets, Southwest
Washington, DC 20406-0001
WEB: www.gsa.gov

ICEA Insulated Cable Engineer Association
P. O. Box 1568
Carrollton, GA 30112-0030
TEL: (770) 830-0369
WEB: www.icea.net

IEEE Institute of Electrical and Electronics Engineers
445 Hoes Lane
Piscataway, NJ 08854-4141
TEL: (732) 981-0060
WEB: www.ieee.org

ISA International Society of Arboriculture
P. O. Box 3129
Champaign, IL 61826-3129
TEL: (217) 355-9411
WEB: www.isa-arbor.com

MIL Military Specifications
General Services Administration
Specifications Unit (WFSIS)
7th and D Streets, Southwest
Washington, DC 20406-0001
WEB: www.gsa.gov

NACE National Association of Corrosion Engineers
1440 South Creek Drive
Houston, TX 77084-4906
TEL: (281) 228-6200
FAX: (281) 228-6300
WEB: www.nace.org

NEMA National Electrical Manufacturers Association
1300 North 17th Street, Suite 1752
Rosslyn, VA 22209-3806
TEL: (703) 841-3200
FAX: (703) 841-5900
WEB: www.nema.org

NFPA National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02169-7471
TEL: (617) 770-3000
FAX: (617) 770-0700
WEB: www.nfpa.org

NICET — National Institute for Certification in Engineering Technologies
1420 King Street
Alexandria, VA 22314-2794
TEL: (888) 476-4238
WEB: www.nicet.org

OSHA — Occupational Safety Health Administration
200 Constitution Avenue, NW
Washington, DC 20210-0001
TEL: (800) 321-6742
WEB: www.osha.gov

PCA — Portland Cement Association
5420 Old Orchard Road
Skokie, IL 60077-1053
TEL: (847) 996-6200
FAX: (847) 996-8389
WEB: www.cement.org

PCI — Prestressed Concrete Institute
209 W. Jackson Boulevard, Suite 500
Chicago, IL 60606-6938
TEL: (312) 786-0300
WEB: www.pci.org

SDI — Steel Deck Institute
P. O. Box 25
Fox River Grove, IL 60021-0025
TEL: (847) 458-4647
FAX: (847) 458-4648
WEB: www.sdi.org

TAC — Texas Administrative Code
Secretary of State
P. O. Box 12887
Austin, TX 78711-2887
TEL: (512) 463-0500
WEB: www.sos.state.tx.us

TCEQ — Texas Commission on Environmental Quality
P. O. Box 13087
Austin, TX 78711-3087
TEL: (512) 239-1000
WEB: www.tceq.state.tx.us

TxDOT Texas Department of Transportation
125 East 11th Street
Austin, TX 78701-2409
TEL: (512) 305-9500
WEB: www.dot.state.tx.us

UL Underwriters Laboratories, Inc.
333 Pfingsten Road
Northbrook, IL 60062-2096
TEL: (847) 272-8800
FAX: (847) 272-8129
WEB: www.ul.com

UNI-BELL UNI-BELL Pipe Association
2711 LBJ Freeway, Suite 1000
Dallas, TX 75234-7354
TEL: (972) 243-3902
FAX: (972) 243-3907
WEB: www.uni-bell.org

PART II: PRODUCTS – NOT USED.

PART III: EXECUTION – NOT USED.

END OF SECTION

SECTION 01430

PROJECT SIGNAGE

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

A. Requirements for furnishing, fabricating and installing non-reflectorized plywood project signs.

B. Requirements for furnishing, fabricating and installing various interior and exterior aluminum and plastic signs.

C. Installation of aluminum reflectorized street signage.

D. Commemorative Plaques.

1.2 PAYMENT AND MEASUREMENT

A. Unit Prices:

1. Payment for Project Signs shall be per each sign, which shall be full compensation for sign blanks, fabrication of the sign, signposts, all mounting hardware, washing, cleaning, repairing, all incidentals needed to furnish, fabricate and erect sign, and removal of the sign.

