# CONTRACT DOCUMENTS
# AND
# TECHNICAL SPECIFICATIONS

**FOR**

## 184 BLUFFTON ROAD

## TOWN OF BLUFFTON

**PREPARED FOR**

**TOWN OF BLUFFTON**

**JANUARY, 2019**

**J – 26436.2000**


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**TESTING AND INSPECTING SERVICES**

# SECTION 01 45 23

# TESTING AND INSPECTING SERVICES

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B. Contractor submittals.

C. Testing agency responsibilities.

D. Testing agency reports.

E. Limits on testing authority.

F. Contractor responsibilities.

G. Schedule of tests.

### 1.2 RELATED SECTIONS

A. Testing and acceptance required by public authorities.

B. Section 01 33 00 – Submittal Procedures: Manufacturer's certificates.

C. Section 01 77 00 – Closeout Procedures: Project record documents.

### 1.3 REFERENCES (LATEST REVISION)

A. ASTM C 802 – Practice for Conducting an Interlaboratory Test Program to Determine the Precision of Test Methods for Construction Materials.

B. ASTM C 1077 – Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

C. ASTM C 1093 – Practice for Accreditation of Testing Agencies for Masonry.

D. ASTM D 3740 – Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

E. ASTM D 4561 – Practice for Quality Control Systems for Organizations Producing and Applying Bituminous Paving Materials.

F. ASTM E 329 – Specification for Agencies Engaged in Construction Inspection and/or Testing.

G. ASTM E 543 – Practice for Agencies Performing Nondestructive Testing.

H. ASTM E 548 – Guide for General Criteria Used for Evaluating Laboratory Competence.

I. ASTM E 699 – Practice for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating of Building Components.

**1.4 SELECTION AND PAYMENT**

A. Owner will employ and pay for services of an independent testing agency or laboratory to perform specified testing. Contractor shall pay for all retesting of failed tests.

A. Employment of testing agency or laboratory in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

**1.5 QUALITY ASSURANCE**

A. Comply with requirements of practices listed in paragraph 1.3.

B. Laboratory: Authorized to operate in State in which project is located.

C. Laboratory Staff: Maintain a full time registered Engineer on staff to review services.

D. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

**1.6 CONTRACTOR SUBMITTALS**

A. Prior to start of Work, submit testing laboratory name, address, and telephone number, and names of full time registered Engineer and responsible officer.

B. Submit copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.

**1.7 TESTING AGENCY RESPONSIBILITIES**

A. Test samples of mixes submitted by Contractor.

B. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.

C. Perform specified sampling and testing of products in accordance with specified standards.

D. Ascertain compliance of materials and mixes with requirements of Contract Documents.

E. Promptly notify Engineer and Contractor of observed irregularities or non–conformance of Work or products.

F. Perform additional tests required by Engineer.

G. Attend preconstruction meetings and progress meetings.

## 1.8 TESTING AGENCY REPORTS

A. After each test, promptly submit two copies of report to Engineer and to Contractor.

B. Include:

1. Date issued.
2. Project title and number.
3. Name of inspector.
4. Date and time of sampling or inspection.
5. Identification of product and specifications section.
6. Location in the Project.
7. Type of inspection or test.
8. Date of test.
9. Results of tests.
10. Conformance with Contract Documents.

C. When requested by Engineer, provide interpretation of test results.

## 1.9 LIMITS ON TESTING AUTHORITY

A. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.

B. Agency or laboratory may not approve or accept any portion of the Work.

C. Agency or laboratory may not assume any duties of Contractor.

D. Agency or laboratory has no authority to stop the Work.

## 1.10 CONTRACTOR RESPONSIBILITIES

A. Deliver to agency or laboratory at designated location, adequate samples of materials proposed to be used requiring testing, along with proposed mix designs.

B. Cooperate with laboratory personnel, and provide access to the Work and to manufacturer's facilities.

C. Provide incidental labor and facilities:

1. To provide access to Work to be tested.
2. To obtain and handle samples at the site or at source of products to be tested.
3. To facilitate tests.
4. To provide storage and curing of test samples.

D. Notify Engineer and laboratory 48 hours prior to expected time for operations requiring testing services.

E. Arrange with laboratory and pay for additional samples and tests required by Contractor beyond specified requirements.

**1.11 SCHEDULE OF TESTS**

| Section | Test | Frequency | Date | Performed By | Notes |
|---|---|---|---|---|---|
| **03 00 00 – Concrete** | | | | | |
| | Mix Designs | 1 per mix design | | | |
| | Compressive Strength | 3 test cylinders for every 50 cubic yards or less of each mix design placed daily | | | |
| | | 1 cylinder broken at 7 days | | | |
| | | 2 cylinders broken at 28 days | | | |
| | Slump | 1 test for each set of cylinders taken | | | |
| **03 30 00 – Cast–in–Place Concrete** | | | | | |
| | Materials | As necessary | | | |
| | Mix Designs | 1 per mix design | | | |
| | Strength | 4 Test Cylinders for each 50 cy or less or each mix design placed daily | | | |
| | Slump | 1 test per each set of cylinders | | | |
| | Air Content | 1 test per each set of cylinders | | | |
| | Temperature | 1 test per each set of cylinders | | | |
| **31 00 00 – Earthwork** | | | | | |
| | Compaction | | | | |
| | Unpaved | 1 test per horizontal layer per 10,000 sf of fill area | | | |
| | Paved | 1 test per horizontal layer per 5,000 sf of subgrade | | | |
| | Building Pad | 1 test per horizontal layer per 1,500 sf of fill area | | | |
| | Curb & gutter | 1 test per 300 lf | | | |
| | Proof Rolling | As necessary | | | |
| **32 11 23 – Aggregate Base Courses** | | | | | |
| | Base Density | 1 test per 5,000 sf | | | |
| **32 11 26 – Asphaltic Base Courses** | | | | | |

| Section | Test | Frequency | Date | Performed By | Notes |
|---|---|---|---|---|---|
| | Asphalt Extraction & Gradation | 1 test per each 250 tons placed | | | |
| | Marshall Stability | 1 test per each 250 tons placed | | | |
| | Core | 1 test for each 250 tons placed | | | |
| | Field Density | 1 test per 5,000 sf | | | |
| **32 11 33 – Cement Treated Base Courses** | | | | | |
| | Compressive Strength | 1 test per 5,000 sf | | | |
| | Base Density | 1 test per 5,000 sf | | | |
| **32 12 16 – Asphalt Paving** | | | | | |
| | Asphalt Extraction & Gradation | 1 test for each 250 tons placed | | | |
| | Marshall Stability | 1 test for each 250 tons placed | | | |
| | Field Density | 1 test for each 250 tons placed | | | |
| | Cores | 1 test for each 250 tons placed | | | |
| **33 10 00 – Water Utilities** | | | | | |
| | Hydrostatic & Leakage | 1.5 times the working pressure (no less than 150 psi). Conducted for 2 hours with maintained pressure of 150 psi (200 psi on fire main) | | | |
| | Bacteriological Samples | 2 taken 24 hours apart after disinfection | | | |
| | Compaction | | | | |
| | Traffic Areas | 1 per 100 lf or less for each 4 ft. of depth | | | |
| | Non–Traffic Areas | 1 per 500 lf or less for each 4 ft. of depth | | | |
| | Fire Flow | 1 per permit | | | |
| **33 30 00 – Sanitary Sewage Utilities** | | | | | |
| | Start–up | Prior to acceptance of Pump Station | | | |

| Section | Test | Frequency | Date | Performed By | Notes |
|---|---|---|---|---|---|
| | Drawdown | Prior to acceptance of Pump Station | | | |
| | Certification | Completion | | | |
| | Warranty | Completion | | | |
| | Television Inspection of Sewers | As requested | | | |
| | Leakage | As necessary | | | |
| | Compaction | | | | |
| | Traffic Areas | 1 per 100 lf or less for each 4 ft. of depth | | | |
| | Non–Traffic Areas | 1 per 500 lf or less for each 6 ft. of depth | | | |
| | Gravity – Air | [ All lines ] | | | |
| | Hydrostatic – Force Main | 100 psi for 2 hours | | | |
| | Deflection | 10% of system | | | |
| **33 40 00 – Storm Drainage Utilities** | | | | | |
| | Compaction | | | | |
| | Traffic Areas | 1 per 100 lf or less for each 4 ft. of depth | | | |
| | Non–Traffic | 1 per 500 lf or less for each 6 ft. of depth | | | |

## PART 2 – PRODUCTS

Not Used

## PART 3 – EXECUTION

Not Used

END OF SECTION

**INDEX TO**

**SECTION 02 41 13 – SELECTIVE SITE DEMOLITION**

# SECTION 02 41 13

# SELECTIVE SITE DEMOLITION

## PART 1 – GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions apply to work of this section.

### 1.2 DESCRIPTION OF WORK

A. Extent of selective demolition work is indicated on drawings.

### 1.3 SUBMITTALS

A. Schedule: Submit schedule indicating proposed methods and sequence of operations for selective demolition work to Owner's representative for review prior to commencement of work. Include coordination for shut–off, capping, and continuation of utility services as required, together with details for dust and noise control protection. Include schedule and location for return of items identified on plans to be delivered to Owner of property.

### 1.4 JOB CONDITIONS

A. Condition of Structures: Owner assumes no responsibility for actual condition of items to be demolished.

B. Partial Demolition and Removal: Items indicated to be removed but of value to Contractor may be removed as work progresses. Transport salvaged items from site as they are removed.

Storage or sale of removed items on site will not be permitted.

C. Protections: Provide temporary barricades and other forms of protection as required to protect Owner's personnel and general public from injury due to selective demolition work.

Protect from damage existing finish work to remain in place and becomes exposed during demolition operations. Remove protections at completion of work.

### 1.5 DAMAGES

A. Promptly repair damages caused to adjacent facilities by demolition work at no cost to Owner.

### 1.6 TRAFFIC

A. Conduct selective demolition operations and debris removal in a manner to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.

Do not close, block or otherwise obstruct streets, walks, or other occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways.

### 1.7 EXPLOSIVES

A. Use of explosives will not be permitted.

### 1.8 UTILITY SERVICES

A. Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.

### 1.9 ENVIRONMENTAL CONTROLS

A. Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practical level. Comply with governing regulations pertaining to environmental protection.

Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

### 1.10 MEASUREMENT AND PAYMENT

A. There will be no measurement for selective demolition. Payment will be made at the contract lump sum price. Payment will include equipment, labor, materials, protection, clean–up, disposal, and all work necessary to complete the selective demolition shown on the construction drawings.

## PART 2 – PRODUCTS

None in this section

## PART 3 – EXECUTION

### 3.1 PREPARATION

A. Prior to commencement of selective demolition work, check areas in which work will be performed. Photograph or video existing conditions of surfaces, equipment, or surrounding properties that could be misconstrued as damage resulting from selective demolition work. File with Owner's representative prior to starting work.

B. Cover and protect equipment and fixtures to remain from soiling or damage when demolition work is performed in areas from which such items have not been removed.

## 3.2 DEMOLITION

A. Perform selective demolition work in a systematic manner. Use such methods as required to complete work indicated on drawings in accordance with demolition schedule and governing regulations.

Demolish concrete in small sections. Cut concrete at junctures with construction to remain using power–driven masonry saw or hand tools. Do not use power–driven impact tools.

Completely fill below–grade areas and voids resulting from demolition work. Provide fill consisting of approved earth, gravel and sand, free of trash and debris, stones over 2" diameter, roots or other organic matter.

If unanticipated mechanical, electrical, or structural elements, which conflict with intended function or design, are encountered, investigate and measure both nature and extent of the conflict. Submit report to Owner's representative in written, accurate detail. Pending receipt of directive from Owner's representative, rearrange selective demolition schedule as necessary to continue overall job progress without delay.

## 3.3 SALVAGE MATERIALS

A. Any articles of historic significance will remain the property of the Owner. Notify Owner's representative if such items are encountered and obtain acceptance regarding method of removal and salvage for Owner.

## 3.4 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove debris, rubbish and other materials resulting from demolition operations from site. Transport and legally dispose of materials off site.

If hazardous materials are encountered during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling, and protection against exposure or environmental pollution.

Burning of removed materials is not permitted on project site.

## 3.5 CLEAN–UP AND REPAIR

A. Upon completion of demolition work, remove tools, equipment and demolished materials from site. Remove protections and leave site clean.

Repair demolition performed in excess of required work. Return structures and surfaces to remain to the condition existing prior to commencement of selective demolition work. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.

Fill in all voids created by selective demolition and grade site to drain. Grass all disturbed areas for erosion control.

END OF SECTION

**INDEX TO**

**SECTION 03 00 00 – CONCRETE**

# SECTION 03 00 00

# CONCRETE

## PART 1 – GENERAL

### 1.1 SECTION INCLUDES

A. Concrete sidewalks, curbs, gutters, median barriers, parking areas, and roads.

### 1.2 RELATED SECTIONS

A. Section 31 00 00 – Earthwork: Preparation of site for paving and base.

B. Section 32 11 23 – Aggregate Base Courses.

C. Section 32–12–16SC – Asphalt Paving.

### 1.3 MEASUREMENT AND PAYMENT

A. Concrete pavement and sidewalk, regardless of thickness, will be measured by the square yard of finished surface complete in place and accepted.

B. Curb and Gutter – Payment for concrete curb and gutter sections will be made at the unit price per linear foot for amount actually installed and accepted. Measurement will be along the centerline of completed and accepted curb.

C. Payment shall constitute full compensation for furnishing all materials, plant, equipment, tools, forms, inserts, and for all labor and incidentals necessary to complete the work required by these specifications. No payment will be made for any material wasted, used for convenience of the Contractor, unused or rejected.

### 1.4 REFERENCES (LATEST REVISION)

A. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials.

B. ACI 301 – Specifications for Structural Concrete.

C. ACI 304R – Guide for Measuring, Mixing, Transporting and Placing Concrete.

D. ACI 318 – Building–Code Requirements for Structural Concrete and Commentary.

E. ACI 330R – Guide for the Design and Construction of Concrete Parking Lots.

F. ASTM A 185 – Steel Welded Wire Reinforcement, Plain, for Concrete.

G. ASTM A 497 – Steel Welded Wire Reinforcement, Deformed, for Concrete.

H. ASTM A 615 – Deformed and Plain Carbon–Steel Bars for Concrete Reinforcement.

I. ASTM C 31 – Making and Curing Concrete Test Specimens in the Field.

J. ASTM C 33 – Concrete Aggregates.

K. ASTM C 39 – Compressive Strength of Cylindrical Concrete Specimens.

L. ASTM C 94 – Ready–Mixed Concrete.

M. ASTM C 150 – Portland Cement.

N. ASTM C 172 – Sampling Freshly Mixed Concrete.

O. ASTM C 260 – Air–Entraining Admixtures for Concrete.

P. ASTM C 309 – Liquid Membrane–Forming Compounds for Curing Concrete.

Q. ASTM C 494 – Chemical Admixtures for Concrete.

R. ASTM C 920 – Elastomeric Joint Sealants.

S. ASTM E 1155 – Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.

T. ASTM C 1116 – Fiber–Reinforced Concrete.

U. ASTM D 1751 – Preformed Expansion Joint Filler for Concrete Paving and Structural Construction. (Nonextruding and Resilient Bituminous Type).