2. Payment for signage in buildings shall be on an allowance basis.

3. Refer to Section 01270 – Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum):

1. If Contract is Stipulated Price Contract, payment for Work in this Section is included in Total Stipulated Price.

1.3 REFERENCES

A. APA – The Engineered Wood Association.

B. ASTM – American Society for Testing and Materials.

1. ASTM A 153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

2. ASTM A 307 – Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.

3. ASTM B 209 – Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.

4. ASTM B 449 – Standard Specification for Chromates on Aluminum.

5. ASTM B 695 – Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.

6. ASTM D 4956 – Standard Specification for Retroreflective Sheeting for Traffic Control.

C. Canadian Council of Forest Industries (COFI).

D. CFTS – City of Friendswood Technical Specifications.

1. Section 01270 – Measurement and Payment.

2. Section 01330 – Submittal Procedures.

3. Section 02865 – Traffic Signs.

4. Section 03300 – Structural Concrete.

E. TxDOT – Texas Department of Transportation.

1. Compliant Work Zone Traffic Control Devices (CWZTCD), latest edition.

2. Department of Materials Specification DMS-7100 Plywood Sign Blanks.

3. Department of Materials Specification DMS-7110 Aluminum Sign Blanks.

4. Department of Materials Specification DMS-8300 Sigh Face Materials.

5. Standard Specifications for Construction of Highways, Streets and Bridges Item 634 – Plywood signs (Type A).

6. Standard Specifications for Construction of Highways, Streets and Bridges Item 636 – Aluminum Signs (Type A).

7. Texas Manual on Uniform Traffic Control Devices (TMUTCD), Latest Edition.

F. U.S. Product Standards PS – 1.

1.4 SUBMITTALS

A. Conform to requirements of Section 01330 – Submittal Procedures.

B. Submit manufacturers' product data for following items for approval for each type of signage specified in this Section.

C. Submit shop drawings and proofs for Interior and Exterior signage and Commemorative Plaque.

D. Submit manufacturer's certification that all signage meets requirements in this Specification.

PART II: PRODUCTS

2.1 PLYWOOD SIGN BLANKS

A. Plywood signs shall conform to Item 634 of the "Texas Department of Transportation Standard Specifications for Construction of Highways, Streets and Bridges" ("TxDOT") and TxDOT Department of Materials Specification DMS-7100.

B. Plywood blanks shall be five-eighths (5/8) inch thick. Plywood shall be smooth, weather-resistant, of one (1) piece construction and free of scarf or finger joints.

C. Plywood shall bear legible grade markings of APA – The Engineered Wood Association or the Canadian Council of Forest Industries (COFI) and shall meet the following requirements:

1. Use plywood that is natural in color or the color approved by the Project Manager.

2. Classification of Species shall be a group one (1) species classification.

3. Exposure Durability Classification shall be for exterior.

4. Use Grade B or better for face and back veneers.

5. Inner plies shall be:

   a. Grade B jointed or

   b. Grade C plugged jointed

6. Inner ply gaps:

   a. Do not exceed three-eighths (3/8) inch for any gaps between adjacent pieces of jointed inner ply and do not exceed three-sixteenths (3/16) inch for average of all gaps in a panel.

   b. Do not exceed four (4) core gaps and edge splits per eight (8) feet of cross-band layer.

7. Use overlay sheets on both sides of the plywood panel of high density material that meets or exceeds the latest revision of U.S. Product Standards PS – 1.

8. Plywood shall maintain a flatness that shall not deviate from a plane surface by more that two (2) inches.

9. Sign blanks shall be of one continuous piece of plywood and shall not be spliced.

10. Plywood blanks shall be used for Temporary or Construction Traffic Signage only.

2.2 ALUMINUM SIGN BLANKS

A. Aluminum sheet or coil sign blanks shall meet all requirements of TxDOT Standards Specification Item 635, TxDOT DMS-7110 Aluminum Sign Blanks and ASTM B 209, Alloys 6061-T-6 or 5052-H38.

B. Sign blanks made from sheet or coil shall be free of buckles, warps, dents, cockles, burrs and other defects an must be a plane surface. Sign blank thickness shall be eight-hundredths (0.08) inch.