V. ASTM D 3740 – Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

W. ASTM E 329 – Agencies Engaged in Construction Inspection and/or Testing.

**1.5 PERFORMANCE REQUIREMENTS**

A. Paving: Designed for main street arteries.

**1.6 SUBMITTALS FOR REVIEW**

A. Section 01 33 00 – Submittals Procedures.

B. Product Data: Provide data on joint filler, admixtures, and curing compounds.

C. Concrete Design Mix.

**1.7 QUALITY ASSURANCE**

A. Perform work in accordance with ACI 301, ACI 318, and ACI 330R.

B. Obtain cementitious materials from same source throughout.

C. Conform to ACI 117 – Specifications for Tolerances for Concrete Construction and Materials.

D. Method of measurement for accessible route with a 24" digital smart–level will be used to measure points along the accessible route. Line of measurement shall be parallel to the long edge of ramp or accessible route, whether straight or curved. Longitudinal measurement lines shall be spaced 3 feet apart, but in no case shall fewer than two lines be used. The horizontal measurement [cross–slope] will be measured every [6] feet. Engineer reserves the right to gather additional measurements if further investigation is necessary. The 24" Smart–level slope readings greater than specified tolerance within contract documents will be identified as non–compliant and not accepted.

E. Engineer reserves the right to mark and reject portions of concrete not within tolerance as specified.

F. Accessible Route Tolerance by measuring Floor Flatness and Levelness. Traffic floors [All Accessible Routes] shall conform to the following surface profile tolerances:

a. Floor Designation: All floor areas not specified to be part of the "defined traffic floor" [Accessible Routes] shall be part of a "random traffic floor" [Non–accessible Route]. Any floor slab comprising part of the traffic floor shall be designated a "traffic slab" [Accessible Route].

b. Flatness and Levelness Tolerances: A traffic floor shall conform to the following surface profile tolerances:

Floor Flatness Number: $F_F$
Specified Overall Value = [38]
Minimum Local Value = [25]
Floor Levelness Number: $F_L$
Specified Overall Value = [25]
Minimum Local Value = [17]

c. Floor Tolerance Measurements: $F_F$ and $F_L$ tolerances shall be tested in accordance with ASTM E 1155. Actual overall F–numbers shall be calculated using the inferior / superior area method.

d. Timeliness of Floor Profile Tests & Reports: All floor tolerance measurements shall be made within [48] hours after slab installation. In all cases, tolerance measurements shall precede the removal of shores and forms. Results of all floor profile tests (including a running tabulation of overall $F_F$ and $F_L$ values for all traffic slabs installed to date) shall be provided to the Contractor within [72] hours after each slab installation.

e. Remedy for Out–of–Tolerance Work: For purposes of flatness and levelness control, minimum floor section boundaries shall coincide with the control joints. Profile test compliance requirements apply to the time period specified above only. Contractor shall remedy any floor section measuring below either the minimum local $F_F$, or $F_L$ number. Any floor section measuring at or above both the minimum local $F_F$ and $F_L$ number

shall be accepted. If actual overall $F_F$ or $F_L$ number for entire random–traffic floor installation measures less than its specified value, then Contractor shall undertake remedial measures acceptable to the Engineer.

G. Defined random traffic floors [Non–accessible Routes] shall conform to the following surface profile tolerances:

a. Floor Designation: All floor areas specified as "defined random traffic floor" include only the [Non–accessible route].

b. Flatness and Levelness Tolerances: The defined traffic floor shall conform to the following surface profile tolerances: $F_{min}$ = [25]

c. Floor Tolerance Measurements: $F_{min}$ tolerances shall be tested in accordance with ASTM E 1486.

d. Timeliness of Floor Profile Tests & Reports: All floor tolerance measurements shall be made by the Contractor within [24] hours after slab installation and before saw cutting of control joints. In all cases, tolerance measurements shall precede the removal of shores and forms. Results of all floor profile tests including a running tabulation of overall $F_{min}$ values for all of defined–traffic slabs installed to date shall be provided to the Contractor within [48] hours after each slab installation.

H. Remedy for Out–of–Tolerance Work: For purposes of flatness and levelness control, minimum floor section boundaries shall coincide with the construction joints. Profile test compliance requirements apply to time period specified above only. Contractor shall remedy any floor section measuring below the $F_{min}$ number, in accordance with recommendations of the Engineer. Any floor section measuring at or above the $F_{min}$ number shall be accepted. If actual overall $F_{min}$ number entire defined–traffic floor installation measures less than its specified value, then Contractor shall undertake remedial measures acceptable to the Engineer.

If a portion of a floor does not meet specified F–number, the following remedies are recommended:

a. Local value is out of spec – grind or replace floor.

b. Overall value is out of spec – Contractor shall pay the Owner per square foot for portion of floor not meeting F–number spec. This can be obtained by specifying a figure in project specifications in conjunction with square footage obtained from reading taken in the field.

## 1.8 REGULATORY REQUIREMENTS

A. Conform to Town of Bluffton and SCDOT standards for paving work on public property.

## 1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

### 1.10 GUARANTEE

A. Contractor shall guarantee the quality of materials and workmanship for a period of 12 months after acceptance. Defects discovered during this period shall be repaired by Contractor at no cost to the Owner.

### 1.11 TESTING

A. Testing laboratory shall operate in accordance with ASTM D 3740 and E 329 and be acceptable to the Engineer.

B. Testing laboratory and Project Engineer/Project Representative shall be given a minimum of 48 hours notice prior to taking any tests.

C. Owner shall select and engage the testing laboratory. Testing laboratory shall be responsible to the Owner and Owner's Engineer. Payment for laboratory and all tests shall be by Owner, except Owner specifically reserves the right to deduct from Contractor's payment, expense, and charges of testing laboratory when:

1. Contractor gives notice work is ready for inspection and testing, and fails to be ready for the test, and/or

2. Testing of the Contractor's work, products, or materials fail, and retesting is required, and/or

3. Contractor abuses services or interferes with the work of testing laboratory in conduct of this work.

D. Test results shall be furnished to the Engineer prior to continuing with associated or subsequent work.

## PART 2 – PRODUCTS

### 2.1 FORM MATERIALS

A. Wood or steel form material, profiled to suit conditions.

B. Joint Filler: ASTM D1751 type; 1/2 inch thick.

### 2.2 REINFORCEMENT

A. Reinforcing Steel: ASTM A 615, Grade 60 billet steel deformed bars; uncoated finish.

B. Welded Steel Wire Fabric: Plain type, ASTM A 185; uncoated finish.

C. Fiber reinforcement: Shall conform to ASTM C 1116 as manufactured by Fibermesh Company or equivalent. Concrete mix design shall utilize between 0.5% and 1.0% fiber content.

## 2.3 CONCRETE MATERIALS

A. Cement: ASTM C 150, Type I – Normal.

B. Fine and Coarse Mix Aggregates: ASTM C 33. Coarse aggregate shall consist of granite stone.

C. Water: Potable, not detrimental to concrete.

D. Air Entrainment: ASTM C 260.

E. Chemical Admixture: ASTM C 494, Type A – Water Reducing.

## 2.4 ACCESSORIES

A. Curing Compound: ASTM C309, clear with fugitive dye.

B. Sealant: Joints shall be sealed per detail on project drawings, conforming to ASTM C 920, Type S or M, Grade P or NS, Class 25.

## 2.5 CONCRETE MIX – BY PERFORMANCE CRITERIA

A. Provide concrete to the following criteria:

1. Flexible Strength: 700 psi.

2. Compressive Strength: 3,000 psi @ 28 days.

3. Slump: 4 to 5 inches.

B. Use accelerating admixtures in cold weather only when acceptable to Engineer. Use of admixtures will not relax cold weather placement requirements.

C. Use calcium chloride only when accepted by Engineer.

D. Use set retarding admixtures during hot weather only when accepted by Engineer.

## 2.6 SOURCE QUALITY CONTROL AND TESTS

A. All sampling and testing services shall be performed, at Owner's expense, by a testing agency operating in accordance to ASTM D 3740 and E 329 latest edition and acceptable to the Engineer.

B. Contractor shall submit to the Engineer a design mix on each class of concrete proposed for use. The mix shall be prepared by an acceptable testing laboratory. Compressive strength of at least four specimens of the design mix shall indicate 15% higher than 28 days strengths specified. During the work, Contractor shall make three test cylinders for each 50 cubic yards, or fraction thereof, of concrete placed each day. One cylinder shall be tested at 7 days

and the other two at 28 days in accordance with ASTM C 39. Copies of all test reports shall be furnished to the Engineer.

## PART 3 – EXECUTION

### 3.1 EXAMINATION

A. Verify subgrade conditions under provisions of Section 31 00 00 – Earthwork.

B. Verify compacted subgrade is acceptable and ready to support concrete and imposed loads.

C. Verify slopes and elevations of subgrade are correct.

### 3.2 CONSTRUCTION OBSERVATION

A. Engineer or Project Representative will have the right to require any portion of work be completed in their presence and if work is covered up after such instruction, it shall be exposed by Contractor for observation. However, if Contractor notifies the Engineer such work is scheduled, and Engineer fails to appear within 48 hours, Contractor may proceed. All work completed and materials furnished shall be subject to review by the Engineer or Project Representative. Improper work shall be reconstructed. All materials, which do not conform to requirements of specifications, shall be removed from the work upon notice being received from Engineer for rejection of such materials. Engineer shall have the right to mark rejected materials to distinguish them as such.

### 3.3 SUBGRADE

A. Prepare subgrade in accordance with Section 31 00 00 – Earthwork.

### 3.4 PREPARATION FOR PLACING

A. Water shall be removed from excavations before concrete is deposited. Hardened concrete debris and other foreign materials shall be removed from the interior of forms and inside of mixing and conveying equipment. The reinforcement shall be made secure in position and shall be subject to examination and acceptance.

B. Moisten subgrade to minimize absorption of water from fresh concrete.

C. Coat surfaces of manhole, inlet, and catch basin frames with oil to prevent bond with concrete pavement.

D. Notify Engineer minimum 48 hours prior to commencement of concreting operations.

### 3.5 FORMING

A. Place and secure forms to correct location, dimension, profile, and gradient.

B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

C. Place joint filler in position, in straight lines. Secure to formwork during concrete placement.

D. Forms shall be constructed to the shape, line, and grade required and shall be maintained sufficiently rigid to prevent deformation under load. Form work and details of construction joints shall conform to ACI–318, Chapter 6.

**3.6 REINFORCEMENT**

A. Place reinforcement as indicated.

B. Interrupt reinforcement at expansion joints.

**3.7 PLACING CONCRETE**

A. Placing of concrete shall conform to Chapter 5 of the American Concrete Institute Standard A.C.I. 318. Concrete having attained initial set or having contained water for more than 45 minutes shall not be used in the work. Concrete shall not be dropped freely more than 5 feet. Concrete shall be mixed and placed only when the temperature is at least 40 degrees F and rising. Concrete shall be placed only upon surfaces free from frost, ice, mud and other detrimental substances or conditions. When placed on dry soil or pervious material, water proof paper or polyethylene sheeting shall be laid over surfaces to receive the concrete.

B. Ensure reinforcement, inserts, embedded parts, formed joints and forms are not disturbed during concrete placement.

C. Place concrete continuously over the full width of panel and between predetermined construction joints. Do not break or interrupt successive pours so cold joints will not occur.

D. Place concrete to elevations indicated on the contract drawings.

**3.8 JOINTS**

A. Place expansion joints at 50 foot intervals and radius points.

B. Place contraction joints at 10 foot intervals. Align curb, gutter, and sidewalk joints.

C. Place joint filler between paving components and building or other appurtenances. Recess top of filler 1/8 inch.

D. Saw cut contraction joints 3/16 inch wide at an optimum time after finishing. Cut 1/3 into depth of slab.

**3.9 FINISHING**

A. Paving: Light broom.

B. Sidewalk Paving: Light broom, radius to 1/2 inch radius, and trowel joint edges.

C. Curbs and Gutters: Light broom parallel to gutter.

D. Inclined Vehicular Ramps: Broomed perpendicular to slope.

E. Place curing compound on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

**3.10 JOINT SEALING**

A. Separate pavement from vertical surfaces with 1/2 inch thick joint filler.

B. Place joint filler in pavement pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

C. Extend joint filler from bottom of pavement to within 1/8 inch of finished surface.

**3.11 TOLERANCES**

A. Section 01 45 00 – Quality Control.

B. General Site Concrete:

1. Maximum Variation of Surface Flatness: 1/4 inch in 10 feet.

2. Maximum Variation From True Position: 1/4 inch.

C. Accessible Routes: Variation from design elevation shall not exceed 1/4 inch; however, accessible routes shall not exceed maximum ADA allowable slopes. Contractor shall remove and replace any and all portions of the accessible route exceeding maximum ADA allowable slopes.

**3.12 CURB AND GUTTER SECTIONS**

A. Shall be constructed as shown on the drawings and in accordance with applicable details. Subgrade below the curb and gutter sections shall be compacted to 98% density. Curb and gutter sections shall be constructed in sections of uniform length and shall not exceed 10 feet or be less than 5 feet in length. Straight edging along the edge of gutter and top of curb shall conform to those requirements for adjacent pavement but with no irregularities to exceed 1/4 inch in 10 feet.

B. If slip–form or extruded construction is used, contraction joints shall be located at intervals no greater than 10 feet by sawing hardened concrete at the proper time. Joints shall be sawed between 4 to 8 hours after placing of concrete. Depth of saw–cut shall be one–fourth thickness of the curb and gutter section. The maximum width of cut shall be 1/4 inch. All joints shall be sawed in succession.

C. Half inch thick premolded expansion joints shall be installed completely through the joints at spaces not to exceed 50 feet and at all structures and walks.

D. When curb forms are removed, backfill shall be immediately placed, tamped, and graded behind the new curb to help protect line and grade. Machine methods of placing and forming may be used provided finished product is satisfactory to the Engineer.

E. Contractor shall place a concrete depressed curb at all driveways shown on the drawings or where a driveway is in use.

F. Cracked curb and gutter will not be accepted.

## 3.13 CONCRETE CURING

A. Immediately after placement and finishing, concrete shall be protected from moisture loss for not less than 7 days. For surfaces not in contact with forms, curing compound shall be uniformly applied after water sheen disappears from the concrete. Formed surfaces shall receive an application of curing compound if forms are removed during the 7 day curing period. Curing compound shall not be applied during rainfall.

B. Curing compound shall be applied under pressure at the rate of 1 gallon per 150 square feet by mechanical sprayers. The spraying equipment shall be of the fully atomizing type. At time of use, curing compound shall be thoroughly mixed with a fugitive dye uniformly dispersed throughout the sprayer. Care shall be taken to prevent application to joints where concrete bond is required, to reinforcement steel and to joints where joint sealer is to be placed. The compound shall form a uniform continuous coherent film which will not crack or peel and shall be free from pinholes and other imperfections. Concrete surfaces subjected to heavy rainfall within 3 hours after curing compound has been applied shall be resprayed by above method and at above coverage at no additional expense to the Owner.

C. No pedestrian or vehicular traffic shall be allowed over the surface for seven days unless surface is protected by planks, plywood, or sand. Protection shall not be placed until at least 12 hours after application of the curing compound.

D. Protect concrete by suitable methods to prevent damage by mechanical injury or excessively hot or cold temperatures.

## 3.14 FIELD QUALITY CONTROL

A. Field quality control tests specified herein will be conducted by the Owner's Independent Testing Laboratory at no cost to Contractor in accordance with Section 01 45 23. Contractor shall perform additional testing as considered necessary by the Contractor for assurance of quality control. Retesting required as a result of failed initial tests shall be at the Contractor's expense.

B. Field testing, frequency, and methods may vary as determined by and between the Owner and Owner's Testing Laboratory.

C. Review the Contractor's proposal materials and mix design for conformance with specifications.

D. Perform testing in accordance with ACI 301 and testing standards listed herein.

E. Strength Tests

1. Secure composite samples in accordance with ASTM C 172. Sample at regularly spaced intervals from middle portion of the batch. Sampling time shall not exceed 15 minutes.

2. Mold and cure specimens in accordance with ASTM C31.

a. A minimum of four concrete test cylinders shall be taken for every 50 cubic yards or less of each class of concrete placed each day and not less that once for each 5,000 square feet of paved area.

b. During initial 24 hours (plus or minus 8 hours) after molding, the temperature immediately adjacent to specimens shall be maintained in a range of 60 to 80 degrees F. Control loss of moisture from specimens by shielding from direct rays of the sun and from radiant heating devices.

c. Specimens transported prior to 48 hours after molding shall not be demolded, but shall continue initial curing at 60 – 80 degrees F until time for testing.

d. Specimens transported after 48 hours age shall be demolded in 24 hours (plus or minus 8 hours). Curing shall then be continued but in saturated limewater at 73.4 degrees (plus or minus 3 degrees F) until the time of testing.

e. Wet cure cylinders under controlled temperature until testing.

3. Test cylinders in accordance with ASTM C 39.

a. Date test cylinders and number consecutively. Give each cylinder of each set an identifying letter (i.e. A, B, C, and D). Prepare a sketch of the building plan for each test set identifying location of placed concrete.

b. Test on cylinder (A) at 7 days for information. If compressive strength of concrete sample is equal to or above the 28 day specified strength, test another cylinder (B) at 7 days. The average of breaks shall constitute compressive strength of concrete sample.

c. Test two cylinders (B and C) at 28 days and the average of breaks shall constitute compressive strength of concrete sample.

d. Retain fourth cylinder (D) for further testing if needed, but do not retain cylinder more than 60 days.

4. Evaluation and Acceptance

   a. Strength level of concrete will be considered satisfactory if the average of all sets of three consecutive strength tests equal or exceed specified strength and no individual strength test (average of two cylinders) results are below specified compressive strength test by more than 500 psi.

   b. Completed concrete work will not be accepted unless requirements of ACI 301, have been met, including dimensional tolerances, appearance, and strength of structure.

**3.15 PROTECTION**

A. Immediately after placement, protect pavement from premature moisture loss, excessive hot or cold temperatures, and mechanical injury.

B. Do not permit vehicular traffic over pavement or curb for seven days minimum after finishing. Do not permit pedestrian traffic over concrete for three days.

END OF SECTION

**INDEX TO**

**SECTION 10 14 53 – TRAFFIC SIGNAGE**

# SECTION 10 14 53 – TRAFFIC SIGNAGE

## PART 1 – GENERAL

### 1.1 WORK INCLUDED

A. Signs.

B. Posts.

C. Fabricating and installing traffic signs in accordance with details shown on construction plans and the Manual on Uniform Traffic Control Devices.

### 1.2 REFERENCES (LATEST REVISION)

A. ASTM A 123 – Zinc (Hot–Dip Galvanized) Coatings on Iron and Steel Products.

B. ASTM A 153 – Zinc Coating (Hot–Dip) on Iron and Steel Hardware.

C. ASTM A 193 – Alloy–Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.

D. ASTM A 307 – Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

E. ASTM A 615 – Deformed and Plain Carbon–Steel Bars for Concrete Reinforcement.

F. ASTM B 209 – Aluminum and Aluminum–Alloy Sheet and Plate.

G. ASTM B 211 – Aluminum and Aluminum–Alloy Bar, Rod, and Wire.

### 1.3 SUBMITTALS

A. A sample of all signs and posts to be placed shall be submitted to the Engineer for review prior to ordering.

### 1.4 QUALITY ASSURANCE

A. Material and equipment shall be the standard product of a manufacturer who has manufactured them for a minimum of 2 years and provides published data on quality and performance.

### 1.5 GUARANTEE

A. Contractor shall guarantee the quality of materials and workmanship for a period of 12 months after acceptance. Defects discovered during this period shall be repaired by Contractor at no cost to the Owner.

### 1.6 MEASUREMENT AND PAYMENT

A. Payment for signs will include all necessary labor and materials to fabricate and install the sign. Payment will be made on a job lump sum basis.

## PART 2 – PRODUCTS

### 2.1 UNIFORMITY

A. All signs shall be uniform in shape, color, dimensions, legends, and illumination or reflectorization.

### 2.2 MATERIALS AND WORKMANSHIP

A. Signs: Shall be aluminum 0.08 inch minimum thickness and shall conform to ASTM B 209, Alloy 6061–T6 or 5053–H38. Finished sign shall be clear cut, the lines of all letters and details true, regular and free from waviness, unevenness, furry edges, or lines and shall be free from all scaling, cracking, blistering, pitting, dents, or blemishes of any kind.

B. Sign Posts: Shall be galvanized steel flanged "U" channel section with a minimum (before punching or drilling) of two (2) pounds per foot and shall conform to the minimum yield point and tensile strength specified in ASTM A 615 Grade 60. Galvanizing shall be in accordance with ASTM A 123. Length as specified on the plans. Holes may be punched or drilled 3/8 inch in diameter and spaced one (1) inch center to center beginning one (1) inch from the top and extending the full length of post.

C. Hardware: Bolts shall be 5/16 inch diameter with hexagonal heads and of sufficient length to extend at least 1/4 inch beyond the nut when installed. Nuts shall be hex nuts of the self–locking plastic insert type. The thread fit for nuts shall be ANSI, Class 2B. The washers shall be flat and 25/64 inch ID by 3/4 inch OD by 0.091 inch thick. These washers are to be placed between head of bolt and sign face. Bolts, nuts, washers and spacers may be aluminum, stainless steel or galvanized steel. Galvanized steel bolts and washers shall conform to ASTM A 307, galvanized in accordance with ASTM A 153. Aluminum shall conform to ASTM B 211, Alloy 2024–T4 for bolts, Alloy 2017–T4 for nuts, and ASTM B 209, Alloy 2024–T4 for washers. Stainless steel shall conform to ASTM A 193, Type B8.

### 2.3 PRODUCT REVIEW

A. Contractor shall provide the Engineer with a complete description of all products before ordering. The Engineer will review all products before they are ordered.

## PART 3 – EXECUTION

### 3.1 GENERAL

A. Sign posts and their foundations and sign mountings shall be constructed to hold signs in a proper and permanent position, to resist swaying in the wind or displacement by vandalism.

### 3.2 LOCATION

A. Signs are to be placed as shown on the plans. Signs shall conform to height and lateral locations as shown in the Manual on Uniform Traffic Control Devices.

## 3.3 ERECTION

A. Drive type posts may either be driven in place or placed in prepared holes. Driven posts will be limited to locations where the surrounding soil is firm and stable. When sandy or unstable soils are present, each drive post shall be placed in a prepared dry hole minimum six (6) inches in diameter. Whenever posts are placed in prepared holes, the holes shall be backfilled with a mixture of Portland Cement and sand. The resultant mixture shall be mixed with water to a moist consistency and placed around posts. All posts shall be erected in a vertical and plumb position to a depth of three (3) feet and at an angle to the roadway as shown on plans or directed by Engineer.

END OF SECTION

**INDEX TO**

**SECTION 31 00 00 – EARTHWORK**

# SECTION 31 00 00

# EARTHWORK

## PART 1 – GENERAL

### 1.1 SECTION INCLUDES

A. Grading

B. Excavation

C. Backfilling

D. Compaction

E. Remove and Replace Topsoil

F. Dressing of Shoulders and Banks

G. Stone Drainage Filter

H. Water Control

I. Testing

### 1.2 RELATED SECTIONS

A. Section 01 45 00 – Quality Control

B. Section 01 45 23 – Testing and Inspecting Services

C. Section 31 10 00 – Site Clearing

### 1.3 MEASUREMENT AND PAYMENT

A. Grading to subgrades, construction of ditches, dressing of disturbed areas, removing and replacing topsoil, excavating, backfilling and compacting to required elevations, testing, staking, and construction supervision shall be included in the contract lump sum price for "Grading."

B. Unsuitable Material – Payment will be made on a contract unit price for each cubic yard removed. Payment will include excavation and disposal of unsuitable material.

C. Borrow – Payment will be made on a contract unit price for each cubic yard in place. Payment will include furnishing materials required in excess of suitable materials available on site.

D. Earthwork – All earthwork associated with the installation of bulkheads, headwalls, wingwalls, weir structures, drainage filters, rip–rap, etc. shall not be measured for

direct payment. Payment for the earthwork shall be included in the item to which it pertains.

E. Dewatering – No direct payment shall be made for dewatering. Dewatering shall be included in the item to which it pertains.

F. Proof Rolling – Payment will be made at the contract unit price. Payment will include furnishing a loaded truck, truck driver, fuel and rolling the designated areas.

G. Lagoon Excavation – Payment will be made at the contract unit price for each cubic yard of soil excavated. Payment will include excavation, grading banks and underwater slopes to plan grade, disposal of material on site as directed by the Owner, or off site at the Contractor's expense, and all equipment and labor necessary to complete the lagoon.

## 1.4 REFERENCES (LATEST REVISION)

A. ASTM D 448 – Sizes of Aggregate for Road and Bridge Construction.

B. ASTM D 1557 – Laboratory Compaction Characteristics of Soil Using Modified Effort.

C. ASTM D 2487 – Classification of Soils for Engineering Purposes (Unified Soil Classification System).

D. ASTM D 6938 – In–Place Density and Water Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth).

E. ASTM D 3740 – Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

F. ASTM E 329 – Agencies Engaged in Construction Inspection and/or Testing.

## 1.5 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Procedures for submittals.

B. Materials Source: Submit gradation analysis, proctor results, and soil classification for all borrow material.

## 1.6 QUALITY ASSURANCE

A. Perform work in accordance with Federal, State of South Carolina, and Town of Bluffton standards.

## 1.7 TESTING

A. Laboratory tests for moisture density relationship for fill materials shall be in accordance with ASTM D 1557, (Modified Proctor).

B. In place density tests in accordance with ASTM D 6938.

C. Testing laboratory shall operate in accordance with ASTM D 3740 and E 329 and be acceptable to the Engineer.

D. The testing laboratory and Project Engineer/Project Representative shall be given a minimum of 48 hours notice prior to taking any of the tests.

E. Owner shall select and engage the testing laboratory. Testing laboratory shall be responsible to the Owner and Owner's Engineer. Payment for laboratory and all tests shall be by the Owner, except Owner specifically reserves the right to deduct from Contractor's payment, expenses and charges of testing laboratory when:

1. Contractor gives notice the work is ready for inspection and testing, and fails to be ready for the test, and/or

2. Testing of the Contractor's work, products or materials fail, and retesting is required, and/or

3. Contractor abuses the services or interferes with the work of the testing laboratory in the conduct of this work.

F. Test results shall be furnished to the Engineer prior to continuing with associated or subsequent work.

## PART 2 – PRODUCTS

### 2.1 MATERIALS

A. Borrow shall consist of sand or sand–clay soils capable of being readily shaped and compacted to the required densities, and shall be reasonably free of roots, trash, rock larger than 2 inches, and other deleterious material.

B. All soils used for structural fills shall have a PI (plastic index) of less than 10, and a LL (liquid limit) of less than 30. Fill soils shall be dried or wetted to appropriate moisture contents prior to compaction. Additionally, fill soils used for the top 2 feet of fill beneath roads and parking lots shall have no more than 15% passing the # 200 sieve. Fill soils used for house lots shall have no more than 25% passing the # 200 sieve.

C. Contractor shall furnish all borrow material.

D. Contractor shall be responsible for and bear all expenses in developing borrow sources including securing necessary permits, drying the material, haul roads, clearing, grubbing, excavating the pits, placing, compaction and restoration of pits and haul roads to a condition satisfactory to property owners and in compliance with applicable federal, state, and local laws and regulations.

### 2.2 SOURCE QUALITY CONTROL

A. If tests indicate materials do not meet specified requirements, change material and retest.

B. Provide materials of each type from same source throughout the Work.

## PART 3 – EXECUTION

### 3.1 TOPSOIL

A. Contractor shall strip topsoil and stockpile on site at a location determined by the Owner at the Contractor's expense.

B. Topsoil shall be placed to a depth of 4 inches over all disturbed or proposed landscaped areas.

C. Topsoil shall be provided at Contractor's expense if it is not available from site.

D. Any remaining topsoil will be hauled off site at the Contractors expense.

E. Do not excavate wet topsoil.

### 3.2 EXCAVATION

A. Suitable excavation material shall be transported to and placed in fill areas within limits of the work.

B. Unsuitable material encountered in areas to be paved and under building pads, shall be excavated 2 feet below final grade and replaced with suitable material from site or borrow excavations. Contractor shall notify Engineer if more than 2 feet of excavation is needed to replace unsuitable material.

C. Unsuitable and surplus excavation material not required for fill shall be disposed of off site.

D. Proper drainage, including sediment and erosion control, shall be maintained at all times. Methods shall be in accordance with the National Pollutant Discharge Elimination System standards and other local, state, and federal regulations.

E. Unsuitable materials as stated herein are defined as highly plastic clay soils, of the CH and MH designation, border line soils of the SC–CH description, and organic soils of the OL and OH description based on the Unified Soils Classification System. Further, any soils for the top two feet of pavement subbase shall have no more than 15% passing the # 200 sieve.

### 3.3 GROUND SURFACE PREPARATION FOR FILL

A. All vegetation, roots, brush, heavy sods, heavy growth of grass, decayed vegetable matter, rubbish, and other unsuitable material within the areas to be filled shall be stripped and removed prior to beginning the fill operation.

B. Sloped ground surfaces steeper than 1 vertical to 4 horizontal, on which fill is to be placed shall be plowed, stepped, or benched, or broken up as directed, in such a manner where fill material will bond with the existing surface.

C. Surfaces on which fill is to be placed and compacted shall be wetted or dried as may be required to obtain the specified compaction.

**3.4 FILL**

A. Shall be placed in successive horizontal layers 8 inches to 12 inches in loose depth for the full width of the cross–section and compacted as required.

**3.5 FINISHED GRADING**

A. All areas covered by the project including excavated and filled sections and adjacent transition areas shall be smooth graded and free from irregular surface changes.

B. Degree of finish shall be that ordinarily obtainable from either blade–grader or scraper operations, supplemented with hand raking and finishing, except as otherwise specified.

C. Unpaved areas to within 0.1 feet of elevations shown on the drawings provided such deviation does not create low spots that do not drain.