C. Treat all sign blanks fabricated from sheet and coil with a chromate chemical process resulting in a coating meeting the requirements of ASTM B 449, Class 2. The coating shall be light colored, tight and free from powdery residues.

D. Manufacturer shall furnish mill test reports for aluminum sheet or coil which reflect the chemical and physical properties of the aluminum.

2.3 SIGN MOUNTING HARDWARE AND ADHESIVES

A. All material for sign posts and mounting hardware shall be galvanized steel and be in compliance with ASTM A307, ASTM A153 and ASTM B695.

B. Sign posts shall be galvanized steel two and three-eighths (2-3/8) inch outside diameter.

C. Sign Post mounting shall be “Pos-Lok” or equal system consisting of sixteen (16) inch sleeve and removable wedge.

D. Pipe and post clamp castings and miscellaneous fasteners shall be verified by manufacturer’s certifications stating that the material meets all applicable requirements.

E. Interior signage shall either use fasteners or bound adhesive to fasten sign to the wall.

F. Exterior signage and plaque shall have studs on back of signage and use either cement or bonding agent.

2.4 FACE MATERIALS

A. All materials are to be certified by lot or shipment that material supplied meets requirements listed in this Specifications. Material shall also comply with ASTM D4956 and TxDOT DMS 8300.

B. Sign face materials shall be processed, applied and stored according to the manufacturer’s recommendations. Sign face materials shall perform for a minimum of ten (10) years.

C. The Project Manager shall reject any sign and/or face material for the following reasons:

1. Cracks discernible with the unaided eye from the driver's position while in an outside lane at a distance of fifty (50) feet or greater from the sign;

2. Peeling in excess of one-quarter (1/4) inch;

3. Shrinkage in excess of one-eighth (1/8) inch total per forty-eight (48) inches of sheeting width

4. Fading or loss of color to the extent that color fails to meet the requirements of ASTM D 4956 or TxDOT DMS 8300;

5. In non-construction zone – loss of reflectivity to a level eighty (80) percent of the minimum values as specified in ASTM D 4956;

6. In construction zone – loss of reflectivity to a level sixty (60) percent of the minimum values as specified in ASTM D 4956; or

7. Consist of pressure activated material of diamond or prismatic vinyl.

D. Any sign face that does not conform to this Section shall be rejected, and the Contractor shall replace it with no additional cost to the City.

2.5 INTERIOR BUIILDING SIGNAGE

A. All interior signs shall be made of intergraded photo-etched plastic, with letters either raised or etched. All interior signage shall be ADA compliant and shall include at the bottom of the sign Grade 2 Braille raised one-thirty-seconds (1/32) inch.

2.6 EXTERIOR BUILDING SIGNAGE

A. Raised lettering and numbers on the exterior of buildings shall be of the type and size shown in the Drawings and approved by the Project Manager.

B. Acceptable sign materials shall be one (1) of the following:

1. Anodized Aluminum, satin finish.

a. Color shall be either clear satin or;

b. Medium Bronze or;

c. Dark Bronze

2. Bronze finish

a. Color shall be either natural satin or;

b. Oxidized Bronze or;

c. Dark Oxidized

3. Plastic or Acrylic

a. Color shall compliment the building finish and to be selected by the City.

2.7 PROJECT SIGN

A. Projects signs shall use materials as stated in paragraphs 2.1 and 2.4. Signs using non-reflective facing shall be in conformance with the City's Sign Ordinance. Sign post shall be painted non-reflective white.

B. Project sign shall have the following information:

1. City of Friendswood Seal

2. Words "City of Friendswood"

3. Project Name

4. Design Professional Name and address

5. Contractor Name, address and phone number

6. Name of Mayor, City Council and City Manager

7. City contact information

C. Proof shall be approved by the Project Manager before sign is made. If the Contractor has the sign made without the approval of the Project Manager, the Contractor shall replace at no additional cost to the City. See Figure 4.1 of this Section for typical project sign.

2.8 COMMEMORATIVE PLAQUE

A. Commemorative plaques shall be made of either brass or bronze. Finish shall be either dark oxidized or light oxidized. Lettering shall have satin finish.