D. Paved Areas – Subgrade to within 0.05 feet of the drawing elevations less the compacted thickness of the base and paving.

E. Ditches and lagoon banks shall be finished graded, dressed, and seeded within 14 calendar days of work to reduce erosion and permit adequate drainage.

F. Portland Cement Pervious Pavement:

1. Subgrade Materials – The top 6 inches shall be composed of granular or gravely soil predominantly sandy with no more than a moderate amount of silt or clay.

2. Subgrade Permeability – Prior to placement of Portland Cement Pervious Pavement, the subgrade shall be tested for rate of permeability by double ring infiltrometer, or other suitable test of subgrade soil permeability. The tested permeability must reasonably compare to design permeability.

3. Subgrade Support – Shall be compacted by a mechanical vibratory compactor to a minimum density of 92% of a maximum dry density as established by ASTM D 1557 or AASHTO T 180.

   If fill material is required to bring the subgrade to final elevation, it shall be clean and free of deleterious materials. It shall be placed in 8 inch maximum layers, and compacted by a mechanical vibratory compactor

to a minimum density of 92% of a maximum dry density as established by ASTM D 1557 or AASHTO T 180.

4. Subgrade Moisture – Subgrade shall be in a moist condition (within +/– 3% of optimum moisture content as determined by modified compaction test ASTM D 1557 or AASHTO T 180).

**3.6 DISPOSAL OF WASTE MATERIAL**

A. All vegetation, roots, brush, sod, broken pavements, curb and gutter, rubbish, and other unsuitable or surplus material stripped or removed from limits of construction shall be disposed of by the Contractor.

**3.7 PROTECTION**

A. Graded areas shall be protected from traffic, erosion, settlement, or any washing away occurring from any cause prior to acceptance.

B. Contractor shall be responsible for protection of below grade utilities shown on the drawings or indicated by the Owner at all times during earthwork operations.

C. Repair or re–establishment of graded areas prior to final acceptance shall be at the Contractors expense.

D. Site drainage shall be provided and maintained by Contractor during construction until final acceptance of the project. Drainage may be by supplemental ditching, or pumping if necessary, prior to completion of permanent site drainage.

**3.8 DRAINAGE**

A. Contractor shall be responsible for providing surface drainage away from all construction areas. This shall include maintenance of any existing ditches or those constructed in the immediate vicinity of the work. Contractor shall provide proper and effective measures to prevent siltation of wetlands, streams, and ditches on both the Owner's property, and those properties downstream.

**3.9 FIELD QUALITY CONTROL**

A. Compaction testing shall be performed in accordance with ASTM D 6938. Where tests indicate the backfill does not meet specified requirements, the backfill shall be reworked or removed and replaced, and then retested at the Contractor's expense.

B. Unpaved areas – at least 90% of maximum laboratory density within 2% optimum moisture content unless otherwise approved by the Engineer.

C. Paved Areas and Under Structures – top 6 inch layer of subbase to at least 98% of maximum laboratory density within 2% optimum moisture content. Layers below top 6 inches shall be compacted to 95% of maximum laboratory density within 2% optimum moisture content.

D. Rolling and compaction equipment and methods shall be subject to acceptance by the Engineer. Acceptance in no way relieves Contractor of the responsibility to perform in correct and timely means.

E. Number of Tests – Under paved areas, no less than one density test per horizontal layer per 5,000 square feet of subbase shall be made. In unpaved areas, no less than one density test per horizontal layer per 10,000 square feet of fill area shall be made. Under curb and gutter, no less than one density test per every 300 linear feet. [

**3.10 PROOF ROLLING**

A. Shall be required on the subbase of all curb and gutter and paved areas and on the base of all paved areas where designated by the Engineer. Proof rolling shall take place after all underground utilities are installed and backfilled. The operation shall consist of rolling the subbase or base with a fully loaded 10–wheeled dump truck. A full load shall consist of 10 to 12 cubic yards of soil or rock. The dump truck shall be capable of traveling at a speed of two to five miles per hour and be in sound mechanical shape with no exhaust leaks or smoking from burning oil. The Engineer shall determine number of passes and areas rolled.

END OF SECTION

**INDEX TO**

**SECTION 31 10 00 – SITE CLEARING**

# SECTION 31 10 00

# SITE CLEARING

## PART 1 – GENERAL

### 1.1 SECTION INCLUDES

A. Removal of surface debris.

B. Removal of paving, curbs, and sidewalk.

C. Removal of trees, shrubs, and other plant life.

D. Topsoil excavation.

### 1.2 RELATED SECTIONS

A. Section 31 00 00 – Earthwork.

B. Section 02 41 13 – Selective Site Demolition.

### 1.3 MEASUREMENT AND PAYMENT

A. Site Clearing: Clearing, grubbing and other items to be removed will be included in the lump sum price in the proposal for clearing work. Includes clearing site, removing stumps, loading and removing waste materials from site.

### 1.4 REGULATORY REQUIREMENTS

A. Conform to applicable South Carolina code for environmental requirements, disposal of debris, and use of herbicides.

B. Coordinate clearing Work with utility companies.

## PART 2 – PRODUCTS

### 2.1 MATERIALS

A. Provide tree protection materials as detailed on the construction drawings.

## PART 3 – EXECUTION

### 3.1 PREPARATION

A. Verify existing plant life designated to remain is tagged or identified.

### 3.2 PROTECTION

A. All trees on site will be saved except those marked specifically by the Owner's representative for removal during construction. No trees, including those marked

for removal on site or any other tree, may be removed prior to the preconstruction conference. All trees not to be removed will be protected from injury to their roots and to their top to a distance three feet beyond the drip–line and no grading, trenching, pruning, or storage of materials may go in this area except as provided by an Owner's representative stakeout. Contractor will pay a penalty for any tree removed from the site that has not been marked specifically for removal. Contractor also will pay for any tree that dies due to damage during construction. This applies to all trees on site whether or not they are shown on the plans.

B. Contractor shall not be held accountable for damages to trees resulting from placement of fill or removal of soils where such action is required by the contract documents. Any tree, the trunk of which is within 10 feet of any footing or trench, shall be exempt from these penalties except Contractor shall exercise all reasonable precautions to preserve even these trees. Contractor agrees to pay fines as established below in the event he or any of his subcontractors causes loss or removal of trees designated to be saved under provisions of this contract.

The fines are as follows:

| Caliper | Fine |
|---|---|
| 1" – 2" | $ 150.00 |
| 2" – 3" | 200.00 |
| 3" – 4" | 250.00 |
| 4" – 5" | 400.00 |
| 5" – 6" | 500.00 |
| 6" – 7" | 600.00 |
| 7" – 8" | 750.00 |
| 8" – 11" | 1,500.00 |
| 12" – 20" | 2,000.00 |
| 21" & larger | $ 2,500.00 |

C. Trees shall be graded by Owner's representative as to variety, condition, and site importance, with above figures acting as a maximum fine. Lowest assessment amount shall be no less than one–half of the above fine figures.

D. Protect benchmarks, survey control points, and existing structures from damage or displacement.

E. Protect all remaining utilities.

F. Clearing operations shall be conducted to prevent damage by falling trees to trees left standing, to existing structures and installations, and to those under construction, and to provide for the safety of employees and others.

## 3.3 CLEARING

A. Clear areas required for access to site and execution of work. Clearing shall consist of felling and cutting trees into sections, and satisfactory disposal of trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within area to be cleared. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be removed completely

from the site, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within cleared areas shall be trimmed of dead branches 1–1/2 inch or more in diameter. Limbs and branches to be trimmed shall be neatly cut close to the trunk of the tree or main branches. Cuts more than 1–1/2 inches in diameter shall be painted with an accepted treewound paint. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations, by the erection of timber barriers or by such other means as circumstances require. Such barriers must be placed and be checked by the OWNER before construction observations can proceed (See 3.2). Clearing shall also include removal and disposal of structures obtruding, encroaching upon, or otherwise obstructing the work.

**3.4 REMOVAL**

A. Where indicated or directed, trees and stumps shall be removed from areas outside those areas designated for clearing and grubbing. Work shall include felling of such trees and removal of their stumps and roots. Trees shall be disposed of as hereinafter specified.

B. Remove debris, rock, and other extracted plant life from site.

C. Partially remove paving, curbs, and sidewalk; as indicated. Neatly saw cut edges at right angle to surface.

**3.5 DISPOSAL**

A. Disposal of trees, branches, snags, brush, stumps, etc., resulting from clearing and grubbing shall be the Contractor's responsibility and shall be disposed of by removal from site. All costs in connection with disposing of materials will be at the Contractor's expense. All liability of any nature resulting from disposal of cleared and grubbed material shall become the Contractor's responsibility. Disposal of all materials cleared and grubbed will be in accordance with rules and regulations of the State of South Carolina. No material will be burned unless directed to do so by the OWNER. Contractor shall obtain a permit to burn on site from local fire department, before beginning the work.

**3.6 GRUBBING**

A. Grubbing shall consist of removal and disposal of stumps, roots larger than one inch in diameter, and matted roots from designated grubbing areas. This material, together with logs and other organic or metallic debris not suitable for building of pavement subgrade or building pads, shall be excavated and removed to a depth of not less than 18 inches below original surface level of the ground in embankment areas and not less than 2 feet below finished earth surface in excavated areas. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform to original adjacent ground.

END OF SECTION

**INDEX TO**

**SECTION 31 25 00 – EROSION AND SEDIMENTATION CONTROLS**

# SECTION 31 25 00

# EROSION AND SEDIMENTATION CONTROLS

## PART 1 – GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions apply to this section.

### 1.2 DESCRIPTION OF WORK

A. Extent of soil erosion control work includes all measures necessary to meet the requirements of this section.

Erosion and sediment control measures shall be installed prior to any construction activity.

Soil erosion and sediment control measures shall include all temporary and permanent means of protection and trapping soils of the construction site during land disturbing activity. Activity covered in this contract shall meet standards of NPDES General Permit for the state where work is performed.

### 1.3 PURPOSES

A. Contractor is to achieve the following goals:

1. Minimize soil exposure by proper timing of grading and construction.
2. Retain existing vegetation whenever feasible.
3. Vegetate and mulch denuded areas as soon as possible.
4. Divert runoff away from denuded areas.
5. Minimize length and steepness of slopes when it is practical.
6. Reduce runoff velocities with sediment barriers or by increasing roughness with stone.
7. Trap sediment on site.
8. Inspect and maintain erosion control measures.

### 1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of soil erosion control systems products of types and sizes required, whose materials have been in satisfactory use for not less than 5 years.

B. Codes and Standards: Comply with all applicable Local, State, and Federal Standards pertaining to soil erosion control.

### 1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instruction for soil erosion control materials and products.

### 1.6 MEASUREMENT AND PAYMENT

A. No unit measurements will be made for soil erosion control. Payment will be made at the lump sum price as shown on the bid proposal. The cost of soil erosion control shall include all equipment, labor and materials necessary to comply with the State of South Carolina Erosion and Sediment Control Program.

## PART 2 – PRODUCTS

### 2.1 GRASSING MATERIALS

A. Refer to Section 32 92 00 – Turf and Grasses.

1. General: All grass seed shall be free from noxious weeds, grade A recent crop, recleaned and treated with appropriate fungicide at time of mixture. Deliver to site in original sealed containers with dealer's guarantee as to year grown, percentage of purity, percentage of germination and date of the test by which percentages of purity and germination were determined. All seed sown shall have a date of test within six months of the date of sowing.

2. Type of Seed: Either Annual Rye or Common Bermuda Grass seed will be used depending on time of year in which seeding is to occur.

3. Mulch: Straw.

4. Fertilizer: Commercial balanced 4–12–12 fertilizer.

### 2.2 HAY BALES

A. Standard size, densely baled straw or hay, wrapped with synthetic or wire bands (two minimum per bale).

### 2.3 SILT FENCE

A. Silt fence shall be a woven geotextile fabric sheet. Fabric shall be a synthetic polymer composed of at least 85% by weight propylene, ethylene, amide, ester, or vinylidene chloride, and shall contain stabilizer and/or inhibitors added to the base plastic to make filaments resistant to deterioration due to ultra–violet and/or heat exposure. Fabric should be finished so the filaments will retain their relative position with respect to each other. Fabric shall be free of defects, rips, holes, or flaws.

Fabric shall meet the following requirements:

| Woven Fabrics | |
|---|---|
| Grab Strength | 90 lbs. |
| Burst Strength | 175 PSI |
| UV Resistance | 80% |

### 2.4 CHEMICALS FOR DUST CONTROL

A. Calcium Chloride, Anionic Asphalt Emulsion, latex Emulsion or Resin–in–Water Emulsion may be used for dust control.

### 2.5 RIP–RAP

A. Shall be hard quarry or field stone of such quality the pieces will not disintegrate on exposure to water, sunlight, or weather. Stone shall range in weight from a minimum of 25 pounds to a maximum of 125 pounds. At least 50 percent of the stone shall weigh more than 60 pounds. The stone shall have a minimum dimension of 12 inches.

### 2.6 PRODUCT REVIEW

A. Contractor shall provide the Engineer with a complete description of all products before ordering. Engineer will review all products before they are ordered.

## PART 3 – EXECUTION

### 3.1 GENERAL

A. All disturbed soil areas except those to support paving shall be graded and protected from erosion by grassing. Disturbed areas must be grassed within 14 days of work ending unless work is to begin again before 21 days. Storm water conveyance systems shall have sediment barriers installed at all entrances, intersections, change in direction and discharge points.

### 3.2 GRASSING

A. Refer to Section 32 92 00 – Turf and Grasses.

### 3.3 SEDIMENT BARRIERS

A. Hay Bales for Sheet Flow Applications:

1. Excavate a 4 inch deep trench the width of a bale and length of proposed barrier. Barrier should be parallel to the slope. Place barrier 5 to 6 feet away from toe of slope, unless otherwise instructed.

2. Place bales in the trench with their ends tightly abutting. Corner abutment is not acceptable. A tight fit is important to prevent sediment from escaping through spaces between the bales.

3. Backfill the trench with previously excavated soil and compact it. Backfill soil should conform to ground level on downhill side of barrier and should be built up to 4 inches above ground on uphill side of bales.

4. Inspect and repair or replace damaged bales promptly. Remove hay bales when uphill sloped areas have been permanently stabilized.

B. Rock Ditch Check

1. Excavate a 6 inch deep trench the width and length of proposed barrier. Install a non–woven geotextile fabric in the trench before placing rock for the ditch check.

2. The body of the ditch check shall be constructed of 12 inch rip–rap. The upstream face may be covered with 1–inch washed stone.

3. Ditch checks shall not exceed a height of 2 feet at centerline of the channel and have a minimum top flow length of 2 feet.

4. Rip–rap shall be placed over the channel banks to prevent water from flowing around ditch check. Rock must be installed by hand or mechanical placement (no dumping of rock) to achieve complete coverage of the ditch and ensure the center of the check is lower than the edges.

5. The maximum spacing between ditch checks shall be where the toe of the upstream check is at the same elevation as the top of the downstream check.

6. Contractor shall maintain ditch checks as required by State regulations.

## 3.4 SILT FENCE

A. Silt fence shall be placed at approximate location shown and installed in accordance with the detail on the construction drawings. Contractor shall maintain silt fence as required by state regulations.