B. Commemorative plaque shall be either eighteen (18) inches wide by twenty-four (24) inches tall, or twenty-four (24) inches wide by eighteen (18) inches tall.

C. Commemorative plaque shall have the following information:

1. City of Friendswood Seal
2. Words “City of Friendswood”
3. Project Name
4. Name of Mayor, City Council and City Manager at the time that the Project was funded and approved for construction.
5. Year the construction was completed.
6. Optional emblem of Sponsor Department.

2.9 TEMPORARY SIGN POSTS

A. Sign posts shall be either:

1. Four (4) inch by four (4) inch Pressure Treated Lumber. Sign posts shall be painted non-reflective white. Timber post shall be used for temporary construction and temporary projects signs only, no exceptions.
2. One and seven-eighths square galvanized metal tubing (SGMT), with seven-sixteenths (7/16) holes punched on one (1) inch centers. SGMT and mounting shall conform to the TxDOT Construction Work Zone Traffic Control Devices (CWTZTD). This sign post shall be used for temporary construction signs only, no exceptions.

B. Posts shall be installed as specified in Paragraph 3.2.A.2.a or other method approved by the Project Manager.

PART III: EXECUTION

3.1 GENERAL

A. Installation of signs shall be in compliance with current City of Friendswood Sign Ordinance.

B. All signs shall be installed at the locations directed by the Project Manager.

3.2 TRAFFIC SIGNS

A. All traffic signs, whether permanent or temporary, and their installation shall be accordance with the latest edition of the "Texas Manual on Construction Traffic Control Devices" (TMUTCD), "Construction Work Zone Traffic Control Devices" (CWZTCD) and Section 02865 – Traffic Signs.

1. Permanent Signs

a. Permanent traffic sign posts mounting device shall be set a minimum of two (2) foot – six (6) inches in depth in a twelve (12) inch diameter hole filled with Class C concrete as specified in Section 03300 – Structural Concrete to within three (3) inches below finished grade.

b. Mounting wedge shall extend two (2) inches above natural grade.

c. Bottom of sign shall be a minimum of seven (7) feet above natural or finished grade or above top of curb/edge of pavement, whichever is higher.

d. Side of sign closest to traffic shall be a minimum of two (2) feet from either back of curb or edge of pavement.

2. Temporary Traffic Sign

a. Temporary construction posts shall be set a minimum of three (3) feet in depth in a twelve (12) inch diameter hole filled with either sand or natural ground which shall be compacted to ninety-five (95) percent density.

b. Bottom of sign shall be a minimum of seven (7) feet above natural or finished grade or above top of

curb/edge of pavement, whichever is higher.

c. Side of sign closest to traffic shall be a minimum of two (2) feet from either back of curb or edge of pavement.

d. Signs shall be maintained, cleaned and repaired as needed during the construction of the project.

e. Signs shall be permitted and installed on the right-of-way where designated by the Project Manager or Traffic Control Plan.

f. The signs shall become the property of the Contractor and shall be removed at the completion of the project.

3.3 PROJECT SIGN

A. project sign posts shall be set a minimum of three (3) feet in depth in a twelve (12) inch diameter hole filled with either sand or natural ground which shall be compacted to ninety-five (95) percent density.

B. Project signs shall be mounted so that the top of the sign does not exceed eight (8) feet above natural ground.

C. There shall be two (2) signs for street, drainage and utility improvements or one (1) sign for public facility projects.

D. Signs shall be maintained, cleaned and repaired as needed during the construction of the project.

E. Signs shall be permitted and installed on the right-of-way or the project site where designated by the Project Manager or Traffic Control Plan.