## 3.5 DUST CONTROL

A. Dust raised from vehicular traffic will be controlled by wetting down access road with water or by the use of a deliquescent chemical, such as calcium chloride, if relative humidity is over 30%. Chemicals shall be applied in accordance with manufacturer's recommendations.

B. Contractor shall use all means necessary to control dust on and near the work, or off–site borrow areas when dust is caused by operations during performance of work or if resulting from the condition in which any subcontractor leaves the site. Contractor shall thoroughly treat all surfaces required to prevent dust from being a nuisance to the public, neighbors, and concurrent performance of work on site.

**3.6 SEDIMENT BASIN**

A. A sediment basin equal in volume to 3,600 cubic feet per disturbed acre is required. The sediment basin/lagoon adjacent to the outfall for the site shall be constructed and stabilized prior to any additional land disturbed activity.

**3.7 RIP–RAP**

A. Rip–Rap shall be placed at the locations shown and installed in accordance with the detail on the construction drawings.

**3.8 CONSTRUCTION EXIT**

A. Construct exit at the location shown per detail on the construction drawings. Contractor shall maintain construction exit as required by state regulations.

**3.9 INLET PROTECTION**

A. Install inlet protection per detail on the construction drawings. Contractor shall maintain inlet protection as required by state regulations until all disturbed surfaces are stabilized.

END OF SECTION

**INDEX TO**

**SECTION 31 37 00 – RIP–RAP**

# SECTION 31 37 00

# RIP–RAP

## PART 1 – GENERAL

### 1.1SECTION INCLUDES

A. Material placed as bank protection and erosion control.

### 1.2RELATED SECTIONS

A. Section 31 25 00 – Erosion and Sedimentation Control

### 1.3ALLOWABLE TOLERANCES

A. Depth of rip–rap blanket as shown on the drawings and in these specifications is a minimum depth.

### 1.4 MEASUREMENT AND PAYMENT

A. Rip–Rap: Payment will be made at the contract unit price. Payment will include furnishing all labor, materials, and equipment and placing on a prepared surface.

### 1.5 REFERENCES (LATEST REVISION)

A. ASTM C 150 – Portland Cement.

## PART 2 – PRODUCTS

### 2.1 MATERIALS

A. Stone Rip–Rap: Shall be hard quarry or field stone of such quality the pieces will not disintegrate on exposure to water, sunlight, or weather. Stone shall be solid and non–friable and range in weight from a minimum of 25 pounds to a maximum of 150 pounds. At least 50 percent of the stone pieces shall weigh more than 60 pounds. The stone pieces shall have a minimum dimension of 12 inches. Documents indicating stone analysis, source and other pertinent data (i.e. – filter fabric) shall be submitted for review by the Engineer prior to delivery.

B. Sand–Cement Bag Rip–Rap:

1. Bags: Shall be of cotton, burlap, or fiber–reinforced paper capable of containing the sand–cement mixture without leakage during handling and placing. Bags previously used for any purpose shall not be used. Capacity shall be not less than 0.75 cubic foot nor more than two cubic feet.

2. Cement: Portland cement shall be Type I meeting requirements of ASTM C 150. Cement which has been damaged, or which is partially set, lumpy, or caked shall not be used.

3. Fine Aggregate: Shall be composed of hard, durable particles, free from injurious amounts of organic impurities and shall contain, in the material passing the No. 10 sieve, not more than 7 percent clay, and not more than 20 percent passing the No. 200 sieve.

C. Filter Fabric: Shall be a woven fabric of monofilament and multifilament yarn equivalent to Mirafi FW700. Fabric shall be finished so the filaments will retain their relative position with respect to each other. Fabric shall contain stabilizers and/or inhibitors added to make filaments resistant to deterioration due to ultraviolet and/or heat exposure. Fabric shall be free of flaws, rips, holes, or defects.

### 2.2 PRODUCT REVIEW

A. Contractor shall provide the Engineer with a complete description of all products before ordering. Engineer will review all products before they are ordered.

## PART 3 – EXECUTION

### 3.1PREPARATION

A. The surface to receive rip–rap shall be prepared to a relatively smooth condition free of obstruction, depressions, debris, rises, and soft or low density pockets of material. Contours and elevations on construction drawings are to the surface of rip–rap material.

### 3.2PLACEMENT

A. Filter fabric shall be placed with the long dimension running up slope. The strips shall be placed to provide a minimum width of one foot of overlap for each joint. Fabric shall be anchored in place with securing pins of the type recommended by fabric manufacturer. Pins shall be placed on or within 3 inches of the over–lap. Place fabric so upstream strip will overlap the downstream strip. Fabric shall be placed loosely to give and avoid stretching and tearing during placement of the stones.

B. Minimum depth or thickness of stone blanket shall be 12 inches with no under tolerance. Stones shall be dropped no more than three feet during construction. Placing shall begin at bottom of slope. Provide a toe trench if required as detailed on the construction drawings. Entire mass of stone shall be placed to conform with lines, grades, and thickness shown on the plans. Rip–rap shall be placed to its full course thickness at one operation and in such a manner as to avoid displacing the underlying material. Placing of rip–rap in layers, or by dumping into chutes, or by similar methods likely to cause segregation, will not be permitted.

Larger stones shall be well distributed and the entire mass of stone shall conform to gradation specified. All material used in rip–rap protection shall be placed

and distributed so there will be no large accumulations of either the larger or smaller sizes of stone.

It is the intent of these specifications to produce a fairly compact rip–rap protection in which all sizes of material are placed in their proper proportions. Hand placing or rearranging of individual stones by mechanical equipment may be required to secure the results specified.

C. Sand–Cement Bag Rip–Rap: Bags shall be uniformly filled. Bagged rip–rap shall be placed by hand with tied ends facing the same direction, with close, broken joints. After placing, bags shall be rammed or packed against one another to produce the required thickness and form a consolidated mass. The top of each bag shall not vary more than 3 inches above or below required plane. When directed by the Engineer or required by construction drawings, header courses shall be placed.

END OF SECTION

**INDEX TO**

**SECTION 32 11 23 – AGGREGATE BASE COURSES**

# SECTION 32 11 23

# AGGREGATE BASE COURSES

## PART 1 – GENERAL

### 1.1SECTION INCLUDES

A. Aggregate base course.

### 1.2RELATED SECTIONS

A. Section 01 22 00 – Unit Prices: Requirements applicable for the work of this section.

B. Section 01 45 00 – Quality Control.

C. Section 31 00 00 – Earthwork

D. Section 32 12 16 – Asphalt Paving: Binder and finish asphalt courses.

### 1.3 MEASUREMENT AND PAYMENT

A. Aggregate Base Course: Payment will be made at the contract unit price. Payment will include supplying all material, labor, and equipment, stockpiling, scarifying substrate surface, placing where required, and compacting.

B. Prime Coat: Bituminous prime coat will not be measured for separate payment. All costs connected with applying prime coat will be included in the unit price bid for Aggregate Base Course.

### 1.4 REFERENCES (LATEST REVISION)

A. ASTM C 131 – Resistance to Degradation of Small–Size Course Aggregate by Abrasion and Impact in the Lost Angeles Machine.

B. ASTM D 1557 – Laboratory Compaction Characteristics of Soil Using Modified Effort.

C. ASTM D 6938 – In–Place Density and Water Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth).

D. ASTM D 3740 – Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock Used in Engineering Design and Construction.

E. ASTM E 329 – Agencies Engaged in Construction Inspection and/or Testing.

### 1.5 QUALITY ASSURANCE

A. Perform work in accordance with the South Carolina Department of Transportation 2007 Standard Specifications for Highway Construction.

### 1.6 TESTING

A. Laboratory tests for moisture density relationship for fill materials shall be in accordance with ASTM D 1557, (Modified Proctor).

B. In place density tests in accordance with ASTM D 6938.

C. Testing laboratory shall operate in accordance with ASTM D 3740 and E 329 and be acceptable to the Engineer.

D. Testing laboratory and Project Engineer/Project Representative shall be given a minimum of 48 hours notice prior to taking any tests.

E. Owner shall select and engage the Testing Laboratory. Testing Laboratory shall be responsible to the Owner and Owner's Engineer. Payment for laboratory and all tests shall be by the Owner, except Owner specifically reserves the right to deduct from Contractor's payment, expenses and charges of Testing Laboratory when:

1. Contractor gives notice the work is ready for inspection and testing, and fails to be ready for the test, and/or

2. Testing of the Contractor's work, products, or materials fail, and retesting is required, and/or

3. Contractor abuses the services or interferes with the work of the testing laboratory in the conduct of this work.

F. Test results shall be furnished to the Engineer prior to continuing with associated or subsequent work.

## PART 2 – PRODUCTS

### 2.1 MATERIALS

A. Aggregate shall consist of processed and blended crushed stone. Aggregates shall be free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign material and shall be durable and sound. Coarse aggregate shall have a percentage of wear not to exceed 65% after 500 revolutions as determined by ASTM C 131. Aggregate shall meet applicable requirements of Section 305.2 in the South Carolina Department of Transportation Standard 2007 Specifications for Highway Construction. Material shall meet the following gradation and other requirements:

| Granite Stone or Recycled Concrete | |
|---|---|
| Sieve Size | Percent by Weight Passing |
| 2" | 100 |
| 1–1/2" | 95 – 100 |
| 1" | 70 – 100 |

| | |
|---|---|
| 1/2" | 48 – 75 |
| # 4 | 30 – 60 |
| # 30 | 11 – 30 |
| #200 | 0 – 12 |
| Liquid Limit | 0 to 25 |
| Plasticity Index | 0 to 6 |

| Marine Limestone | |
|---|---|
| Sieve Size | Percent by Weight Passing |
| 2" | 100 |
| 1–1/2" | 95 – 100 |
| 1" | 70 – 100 |
| 1/2" | 50 – 85 |
| # 4 | 30 – 60 |
| # 30 | 17 – 38 |
| #200 | 0 – 20 |
| Liquid Limit | 0 to 25 |
| Plasticity Index | 0 to 6 |

B. Prime Coat: Shall be EA–P Special, Emulsified asphalt, conforming to Section 407 of the South Carolina Department of Transportation 2007 Standard Specifications for Highway Construction.

## PART 3 – EXECUTION

### 3.1 EXAMINATION

A. Verify subbase has been tested, is dry, and slopes and elevations are correct.

B. ON SITE OBSERVATIONS OF WORK: Owner's Representative or Engineer will have the right to require any portion of the work be completed in their presence. If the work is covered up after such instruction, it shall be exposed by Contractor for observation at no additional cost to the Owner. However, if Contractor notifies Owner such work is scheduled, and the Owner fails to appear within 48 hours, Contractor may proceed. All work completed and materials furnished shall be subject to review by the Owner, Engineer, or Project Representative. Improper work shall be reconstructed. All materials, which do not conform to requirements of specifications, shall be removed from the work upon notice being received from Engineer for rejection of such materials. Engineer shall have the right to mark rejected materials to distinguish them as such.

Contractor shall give the Owner, Project Engineer or Project Representative a minimum of 48 hours notice for all required observations or tests.

### 3.2PREPARATION

A. Subbase shall be graded and shaped conforming to the lines, grades, and cross sections required and cleaned of all foreign substances prior to constructing base course. Do not place base on soft, muddy or frozen surfaces. Correct

irregularities in subbase slope and elevation by scarifying, reshaping, and recompacting.

B. At the time of base course construction, subbase shall contain no frozen material.

C. Surface of subbase shall be checked by the Engineer or Project Representative for adequate compaction and surface tolerances. Ruts or soft yielding spots appearing in areas of subbase course having inadequate compaction, and areas not smooth or which vary in elevation more than 3/8 inch above or below required grade established on the plans, shall be corrected to the satisfaction of the Engineer or Project Representative. Base material shall not be placed until subbase has been properly prepared and test results have so indicated.

## 3.3 AGGREGATE PLACEMENT

A. Aggregate shall be placed in accordance with South Carolina Department of Transportation 2007 Standard Specifications for Highway Construction Section 305 and in accordance with all terms included in these specifications.

B. Level and contour surfaces to elevations and slopes indicated.

C. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.

D. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.

E. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

F. While at optimum moisture (± 1–1/2%), compact base course with rollers capable of obtaining required density. Vibratory, flatwheel, and other rollers accepted by the Engineer may be used to obtain required compaction. Rolling shall continue until base is compacted to 98% of the maximum laboratory dry density as determined by ASTM D 1557. In–place density of the compacted base will be determined in accordance with ASTM D 6938.

## 3.4 PRIME COAT

A. Bituminous material for the prime coat shall be applied uniformly and accurately in quantities of not less than 0.15 gallons per square yard nor more than 0.30 gallons per square yard of base course. All irregularities in the base course surface shall be corrected prior to application of prime coat. Clean the base course of all mud, dirt, dust, and caked and loose material

B. Do not apply prime to a wet surface nor when temperature is below 40°F in the shade. Do not apply prime when rain threatens nor when weather conditions prevent proper construction and curing of prime coat.

C. The primed base should be adequately cured before the binder or surface course is laid. In general, a minimum of 48 hours should be allowed for complete

curing. Ordinarily, proper surface condition of the prime is indicated by a slight change in the shiny black appearance to a slightly brown color.

## 3.5 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch measured with an acceptable 10–foot straight edge.

B. Scheduled Compacted Thickness: Within 3/8 inch.

C. Variation from Design Elevation: Within 3/8 inch.

D. Depth measurements for compacted thickness shall be made by test holes through the base course. Where base course is deficient, correct such areas by scarifying, adding base material, and recompacting as directed by the Engineer.

## 3.6 FIELD QUALITY CONTROL

A. Section 01 45 00 – Quality Control: Field observation.

B. Density and moisture testing will be performed in accordance with ASTM D 1557 and ASTM D 6938.

C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.

D. Frequency of Tests:

1. Base Density and Thickness – One test per 5,000 square feet.

END OF SECTION

**INDEX TO**

**SECTION 32 11 26 – ASPHALTIC BASE COURSES**

# SECTION 32 11 26

# ASPHALTIC BASE COURSES

## PART 1 – GENERAL

### 1.1 SECTION INCLUDES

A. Asphaltic Concrete Base Course

### 1.2 RELATED SECTIONS

A. Section 01 22 00 – Unit Prices

B. Section 01 45 00 – Quality Control

C. Section 31 00 00 – Earthwork

D. Section 32 12 16 – Asphalt Paving

### 1.3 MEASUREMENT AND PAYMENT

A. Asphaltic Concrete Base Course: Payment will be made at the contract unit price. Payment will include furnishing and placing base, compaction, testing, and all equipment, labor, and materials necessary to complete the work.

### 1.4 REFERENCES (LATEST REVISION)

A. ASTM D 946 – Penetration–Graded Asphalt Cement for Use in Pavement Construction.

B. ASTM E 329 – Agencies Engaged in Construction Inspection and/or Testing.

C. ASTM D 2726 – Bulk Specific Gravity and Density of Non–Absorptive Compacted Bituminous Mixtures.

D. ASTM D 2950 – Density of Bituminous Concrete in Place by Nuclear Methods.

E. ASTM D 3740 – Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock Used in Engineering Design and Construction.

F. AASHTO T 245 – Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.

G. AASHTO T 179 – Effect of Heat and Air on Asphalt Materials (Thin–Film Oven Test).

H. AASHTO M 226 – Viscosity Graded Asphalt Cement.

### 1.5 QUALITY ASSURANCE

A. Perform work in accordance with South Carolina Department of Transportation 2007 Standard Specifications for Highway Construction.

B. Mixing Plant: Conform to South Carolina Department of Transportation 2007 Standard Specifications for Highway Construction.

## 1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not place asphalt mixture when ambient air temperature is less than that indicated in the Table nor when the surface is wet or frozen.

| Lift Thickness | Min. Air Temperature, Degrees F. |
|---|---|
| 1" or Less | 55 |
| 1.1" to 2" | 45 |
| 2.1" to 3" | 35 |
| 3.1" to 4" | 30 |
| 4.1" to 8" | Contractor's Discretion |

B. Place bitumen mixture when mixture temperature is not more than 15 degrees F below bitumen supplier's bill of lading and not more than the maximum specified temperature.

## 1.7 TESTING

A. Testing laboratory shall operate in accordance to ASTM D 3740 and E 329 and shall be acceptable to the Engineer.

B. The testing laboratory and Project Engineer/Project Representative shall be given a minimum of 48 hours notice prior to taking any tests.

C. Testing Laboratory shall be selected by, engaged by and be the responsibility of Owner. Testing Laboratory shall be responsible to Owner and the Owner's Engineer. Payment for laboratory and all tests shall be by Owner, except Owner specifically reserves the right to deduct from Contractor's payment, expense and charges of Testing Laboratory when:

1. the Contractor gives notice work is ready for inspection and testing, and Contractor fails to be ready for test, and/or

2. the test of Contractor's work, products, or materials fail, and retesting is required, and/or

3. the Contractor abuses services or interferes with work of testing laboratory in conduct of this work.

D. Test results shall be furnished to the Engineer prior to continuing with associated or subsequent work.

## PART 2 – PRODUCTS

### 2.1 MATERIALS

A. Asphalt Cement: PG64–22 (SC).

B. Anti–Stripping: Anti–stripping agents or other additives required shall be acceptable to the Engineer prior to their use. Additive delivery systems shall be acceptable to the Engineer.

C. Aggregate shall consist of processed and blended crushed stone and be free of lumps and balls of clay, organic matter, objectionable coatings and other foreign material, and shall be durable and sound. Material shall meet applicable requirements of Section 310 of the South Carolina Department of Transportation Standard Specifications.

D. Base Mixture: Shall meet Section 310 of the South Carolina State Highway Department Standard Specifications.

### 2.2 SOURCE QUALITY CONTROL AND TESTS

A. Section 01 45 00 – Quality Control, 01 45 23 – Testing and Inspecting Services. Provide mix design for asphalt.

B. Submit proposed mix design for review prior to beginning of work.

C. Test samples in accordance with the requirements of these specifications.

## PART 3 – EXECUTION

### 3.1 EXAMINATION

A. Verify subbase has been tested, is dry, and gradients and elevations are correct.

B. ON–SITE OBSERVATIONS OF WORK: Owner's Representative or Engineer will have the right to require any portion of work be completed in their presence. If the work is covered up after such instruction, it shall be exposed by the Contractor for observation at no additional cost to Owner. However, if Contractor notifies Owner such work is scheduled, and Owner fails to appear within 48 hours, the Contractor may proceed. All work completed and materials furnished shall be subject to review by the Owner, Engineer, or Project Representative. Improper work shall be reconstructed. All materials, which do not conform to requirements of specifications, shall be removed from the work upon notice being received from Engineer for rejection of such materials. Engineer shall have the right to mark rejected materials to distinguish them as such.

Contractor shall give the Owner, Project Engineer or Project Representative a minimum of 48 hours notice for all required observations or tests.

## 3.2 PREPARATION

A. Subbase shall be leveled to lines and grades of plans and cleaned of all foreign substances prior to constructing the base course.

Do not place base on soft, muddy, or frozen surfaces.

Correct irregularities in subbase gradient and elevation by scarifying, reshaping, and recompacting.

B. At the time of base course construction, the subbase shall contain no frozen material.

C. The surface of subbase shall be checked by Engineer or Project Representative for adequate compaction and surface tolerances. Ruts or soft yielding spots appearing in areas of the subbase course having inadequate compaction, and areas not smooth or which vary in elevation more than 3/8 inch above or below required grade established on plans shall be corrected to satisfaction of Engineer or Project Representative. Base material shall not be placed until subbase has been properly prepared and test results have so indicated.

## 3.3 PLACEMENT

A. Construction shall be in accordance with Sections 310 and 401 of the South Carolina Department of Transportation Standard Specifications.

## 3.4 TOLERANCES

A. General: All paving shall be subject to visual and straightedge checking during construction operations and thereafter prior to final acceptance. A 10–foot straightedge shall be maintained in the vicinity of paving operation at all times for measuring surface irregularities on all paving courses. The straightedge and labor for its use shall be provided by Contractor. The surface of all courses shall be checked with a straightedge as necessary to detect surface irregularities. Irregularities such as ripping, tearing or pulling, which in the judgment of Engineer indicate a continuing problem in equipment, mixture or operating technique, will not be permitted to recur. The paving operation shall be stopped until appropriate steps are taken by Contractor to correct problem.

B. Flatness: Maximum variation of 1/4 inch measured with an acceptable 10 foot straight edge.

C. Scheduled Compacted Thickness: Within 3/8 inch under tolerance.

D. Variation from Design Elevation: Within 3/8 inch.

E. Base Deficient in Thickness: When measurement of any core indicates base is deficient in thickness, additional cores will be drilled 10 feet either side of the deficient core along centerline of lane until cores indicate thickness conforms to above specified requirements. A core indicating thickness deficiencies is considered a failed test. Base deficient in thickness shall be removed and replaced with the appropriate thickness of materials. If Contractor believes cores

and measurements taken are not sufficient to indicate fairly the actual thickness of base, additional cores and measurements will be taken, provided Contractor will bear extra cost of drilling cores and filling holes in roadway as directed.

## 3.5 FIELD QUALITY CONTROL

A. Section 01400 – Quality Assurance: Field Observation.

B. Density Testing: Performed in accordance with ASTM D–2726 and ASTM D–2950. Core samples for each day's operation shall be taken, tested and results reported to Engineer the following day. The areas sampled shall be properly restored by Contractor at no additional cost to Owner. Compaction must be accomplished when the temperature of mix is above 185 degrees F and below 300 degrees F. Nuclear gauge tests shall be taken during the asphaltic concrete placement.

1. The pavement core and nuclear gauge densities shall range between 94% and 96% of the theoretical maximum density.

C. Temperature:

1. Asphaltic concrete shall not exceed 325 degrees F at any time.

2. Temperature at time of loading shall be recorded on the truck delivery ticket.

D. Frequency of Tests:

1. Asphaltic Concrete – One test for each 250 tons placed.

a. Asphalt extraction and gradation test.

b. Core Sample

2. Field determination of density by nuclear method every 5,000 square feet during construction of the base course.

END OF SECTION

**INDEX TO**

**SECTION 32 12 16SC – ASPHALT PAVING**

# SECTION 32 12 16SC

# ASPHALT PAVING

## PART 1 – GENERAL

### 1.1 SECTION INCLUDES

A. Surface Course

B. Binder Course

### 1.2 RELATED SECTIONS

A. Section 01 22 00 – Unit Prices

B. Section 01 45 00 – Quality Control

C. Section 31 00 00 – Earthwork

D. Section 32 11 23 – Aggregate Base Courses

E. Section 32 11 26 – Asphaltic Base Courses

### 1.3 MEASUREMENT AND PAYMENT

A. Asphaltic Concrete Binder Course: Will be paid for at the contract unit price per square yard of completed and accepted binder course for the thickness specified.

B. Asphaltic Concrete Surface Course: Will be paid for at the contract unit price per square yard of completed and accepted surface course for the thickness specified.

C. Tack Coat: Will be paid for at the contract unit price per square yard of base or pavement covered.

D. Payment for pavement and tack coat will be in full for preparing and cleaning, providing all materials, labor and equipment including placing, compacting and testing.

### 1.4 REFERENCES (LATEST REVISION)

A. ASTM D 946 – Penetration–Graded Asphalt–Cement for Use in Pavement Construction.

B. ASTM E 329 – Agencies Engaged in Construction Inspection and/or Testing.

C. ASTM D 3740 – Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock Used in Engineering Design and Construction.

D. ASTM D 2726 – Bulk Specific Gravity and Density of Non–Absorptive Compacted Bituminous Mixtures.

E. ASTM D 2950 – Density of Bituminous Concrete in Place by Nuclear Methods.

F. ASTM D 1188 – Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples.

G. ASTM D 1754 – Effect of Heat and Air on Asphaltic Materials (Thin–film Oven Test).

**1.5 QUALITY ASSURANCE**

A. Perform work in accordance with South Carolina Department of Transportation 2007 Standard Specifications for Highway Construction.

B. Mixing Plant: Conform to South Carolina Department of Transportation 2007 Standard Specifications for Highway Construction.

**1.6 ENVIRONMENTAL REQUIREMENTS**

A. Do not place asphalt mixture when ambient air temperature is less than that indicated in the Table nor when the surface is wet or frozen.

| Lift Thickness | Min. Air Temperature, Degrees F. |
|---|---|
| 1" or Less | 55 |
| 1.1" to 2" | 45 |
| 2.1" to 3" | 40 |
| 3.1" to 4.5" | 35 |

B. Mixture shall be delivered to the spreader at a temperature between 250 degrees F and 325 degrees F.

**1.7 GUARANTEE**

A. Contractor shall guarantee the quality of materials, equipment, and workmanship for a period of 12 months after acceptance. Defects discovered during this period shall be repaired by the Contractor at no cost to the Owner.

**1.8 TESTING**

A. Testing laboratory shall operate in accordance with ASTM D 3740 and E 329 and be acceptable to the Engineer.

B. Testing laboratory and Project Engineer/Project Representative shall be given a minimum of 48 hours notice prior to taking any tests.

C. Owner shall select and engage the testing laboratory. Testing laboratory shall be responsible to the Owner and Owner's Engineer. Payment for laboratory and all tests shall be by the Owner, except Owner specifically

reserves the right to deduct from Contractor's payment, expenses and charges of testing laboratory when:

1. Contractor gives notice the work is ready for inspection and testing, and fails to be ready for the test, and/or

2. Testing of the Contractor's work, products or materials fail, and retesting is required, and/or

3. Contractor abuses the services or interferes with the work of the testing laboratory in the conduct of this work.

D. Test results shall be furnished to the Engineer prior to continuing with associated or subsequent work.

## PART 2 – PRODUCTS

### 2.1 TACK COAT

A. Shall consist of asphalt binder (asphalt cement) or emulsified asphalt, conforming to Section 401 of the South Carolina Department of Transportation 2007 Standard Specifications for Highway Construction. Asphalt binder shall be PG64–22. The acceptable grades of emulsified asphalt are RS–1, MS–1, MS–2, HFMS–1, HFMS–2, SS–1, CRS–1, CRS–2, CMS–2, and CSS–1.

### 2.2 ASPHALT BINDER AND ADDITIVES

A. Shall be PG64–22 and conform to Section 401 of the South Carolina Department of Transportation 2007 Standard Specifications for Highway Construction.

B. Anti–Stripping: Shall conform to requirements of Section 401 of the South Carolina Department of Transportation 2007 Standard Specifications for Highway Construction.

### 2.3 AGGREGATES

A. General: Mineral aggregate shall be composed of fine aggregate or a combination of fine and coarse aggregate. Coarse aggregate shall be that portion of the material retained on a No. 4 sieve.

Fine aggregate shall be considered that portion passing the No. 4 sieve. Fine aggregate, coarse aggregate, and any additives in combination with the specified percentage of asphalt cement shall meet the requirements of tests specified, before acceptance may be given for their individual use. Marine (Fossiliferous) limestone shall not be used.

B. Fine Aggregate: Shall conform to the requirements of Section 401 of the South Carolina Department of Transportation Standard Specifications for Highway Construction.

C. Coarse Aggregate: Shall be granite stone and conform to the requirements of Section 401 of the South Carolina Department of Transportation 2007 Standard Specifications for Highway Construction.

D. Surface Course: The surface course shall consist of fine and coarse aggregate and mineral filler uniformly mixed with hot asphalt binder in an acceptable mixing plant. The plant shall conform to South Carolina Department of Transportation 2007 Standard Specifications for Highway Construction. The gradations, asphalt content and air voids shall be the following:

| **TYPE B** | |
|---|---|
| Sieve Designation | Sieve Designation |
| 1 inch | 1 inch |
| 3/4 inch | 3/4 inch |
| 1/2 inch | 1/2 inch |
| 3/8 inch | 3/8 inch |
| No. 4 | No. 4 |
| No. 8 | No. 8 |
| No. 30 | No. 30 |
| No. 100 | No. 100 |
| No. 200 | No. 200 |
| % Asphalt Binder | % Asphalt Binder |

E. Intermediate or Binder Course: The mineral aggregates and asphalt binder shall be combined in such proportions the composition by weight of the finished mixture shall be within the following range limits:

| **TYPE B** | |
|---|---|
| Sieve Designation | Percentage by Weight Passing |
| 1 inch | 100 |
| 3/4 inch | 90 – 100 |
| 1/2 inch | 75 – 90 |
| 3/8 inch | 64 – 80 |
| No. 4 | 38 – 54 |
| No. 8 | 22 – 36 |
| No. 30 | 8 – 22 |
| No. 100 | 3 – 10 |
| No. 200 | 2 – 8 |
| % Asphalt Binder | 4 – 6 |
| Air Voids, % | 3.5 – 4.5 |

## 2.4 SOURCE QUALITY CONTROL AND TESTS

A. Section 01 45 00 – Quality Control and Section 01 45 23 – Testing and Inspecting Services.

B. Submit proposed mix design for review prior to beginning of work.

C. Test samples in accordance with the requirements of these specifications.

## PART 3 – EXECUTION

### 3.1 EXAMINATION

A. On–Site Observations: Owner's Representative or Engineer will have the right to require any portion of work be completed in their presence. If work is covered up after such instruction, it shall be exposed by the Contractor for observation at no additional cost to Owner. However, if Contractor notifies Engineer such work is scheduled, and Engineer fails to appear within 48 hours, the Contractor may proceed. All work completed and materials furnished shall be subject to review by the Engineer or Project Representative. Improper work shall be reconstructed. All materials, which do not conform to requirements of specifications, shall be removed from the work upon notice being received from Engineer for rejection of such materials. Engineer shall have the right to mark rejected materials to distinguish them as such.

Contractor shall give the Owner, Project Engineer or Project Representative a minimum of 48 hours notice for all required observations or tests.

B. Contractor shall verify base has been tested, is dry, and slopes and elevations are correct.

### 3.2 PREPARATION

A. Apply tack coat in accordance with Section 401 of the South Carolina Department of Transportation 2007 Standard Specifications for Highway Construction. Rate of application shall be 0.05 to 0.15 gallons per square yard of surface.