F. The signs shall become the property of the Contractor and shall be removed at the completion of the project.

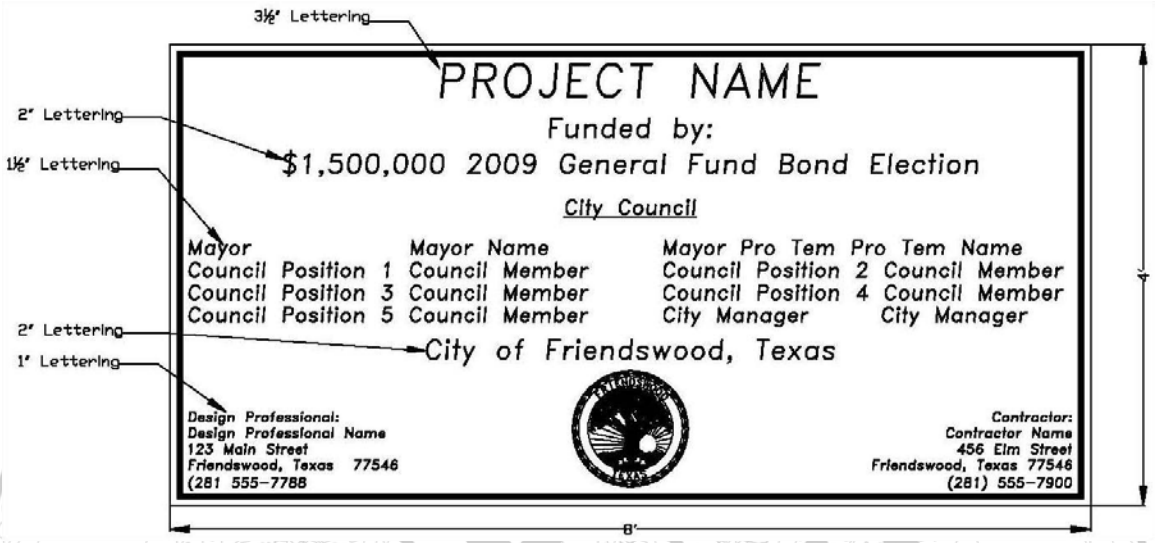
3.4 INTERIOR AND EXTERIOR SIGNS AND COMMEMORATIVE PLAQUE.

A. Interior and exterior signs and Commemorative Plaque shall be installed in conformance with all specifications in this Section.

B. All protective coatings or materials shall remain in place until facility is accepted.

PART IV: FIGURES

4.1 TYPICAL PROJECT SIGN



END OF SECTION

SECTION 01450

CONTRACTOR'S QUALITY CONTROL

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

A. Quality assurance and control of Installation and manufacturers' field services and reports.

1.2 QUALITY ASSURANCE AND CONTROL OF INSTALLATION

A. Monitor quality control over Suppliers, Manufacturers, Products, services, site conditions and workmanship, to produce work of specified quality at no additional cost to the City.

B. Comply fully with manufacturers' Installation instructions, including each step in sequence.

C. Request clarification from the Project Manager before proceeding when manufacturers' instructions conflict with the Contract Documents.

D. Comply with specified standards as minimum requirements for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform the Work by persons qualified to produce a specified level of workmanship.

1.3 REFERENCES

A. Obtain copies of standards and maintain at job site when required by individual Technical Specification sections.

1.4 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. When specified in individual Technical Specification sections, or as required by the Project Manager, provide Product suppliers' or manufacturers' technical representative to observe site conditions, conditions of surfaces and Installation, quality of workmanship, start-up of equipment, operator training, testing, adjusting and balancing of equipment as applicable and to initiate required operation. Conform to minimum time requirements for start-up operations and operator training when provided in Technical Specification sections.

B. At the Project Manager's request, submit qualifications of manufacturers' representative to the Project Manager fifteen days (15 D) in advance of required representatives' services. Representative is subject to approval by the Project Manager.

C. Manufacturer's representatives shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to a manufacturer's written instructions. Submit report within fourteen days (14 D) of observation to the Project Manager for review.

PART II: PRODUCTS – NOT USED.

PART III: EXECUTION – NOT USED.

END OF SECTION

SECTION 01455

INSPECTION SERVICES

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

A. Inspection services and references.

1.2 INSPECTION

A. The Director of Community Development shall appoint a Project Manager to represent the City and perform inspections, tests, and other services specified in individual Technical Specification sections.

B. The Director of Community Development may also appoint, employ, and pay an independent firm to provide additional inspection or construction management services as indicated in Section 01470 – Testing Laboratory Services.

C. The independent firm will submit reports to the Project Manager, indicating observations and results of tests and indicating compliance or noncompliance with the Contract requirements.