B. Work shall be planned so no more tack coat than is necessary for the day's operation is placed on the surface. All traffic not essential to the work should be kept off the tack coat.

C. Apply tack coat to contact surfaces of curbs and gutters. Apply in manner so exposed curb or gutter surfaces are not stained.

D. Coat surfaces of manhole frames and inlet frames with oil to prevent bond with asphalt pavement. Do <u>not</u> tack coat these surfaces.

### 3.3 PLACEMENT

A. Construction shall be in accordance with Sections 401, 402, and 403 of the South Carolina Department of Transportation 2007 Standard Specifications for Highway Construction.

B. Asphaltic concrete shall not be placed on a wet or frozen surface.

C. Compaction shall commence as soon as possible after the mixture has been spread to the desired thickness. Compaction shall be continuous and uniform over the entire surface. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks. Compaction rolling shall be complete before material temperature drops below 175° F.

D. Areas of pavement with deficient thickness or density shall be removed and replaced at no additional cost to the Owner.

**3.4 TOLERANCES**

A. General: All paving shall be subject to visual and straightedge evaluation during construction operations and thereafter prior to final acceptance. A 10–foot straightedge shall be maintained in the vicinity of the paving operation at all times for the purpose of measuring surface irregularities on all paving courses. The straightedge and labor for its use shall be provided by the Contractor. The surface of all courses shall be checked with the straightedge as necessary to detect surface irregularities. Irregularities such as rippling, tearing or pulling, which in the judgment of the Engineer indicate a continuing problem in equipment, mixture or operating technique, will not be permitted to recur. The paving operation shall be stopped until appropriate steps are taken by the Contractor to correct the problem.

B. Flatness: All irregularities in excess of 1/8 inch in 10 feet for surface courses and 1/4 inch in 10 feet for intermediate courses shall be corrected.

C. Variation from Design Elevation:

1. General Paving: Less than 1/4 inch.

2. Accessible Routes: Shall not exceed 1/4 inch. However, accessible routes shall not exceed maximum ADA allowable slopes. Contractor shall remove and replace any and all portions of the accessible route that exceed maximum ADA allowable slopes.

D. Scheduled Compacted Thickness: Within 1/4 inch per lift.

E. Pavement Deficient in Thickness: When measurement of any core indicates the pavement is deficient in thickness, additional cores will be drilled 10 feet either side of the deficient core along the centerline of the lane until the cores indicate the thickness conforms to the above specified requirements. A core indicating thickness deficiencies is considered a failed test. Pavement deficient in thickness shall be removed and replaced with the appropriate thickness of materials. If the Contractor believes the cores and measurements taken are not sufficient to indicate fairly the actual thickness of the pavement, additional cores and measurements will be taken, provided the Contractor will bear the

extra cost of drilling the cores and filling the holes in the roadway as directed.

## 3.5 FIELD QUALITY CONTROL

A. Acceptance of the in–place density of the binder and surface courses shall be in accordance with the South Carolina Department of Transportation 2007 Standard Specifications for Highway Construction.

B. Density Testing: Performed in accordance with ASTM D–2726 and ASTM D–2950. Core samples for each day's operation shall be taken, tested and results reported to the Engineer the following day. The areas sampled shall be properly restored by the Contractor at no additional cost to the Owner. Nuclear gauge tests shall be taken during the asphaltic concrete placement.

1. The pavement core and nuclear gauge densities shall range between 94% and 96% of the theoretical maximum density.

C. Temperature:

1. Asphaltic concrete shall not exceed 325 degrees F at any time.

2. Asphaltic concrete shall not be placed once the temperature of the mix falls below 250 degrees F or the delivered temperature is more than 15 degrees F below the batch plant's delivery ticket.

3. Temperature at time of loading shall be recorded on the truck delivery ticket.

D. Frequency of Tests:

1. Asphaltic Concrete – One test for each 250 tons placed.

   a. Asphalt extraction and gradation test.

   b. Core Sample

2. Field determination of density by nuclear method every 5,000 square feet during construction of the asphaltic concrete binder/surface course.

END OF SECTION

**INDEX TO**

**SECTION 32 14 43 – PERMEABLE CLAY PAVERS**

**INDEX TO**

**SECTION 32 14 43 – PERMEABLE CLAY PAVERS**

# SECTION 32 14 43 – PERMEABLE CLAY PAVERS

## PART 1 – GENERAL

### 1.01 SECTION INCLUDES

A. Permeable clay paver units

B. Open graded setting bed (#89)

C. Open graded base aggregate (#57)

D. Open graded subbase aggregate (#2)

E. Bedding and joint/opening filler materials

F. Edge restraints

G. Geotextiles (optional)

### 1.02 RELATED SECTIONS

A. Section 03 00 00 – Concrete

### 1.03 REFERENCES

A. American Society of Testing Materials (ASTM):

1. C902 Standard Specification for Pedestrian and Light Traffic Paving Brick

2. C1272 Standard Specification for Heavy Vehicular Paving Brick

3. C136 Method for Sieve Analysis for Fine and Coarse Aggregate.

4. C67 Method of Sampling and Testing Brick and Structural Clay Tile.

5. D448 Standard Classification for Sizes of Aggregates for Road and Bridge

### 1.04 QUALITY ASSURANCE

A. Paver Installation Subcontractor Qualifications:

1. Utilize an installer having successfully completed permeable paver installation similar in design, material and extent indicated on this project.

2. Utilize an installer holding a completion certificate from the Pave Tech School for Advanced Segmental Paving Permeable Paving Systems course or equivalent.

B. Review the manufacturers' quality control plan, paver installation subcontractor's Method Statement and Quality Control Plan with preconstruction meeting of representatives from the manufacturer, paver installer, general contractor, engineer and/or owner's representative.

**1.05 SUBMITTALS**

A. Submit shop or product drawings

B. Submit permeable clay paver product data.

1. Manufacturer's (Pine Hall Brick Company, Inc.) product catalog sheets with specifications.

2. Three representative full size samples of each paver type, thickness, and color. Submit samples indicating the range of color expected in the finished installation.

3. Accepted samples become the standard of acceptance for the work of this Section.

4. Laboratory test reports certifying compliance of the clay pavers with ASTM C 902 or C1272.

5. Manufacturer's material safety data sheets for the safe handling of the specified materials and products.

C. Submit sieve analysis for grading of subbase, base, and bedding materials per ASTM C136.

D. Submit minimum 3 lb samples of subbase, base and bedding aggregate materials.

E. Submit test results for compliance of paving unit requirements to ASTM C 902 or ASTM C 1272 from and independent testing laboratory.

F. Erosion and sediment control plan

G. Submit installer qualifications: provide satisfactory evidence that the installer complies with the qualifications set out in section 1.03.

1. The installer shall provide installation history, including references from projects of a similar size and complexity in writing with contact information, demonstrating to the owner's satisfaction their ability to perform the paver installation and related work indicated in the plans and specifications.

2. The installer shall have experienced personnel and a management capability to execute the work detailed in the project drawings and specifications. The installer's foreman should have a minimum of 5 years experience in the installation of unit pavers including clay pavers.

### 1.06 MOCK UPS

A. Install a 10 ft. x 10 ft. paver area. This area will be used to determine surcharge of the bedding layer, joint sizes, lines, laying pattern(s), color(s), and texture of the job. This area shall be the standard from which the work will be judged.

### 1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver brick pavers to the site in steel banded, plastic banded, or plastic wrapped cubes or on pallets capable of transfer by fork lift or clamp lift. Unload pavers at job site in such a manner that no damage occurs to the product.

### 1.08 ENVIRONMENTAL CONDITIONS

A. Do not install bedding or pavers during heavy rain or snowfall.

B. Do not install frozen bedding.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURED UNITS

Permeable clay brick pavers have spacer bars on each unit. These insure a minimum joint width between each unit in which the aggregate is placed. Spacer bars help prevent contact of the edges with adjacent pavers and subsequent chipping.

A. Permeable clay brick pavers shall be A Grade pavers manufactured/supplied by a member of the Brick Institute of America (BIA). The BIA manufacturer/supplier shall be:

| | |
|---|---|
| Name: | **PINE HALL BRICK** |
| Address: | P. O. Box 11044 |
| | 2701 Shorefair Drive |
| | Winston Salem, NC 271161044 |
| Phone: | (800) 334–8689 |

B. Product name/shape, overall dimensions, and thickness of the permeable clay paver units shall be:

1. Paver Type: StormPave (Tumbled)

   a. Material Standard: Comply with ASTM C 902 or C1272.

   b. Color : As approved by Owner

   c. Size: 4 inches' x 8 inches' x 2 1/4 inches thick.

   d. Manufacturer item number.

C. Pavers shall meet the following requirements set forth in ASTM C 902, Specification for Pedestrian and Light Traffic Paving Brick or C 1272 Specification for Heavy Vehicular Paving Brick and shall conform to the PX standard.

1. Minimum average compressive strength of 10,000 psi.

2. The average cold water absorption shall not be greater than 6% with no individual unit testing greater than 7%. Absorption test results may not be achieved through the use of sealers or other products applied to the clay paver. (Sealer protection degrades over time requiring reapplication after several years.)

3. Resistance of 50 freeze thaw cycles, when tested in accordance with ASTM C67. In addition the clay paver must pass CSAA231.2 freeze thaw test in saline solution without the use of sealers or other products applied to the paver. A test report must be submitted by the manufacturer. (Salt is the most common substance used for deicing during the winter months.)

4. Dimensional tolerances should meet the PX standard. In addition, the dimensional tolerances around the mean values for length, width, and depth shall be 1/16". (Studies show that dimensional tolerances are directly linked to joint width size and proper interlock.)

5. The pavers should be solid units without core holes or other perforations.

6. The contractor shall ensure that the manufacturer conducts a test sampling of 24 pavers every 50,000 pavers manufactured to determine the pavers compliance with dimensional and water absorption characteristics. The 24 paver sample shall be representative of the color mix in the typical finished package and chosen on a consistent basis from one kiln car. (Proper control procedures and testing are standard operating procedure for high quality manufacturers.)

## 2.02 AGGREGATE MATERIALS

A. Bedding Course and Void Filler Aggregate: The bedding course and void filler aggregate shall be washed, crusher run, free of fines, organics and soluble salts or other contaminants likely to cause efflorescence. The grading requirement shall comply with the following table.

Table 1
ASTM No. 89 Grading Requirements for Bedding Course Aggregates

| ASTM Sieve Size | Percent Passing (by weight) |
|---|---|
| ½ in. | 100 |
| 3/8 in. | 90 to 100 |
| No. 4 | 20 to 55 |
| No. 8 | 5 to 30 |
| No. 16 | 0 to 10 |
| No. 50 | 0 to 5 |

B. Base Course Aggregates: The base course aggregate shall consist of washed open graded stone and comply with the following table.

Table 2
ASTM No. 57 Grading Requirements for Base Course Aggregates

| ASTM Sieve Size | Percent Passing (by weight) |
|---|---|
| 1 ½ in. | 100 |
| 1 in. | 95 to 100 |
| ½ in. | 25 to 60 |
| ¼ in. | 0 to 10 |
| No. 4 | 0 to 5 |

C. SubBase Course Aggregate: The subbase course and void filler aggregate shall be washed, open graded stone and comply with the following table.

Table 3
ASTM No. 2 Grading Requirements for SubBase Course Aggregates

| ASTM Sieve Size | Percent Passing (by weight) |
|---|---|
| 3 in. | 100 |
| 2 ½ in. | 90 to 100 |
| 2 in. | 35 to 70 |
| 1 ½ in. | 0 to 15 |
| 1 in. | 0 to 5 |

### 2.03 EDGE RESTRAINTS

A. Edge restraints are required on all installations. Edge restraints are to be precast or cast in place concrete, plastic, or steel as specified in the drawings. Install as per manufacturer's specifications with mortared pavers for appearance.

### 2.04 FILTER GEOTEXTILE (IF APPLICABLE)

A. A nonwoven geotextile fabric shall be used in areas where tree roots prevent full depth base course.

## PART 3 – EXECUTION

### 3.01 SUBGRADE

A. The site engineer shall verify that the subgrade has been shaped and compacted to 95% standard proctor where tree roots are not impacted in conformance to the lines, grades and cross sections shown on the plans.

B. If necessary, site grades can be raised using the same material as the largest base course (i.e. #2 or #57) being used on the project. The stone should be laid in 6" lifts and compacted using a vibratory smooth drum roller.

C. The requirements to include sub-drains in the pavement base design would depend on the subgrade soil conditions. It is recommended that an experienced, qualified geotechnical engineer determine the requirements for sub-drains. If required, the sub-drain pipe shall consist of a four-inch diameter pvc perforated pipe wrapped with filter fabric. The pipe would be placed at subgrade elevation and surrounded with a minimum of four inches of approved open graded stone. The sub-drain shall drain into a catch basin or other frost free positive outlet.

**3.02 EDGE RESTRAINTS**

A. All edge restraints shall be constructed as shown on the plans and in place prior to the installation of the base course, bedding course and pavers. Poured in place concrete curbs are recommended for commercial permeable paver installations.

**3.03 BASE COURSE**

A. The base course shall consist of a thickness of four inches of aggregate placed in one lift and compacted using a vibratory smooth drum roller until there is no visible movement of aggregate under static rolling. The base course shall be installed to the elevation and cross section per the plan documents.

**3.04 BEDDING COURSE**

A. The bedding course shall be spread loose in a uniform layer to give a depth after compaction of the pavers of two inches, plus or minus ½". The contractor shall screed the bedding course using either a mechanical screed beam apparatus or by the use of screed guides and boards.

B. The screeded bedding aggregate shall not be subjected to any traffic by either mechanical equipment or pedestrian use prior to the installation of the pavers. The voids left after the removal of the screed rails shall be filled with loose aggregate as the paver bedding course proceeds.

**3.05 PERMEABLE CLAY PAVERS**

A. The pavers should be installed according to the information on the cube tag. The pavers should be laid from several cubes throughout the installation.

B. Lay pavers in the pattern as shown on the drawings. Lay pavers away from the existing laying face or edge restraint in such a manner as to ensure that the pattern remains square. Chalk lines (use a heavier chalk cord) shall be used upon the bedding course to maintain straight lines. Joint spacing between pavers shall be between 1/8" and 1/4"; however the joint width may need to be increased to 3/8" to maintain straight lines. Lines and grades shown on the plans shall be established and maintained during the installation of the pavers.

C. Pavers should be cut according to the instructions on the cube tag. Pavers shall be cut using a table mounted masonry wet saw.

D. Once the pavers have been placed upon the bedding course and all cut pavers have been inserted to provide the complete surface, inspect the pavers for

damaged units and remove and replace those units. Once all pattern lines have been straightened, the void filler shall then be placed into the paver openings to the top of the chamfer on the pavers and the surface swept broom clean.

E. The pavement surface shall be compacted to achieve consolidation of the bedding course and pavers and brought to design levels and profiles by two passes of a suitable plate compactor. Compaction of the pavers shall be accomplished by the use of a vibratory plate compactor capable of a minimum of 4,500 pounds of compaction force. No compaction shall be permitted within three feet of unrestrained edges of the pavement. After compaction, inspect the pavers for damaged units and remove and replace those units.