D. The Contractor shall assist and cooperate with the Project Manger; furnish samples of materials, design mix, equipment, tools, and storage.

E. Contractor shall notify the Project Manager a minimum of twenty-four hours (24 Hrs) prior to expected time for operations requiring services.

F. Contractor shall sign and acknowledge reports for the Project Manager.

PART II: PRODUCTS – NOT USED.

PART III: EXECUTION – NOT USED.

END OF SECTION

SECTION 01460

OBSERVATION OF CONSTRUCTION

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

A. This section outlines the duties, responsibilities and limitations of authority of the project representative in connection with his observation of the work.

1.2 AUTHORITY

A. The City's Design Professional – Services of the project representative, in assisting the City's Design Professional, are set forth in Section 00500 – General Conditions. In particular, the definition of the City's Design Professional's duties provides authority for observation of the work.

B. Special Testing – The Project Representative's authority to require special observation or testing in connection with rejected work is also provided in Section 00500 – General Conditions. Furthermore, the provision that, upon request by the Contractor, the Project Representative observe and accept or reject any material furnished is also granted in the Section 00500 – General Conditions.

C. Removing Work – The provision for removing work for observation by the Project Representative is granted in the Section 00500 – General Conditions.

PART II: DEFINITIONS

2.1 PROJECT REPRESENTATIVE

A. The Project Manager shall be the project representative of the City. If an independent individual so named is the City's Design Professional, the City's Design Professional's project representative will be assigned such authority, but shall not override the authority of the City's Project Manager.

2.2 NORMAL WORKING DAYS

A. Normal working days for project representatives are defined as Monday through Friday, exclusive of holidays and between the hours of seven

(7) A.M. to eight (8) P.M. If the Contractor plans work on a Saturday, Sunday or legal holiday, work arrangements shall be made for a project representative a minimum of forty-eight hours (48 Hrs) before the last normal working day before the Saturday, Sunday, or legal holiday.

B. Non-normal work shall be subject to the specifications listed in Section 01140 – Work Restrictions, Paragraph 1.13.

2.3 UNINSPECTED WORK

A. The Project Manager shall request that the Contractor remove or replace any work completed that was not observed by the project representative or the Project Manager. Removal or replacement will be completed at no additional cost to the City.

PART III: PROJECT REPRESENTATIVE

3.1 TRANSLATION

A. Assist the Contractor's superintendent in understanding the intent of the Technical Specifications and the Construction Plans.

3.2 SPOT CHECKS

A. Conduct on-site observations and spot checks of the work in progress as a basis for determining conformance of work, materials, and equipment with the Technical Specifications and the Construction Drawings.

3.3 CONSIDERATION

A. Consider and evaluate suggestions or recommendations which may be submitted by the Contractor to the Project Manager and report them with recommendations to the Project Manager for final decision.

3.4 SCHEDULING

A. Be alert to the construction schedule and to conditions which may cause delay in completion, and report same to the Project Manager.

3.5 LIAISON

A. Maintain liaison with the Contractor and all subcontractors on the project only through the Contractor's superintendent.

3.6 PARTICIPATION

A. Attend conferences held at the project site as directed by the Project Manager. Report to the Project Manager the results of such meetings.

3.7 ADVISING

A. Advise the Project Manager in advance of the schedules of tests and observe that tests at the project site, which are required, by the Technical Specifications and Construction Drawings are actually conducted. Observe, record and report to the Project Manager all details relative to the test procedures.

3.8 ACCOMPANYING OTHERS

A. Accompany anyone representing local, state or federal agencies having jurisdiction, on site visits of the project. Record and report to the Project Manager the results of these site visits.

3.9 RECEIVING

A. Receive samples which are required to be furnished at the site; record date received and from whom, and notify the Project Manager of their readiness for examination; record the Project Manager's approval or rejection; and maintain custody of approved samples.

3.10 REVIEWING

A. Review applications for payment submitted by the Contractor and forward them with recommendations regarding payment and progress to the Project Manager.

3.11 CHECKING

A. After substantial completion, check each incomplete or defective item as it is corrected.

3.12 REPORTING

A. If a situation arises during construction, which requires that work be rejected, report such situation immediately to the Project Manager.

3.13 LIMITATIONS

A. The project representative shall not:

1. Authorize deviations from the Contract Documents;

2. Personally conduct any test;

3. Enter into the area of responsibility of the Contractor's superintendent;

4. Expedite the work for the Contractor;

5. Advise on, or issue directions relative to any aspect of construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the work;

6. Authorize or suggest that the City occupy the project, in whole or in part, prior to substantial completion;

7. Issue a recommendation for payment;

8. Exceed limitations of the City's Design Professional's authority as set forth in the Contract Documents; or

9. Accept Shop Drawings or Samples from anyone other than the Contractor.

END OF SECTION

SECTION 01470

TESTING LABORATORY SERVICES

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

A. Testing laboratory services and the Contractor responsibilities related to those services.

1.2 REFERENCES

A. A2LA – The American Association for Laboratory Accreditation.

B. ASTM – American Society for Testing and Materials.

1. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

2. ASTM D3666 - Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials.

3. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

4. ASTM E329 - Standard Specification for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

C. CFTS – City of Friendswood Technical Specifications

1. Section 00020 – List of Pre-qualified Testing Laboratories.

2. Section 00500 – General Conditions.

3. Section 01475 – Quality Control Testing Procedures.

D. ISO/TES – International Organization for Standards.

1. ISO/TEC Guide 25 - General Requirements for the

Competence of Calibration and Testing Laboratories.

E. TxDOT – Texas Department of Transportation.

1.3 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. The City shall deduct a minimum two hour (2 Hr) charge for testing laboratory time from periodic progress payment when operations requiring testing or inspection are canceled without prior notification.

E. The City shall deduct cost of any necessary retesting, whenever failed work is removed and replaced, from periodic progress payment.

1.4 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 on all projects with public utilities shall be from one (1) or more testing laboratories listed in Section 00020 – List of Pre-Qualified Testing Laboratories.

1.5 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. Keep one (1) copy of each laboratory report distributed or faxed at the site field office for duration of the Work. Laboratory shall fax material supplier, the Contractor and the City's Project Manager reports that indicate failing test results by no later than close of business on the working day following test completion and review.

1.6 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.

1.7 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 shall be made in accordance with Section 00500 – General Conditions:

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.

PART II: PRODUCTS – NOT USED.

PART III: EXECUTION

3.1 CONDUCTING TESTING

A. 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.

B. 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.

C. All testing requirements and quantities shall conform to Section 01475 – Quality Control Testing Procedures unless otherwise approved by the Project Manager.

END OF SECTION

SECTION 01475

QUALITY CONTROL TESTING PROCEDURES

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

A. Provide procedures and quantities for testing of materials, backfill, concrete and other items used.

B. Provide procedures and quantities for testing of water lines, sanitary sewer lines and manholes.

C. Only Independent Testing Laboratories conforming to Section 00020 – List of Pre-Qualified Testing Laboratories shall be used. NO EXCEPTIONS.

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.

F. Requirements in this Section are made for quick reference purposes only on the most common testing incorporated in the Work. Refer to individual work Sections for full details on testing materials, procedures, quantities and frequencies.

1.2 MEASUREMENT AND PAYMENT

A. 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.

B. Contracting with an Independent Testing Laboratory.

1. The City shall contract with an Independent Testing Laboratory for projects funded by public funds. Any retest of failed tests or materials shall be at the Contractor's expense and deducted

from the next progress payment unless Contractor has made financial arrangements with the Independent Testing Laboratory.

2. 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 and shall be qualified as per Section 01470 – Testing Laboratory Services.

1.3 OBSERVATION

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. The City's Project Manager shall be copied on all testing reports issued by the Independent Testing Laboratory.

1.4 REFERENCES

ASTM – American Society for Testing and Materials.

CFSD – City of Friendswood Standard Details.

CFTS – City of Friendswood Technical Specifications.

TCEQ – Texas Commission on Environmental Quality.

TDSHS – Texas Department of State Health Services.

TxDOT – Texas Department of Transportation

A. BACKFILL TESTING

1. ASTM C33 – Standard Specification for Concrete Aggregates (Fine Aggregate).

2. ASTM D558 – Standard Test Methods for Moisture-Density Relations of Soil Cement Mixtures.

3. ASTM D698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft).

4. ASTM D1140 – Standard Test Method for Amount of Material in Sols Finer than No. 200 Sieve.

   ASTM D1163 – Standard Test Method for Compressive Strength of Molded Soil-Cement Cylinders.

5. ASTM D2216 – Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures.

6. ASTM D2487 – Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

7. ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

8. CFTS Section 02110 – Borrow.

9. CFTS Section 02120 – Excavation and Backfill for Structures.

10. CFTS Section 02125 – Excavation and Backfill for Utilities.

11. CFTS Section 02140 – Utility Backfill Materials.

B. CONCRETE TESTING

1. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field.

2. ASTM C33 – Standard Specification for Concrete Aggregates.

3. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

4. ASTM C94 – Standard Specification for Ready-Mixed Concrete.

5. ASTM C143 – Standard Test Method for Slump of Hydraulic Cement Concrete.

6. ASTM C172 – Standard Practice for Sampling Freshly Mixed Concrete.

7. ASTM C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method.

8. ASTM C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

9. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.

10. ASTM C498 – Standard Specification for Chemical Admixtures for Concrete.

11. ASTM C1064 – Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.

12. CFTS Section 03200 – Reinforcing Steel.

13. CFTS Section 03300 – Structural Concrete.

C. DETENTION POND

1. CFTS Section 02900 – Turf Establishment.

2. HCFC- Harris County Flood Control.

3. GCCDD – Galveston County Consolidated Drainage District.

D. SANITARY SEWER MANHOLES

1. CFTS Section 02525 – Acceptance Testing for Gravity Sanitary Sewer Lines.

E. SANITARY SEWER FORCE MAINS

1. ASTM F2164 – Standard Practice for Field Leak Testing of Polytethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure.

2. CFTS Section 02450 – Hydrostatic Testing of Waterlines.

3. CFTS Section 02510 – Sanitary Sewer Force Mains.

F. SANITARY SEWER GRAVITY LINES

1. ASTM C924 – Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.

2. ASTM D3034 – Standard Specification for Type PSM (Polyethylene (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

3. ASTM F1417 – Standard Test Method for Installation Acceptance of Plastic Gravity Sanitary Sewer Lines Using Low Pressure Air.

4. CFTS Section 02525 – Acceptance Testing for Gravity Sanitary Sewer Lines.

G. SUBGRADE

1. ASTM D698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.

2. ASTM D4318 – Standard Test Procedures of Liquid Limit, Plastic Limit and Plasticity Index of Soils.

3. CFTS Section 02700 – Cement-Stabilized Base Course.

4. CFTS Section 02720 – Lime-Stabilized Base Subgrade.

5. TxDOT Tex-101-E – Preparing Soils and Flexible Base Materials for Testing.

6. TxDOT Tex-140-E – Measuring Thickness of Pavement Layer.

7. TxDOT Tex-600-J – Sampling and Testing Lime.

H. WATER LINES

1. ASTM F2164 – Standard Practice for Field Leak Testing of Polytethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure.

2. CFTS Section 02450 – Hydrostatic Testing of Waterlines.

3. CFTS Section 02455 – Disinfection of Waterlines.

PART II: PRODUCTS

2.1 The Contractor is to supply all equipment and labor needed to complete any test listed in this Section. 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.

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. Only the City's Project Manager shall call the Independent Testing Laboratory and schedule their services, no exceptions.

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 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 (± 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 (± 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 (± 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).

3.4 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 (±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 (±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.

3.5 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.

3.6 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.

3.7 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.

3.8 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 lengthy 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 by 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 that two days (2 D) and nor 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.

3.9 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 (±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 that 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 reinstituted 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 recompacted with correct amount of subgrade in place.

3.10 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 one part per million (1.0 ppm) to no more than four and one-half parts per million (4.5 ppm). Water lines having chlorine level above five parts per million (5.0 ppm) 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.

3.11 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 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 TEMPERATURE[1]	
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 HASS 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