F. After completing compaction, the surface tolerances shall be plus or minus ½" from finished grades. The pavers shall be flush to ½" above edge restraints. Additional void filler material shall be swept into the joints as required, to within ½" from the bottom of the chamfer on the paver. Upon completion, the pavement surface shall be swept clean of all excess materials. Remove from the site all surplus materials, equipment and debris resulting from these operations.

END OF SECTION

**ALTERNATE SPECIFICATION FOR AREAS WITH TREE ROOTS OF 1" IN DIAMETER OR MORE WITHIN 4 INCHES OF THE SURFACE.**

## PART 1 – SCOPE

### 1.01 SCOPE

This specification covers sidewalk and driveway construction consisting of permeable clay pavers laid on a gravel leveling course, and should be supplemented by the above referenced specifications

## PART 2 – MATERIALS

### 2.01 PERMEABLE CLAY PAVERS

The bricks shall conform to ASTM C902 and shall be uniform in size, measuring 4 inches in width, 8 inches in length, with a depth of 2 1/4 inches. The color of the brick and the laying pattern shall be full range and herringbone.

### 2.02 BEDDING COURSE AGGREGATE

For sidewalk construction the bedding course aggregate used for a leveling course shall be free of organic material, contaminants of any form, and shall generally be of a coarse, granular consistency.

## PART 3 – LOCATION

### 3.01 LOCATION AND DIMENSIONS

The location and dimensions (width, thickness and extent) of the sidewalk shall be as shown on the plans and verified by the Town of Bluffton Engineering Support Services representative prior to commencement of work.

## PART 4 – EARTHWORK

### 4.01 FILL MATERIAL

All earthwork and fill material supplied and placed shall conform to Specifications for Earthwork.

### 4.02 PROTECTION OF STRUCTURES AND TREE ROOTS

During the excavation process, it shall be the contractor's responsibility to protect all existing structures, including but not limited to, water meter boxes and lids, fencing, and mail boxes. Should tree roots lay within the construction zone the contractor shall contact the Town of Bluffton forester or a designated representative for further instructions. At no time shall the contractor remove any tree roots without approval from the Town of Bluffton forester or a designated representative.

## PART 5 – BEDDING COURSE AGGREGATE

### 5.01 BEDDING COURSE AGGREGATE

The bedding course aggregate shall be between 1 inch, and 1 ½ inches in thickness. The sand shall be placed in accordance with the Permeable Clay Paver Specification. The bedding course aggregate shall be placed to the designated grade, with a tolerance of approximately 1/8 inch when measured with a 10–foot straight edge. Prior to placing the pavers, the bedding course aggregate shall be compacted in accordance with the Permeable Clay Paver Specification.

## PART 6 – BRICK PAVING

### 6.01 LAYING OF BRICK

A. The brick pavers shall be laid to the pattern approved by the Town of Bluffton Engineering Support Services representative on a leveling course of aggregate, and shall be true to line and grade when measured with a 10-foot straight edge. Unless otherwise directed, the grade shall slope at the rate of 1/4 inch per foot. If required, the contractor shall saw cut the brick pavers to match and line up with existing structures using a brick saw. New brick sidewalk abutting existing brick sidewalk shall be separate by a soldier or other approved course of bricks.

B. After the pavers are laid to true line and grade, aggregate shall be swept into the joints, and then bedded using a plate compactor to form a tight consolidated surface. Care should be taken to ensure that no damage occurs to the pavers during this operation. Any pavers damaged during the bedding process shall be replaced at the contractor's expense.

### 6.02 EDGE TREATMENT

All edge restraints shall be constructed as shown on the plans and in place prior to the installation of the base course, bedding course and pavers. Poured in place concrete curbs are recommended for commercial permeable paver installations. Edge restraints are to be precast or cast in place concrete, plastic, or steel as specified in the drawings. Install as per manufacturer's specifications.

END OF SECTION

**INDEX TO**

**SECTION 32 17 23.43 – THERMOPLASTIC PAVEMENT MARKINGS EXTRUDED OR HOT SPRAY APPLICATION**

# SECTION 32 17 23.43

# THERMOPLASTIC PAVEMENT MARKINGS
# EXTRUDED OR HOT SPRAY APPLICATION

## PART 1 – GENERAL

### 1.1 DESCRIPTION:

A. Work shall consist of furnishing and applying thermoplastic reflectorized pavement marking materials on surface of pavements to provide pavement markings of a color (white or yellow) and pattern as indicated on the construction drawings. Contractor shall supply all necessary equipment and materials for the installation of traffic markings.

### 1.2 WARRANTY:

A. Contractor shall transfer warranty to the Owner on thermoplastic materials issued by manufacturer. Contractor shall also furnish the Owner a 12–month warranty for application. These warranties shall specify guaranteed retainage of material for a stated period beginning with the application date. Work will not be allowed to commence until warranties have been received by the Owner.

### 1.3 MEASUREMENT AND PAYMENT:

A. No measurement will be made for this project.

Payment will be included in the contract lump sum price. Payment will include supplying of materials at rate specified, preparation of pavement surface, application of all materials, protection of markings, protection of traffic, and all work involved to provide pavement markings in place, complete in accordance with these specifications and special provisions, including labor, equipment, and incidentals necessary to satisfactorily complete the work specified.

## PART 2 – PRODUCTS

### 2.1 MATERIALS:

A. Pavement marking material shall be a reflectorized mixture of thermoplastic binder and reflectorized glass beads. Additional glass beads are applied by dropping immediately after marking material is applied to surface of the pavement. Prior to application of the pavement marking material, surface of all pavements shall be coated with a primer–sealer material if recommended by thermoplastic manufacturer.

B. Thermoplastic Compound: The hydrocarbon type thermoplastic compound shall meet all requirements of AASHTO M 249. Except material may be shipped in the granulated form.

C. Glass Beads – (Drop–on): The drop–on glass beads shall meet requirements of AASHTO M 247 – Type 1.

D. Primer–Sealer – A primer–sealer as recommended by the manufacturer of thermoplastic pavement marking material shall be utilized on all portland cement pavement surfaces and all bridge surfaces which have not been overlayed with asphalt. Primer–sealer also shall be utilized on any type of pavement prior to the placing of Railroad Crossing Symbols. Primer–sealer shall be used on asphaltic concrete pavement surfaces if recommended by the manufacturer of thermoplastic pavement marking material. Primer–sealer shall form a continuous film which will mechanically adhere to pavement and shall not discolor nor cause any noticeable change in appearance of the pavement outside of finished pavement marking.

E. Contractor shall obtain from manufacturer of the thermoplastic binder, tests results required by AASHTO M 249 for each batch of material furnished along with a final certification stating materials furnished met requirements of contract specifications. Contractor shall obtain from manufacturer of drop–on glass beads a certification stating material furnished met requirements of contract specifications. Copies of above described affidavits shall be furnished to the Owner.

## PART 3 – EXECUTION

### 3.1 APPLICATION PROPERTIES OF AASHTO M 249 IS EXPANDED AS FOLLOWS:

A. Equipment – Material shall be prepared by only means of an insulated batching machine recommended or furnished by manufacturer of compound and shall consist of a special kettle for melting and heating the composition. Applicators may be either a truck mounted liner or a portable unit. "Truck mounted" shall be defined as a self–propelled vehicle with six or more wheels and an enclosed cab for housing the driver.

If contract requires extruded application, material shall be applied to the pavement by an extrusion method wherein one side of the shaping die is the pavement and the other three sides are contained by, or are part of suitable equipment for heating and controlling the flow of the material.

The batching machine shall be constructed to provide continuous mixing and agitation of material. Conveying part of equipment between the main material reservoir and final dispensing nozzle/shaping die shall be constructed to prevent accumulation and clogging. All parts of equipment which come in contact with the material shall be constructed to be easily accessible and exposable for cleaning and maintaining.

Equipment shall be constructed so all mixing and conveying parts to final dispensing nozzle/shaping die maintain material at the plastic temperature.

Equipment shall be constructed to assure continuous uniformity in dimensions of the markings.

Controls shall be set up so the operator can override set automatic cycles in order to extend a line or to begin a new cycle at any selected point.

Applicators shall provide a means for cleanly cutting off square stripe ends. Truck mounted liner shall provide a method of automatically applying "skip" or solid longitudinal lines, including right and left edge lines, of any combination of single or double line configurations (color and pattern) with machine traveling in the direction of normal traffic flow. The use of pans, aprons, or similar appliance which the nozzle/die overruns will not be permitted.

Beads shall be applied to surface of completed stripe by an automatic bead dispenser attached to the applicator. Beads are dispensed almost instantly upon the completed line.

Applicators shall be constructed to produce varying widths of traffic markings as indicated on construction drawings.

Heating of kettles and melters shall be by controlled heat transfer systems which are oil jacketed or indirect flame air jacketed. Directed flame equipment will not be allowed. All kettles and melters must be equipped with an automatic thermostatic control device and proper thermometers to control temperature of the material at manufacturer's recommended application temperature range.

Applicator and kettle must be so equipped and arranged as to satisfy requirements of the National Fire Underwriters, and all state and local requirements.

Applicators shall be mobile and maneuverable so straight lines can be followed and normal curves can be made.

B. Construction Requirements – Traffic shall not be permitted through the project during construction.

1. Preparation of Surface – The pavement shall be dry and free of glaze, oil, dirt, grease or other foreign contaminants. Where directed by Engineer, Contractor shall buff or sand blast pavement surface for a width equal to two inches wider than the stripe to be applied in order to secure a proper surface for adequate bonding of thermoplastic material.

2. Application of Primer–Sealer – Where used, primer–sealer shall be sprayed on the pavement surface where the lines are to be applied. Thickness of application and time on the pavement prior to thermoplastic application shall be governed by recommendations of primer–sealer manufacturer.

3. Application of Marking Material – All longitudinal markings shall be placed with a truck–mounted applicator except where the length of a particular marking is too short, or curvature too great, to permit efficient use of the liner. Transverse markings may be applied with a portable unit.

   The markings shall be straight or of uniform curvature and shall conform uniformly with tangents, curves and transitions. Symbols shall be of dimensions shown on the plans. Markings must be of dimensions and

placed as shown on the plans. The contractor shall provide sufficient control points to serve as guides for application of markings.

Finished line markings shall be free from waviness and the lateral deviation shall not exceed two (2) inches in fifteen (15) feet. Any greater deviation shall be sufficient cause for requiring the Contractor to remove and correct such markings at their own expense. Contractor shall also be required to remove and correct any symbol markings not meeting dimensional requirement shown on the plans.

Contractor shall protect the markings until dry by placing guarding or warning devices as necessary. In the event any vehicle should cross a wet marking, such marking shall be reapplied and lines made by moving vehicle removed by Contractor.

To avoid poor quality marks, markings are to be placed only when surface of pavement is dry as determined by visual inspection, when the relative humidity as reported by local weather authorities is 90% or less, and when the pavement surface temperature, as determined by means of surface thermometers, is 55 degrees F or above. Contractor shall provide appropriate surface thermometers, certified to be correct, to measure pavement temperatures during the work.

No markings shall be applied between October 15 and March 1 inclusive, except by permission of the Engineer.

Sufficient personnel experienced in handling and application of this type of material shall be provided by Contractor to assure work is completed properly.

Work shall be completed only during daylight hours, and all markings shall be sufficiently dry, before sunset, to permit crossing by traffic. All protective devices shall be removed before sunset to allow free movement of traffic at night.

Marking material shall be applied at a temperature providing best adhesion to the pavement and shall be between 380 degrees F and 420 degrees F or as recommended by the manufacturer. The material shall be heated uniformly throughout and shall have uniform disbursement of binder, pigment, and glass beads when applied to surface of the pavement.

All extruded lines 12 inches or less shall be applied with a die equal to the width of the line. All lines greater than 12 inches may be applied with two dies, the total widths of which equal the width of the line.

4. Rate of Application

   a. Marking material shall be applied at the specified widths and at a rate to result in a new material thickness at center of line as specified below.

5. Type of Marking

a. Edge lines and median lines (5" solid white, 5" solid yellow and 5" broken yellow). 90 mils

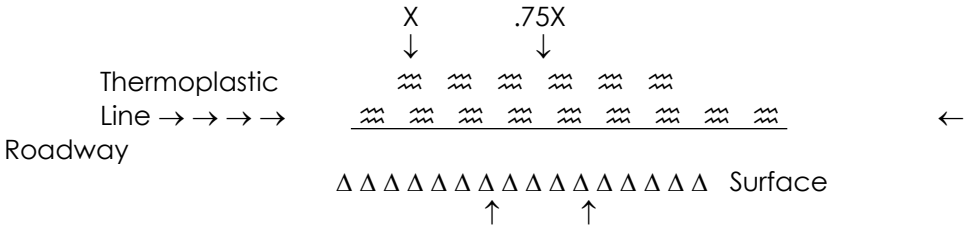
Lane lines (5" broken white) 90 mils

Center lines on two – lane roadways (5" broken yellow and 5" solid yellow) 90 mils

b. All others 125 mils

The diagram below refers to applications of all thicknesses.

The edge of the line shall be not thinner than 75% of the center thickness.




NO SCALE

c. Glass Beads – "Drop–on" glass beads shall be mechanically applied to surface of marking material immediately after material is applied to the pavement surface, and while marking material is still molten so beads will be held by and mechanically embedded in surface of material. Beads shall be uniformly distributed over the minimum rate of 12 pounds per 100 square feet of stripe. Drop–on beads shall be applied mechanically.

**3.2 OBSERVATION AND ACCEPTANCE OF WORK:**

A. All thermoplastic markings shall be checked both day and night to determine whether the intent of these specifications has been achieved. Any markings failing to have satisfactory appearance, either day or night, shall be reapplied at Contractor's expense.

Final acceptance of thermoplastic pavement markings will be delayed for a period of 30 days after completion to permit observation of performance. Contractor shall be required to replace any markings or markers that, in the opinion of Owner, have not performed satisfactorily during this 30–day period due to defective materials and workmanship in manufacture and application.

Application of Pavement Markings and Non–recessed Pavement Markers – When pavement markings (centerline, lane lines, and edge lines) and non–recessed pavement markers are applied on a roadway opened to traffic and in a continuous operation of moving vehicles and equipment, the following minimum warning devices shall be required.

1. The vehicle applying the pavement markings shall have sequential or flashing arrows as directed by Engineer.

2. A shadow vehicle shall maintain at least a distance of 50' behind the vehicle applying pavement markings and shall have an acceptable sequential or flashing arrow board.

Application of pavement markings shall be accomplished without stopping traffic except when directed by the Owner. If Owner allows temporary closing of any part of the traveled width of any pavement, either on main roadway or intersecting roads and drives, and thereby restrict traffic, Contractor shall provide all barricades, lights, flagmen and such other protection to traffic as may be necessary for protection of work and safety of public.

Contractor shall at all times set up and operate equipment to encroach as little as possible upon the traveled width of any pavement opened to traffic.

Contractor shall submit a traffic control plan for application of thermoplastics. The plan will have to be reviewed and accepted by Owner before work begins.

END OF SECTION.

**INDEX TO**

**SECTION 32 92 00 – TURF AND GRASSES**

# SECTION 32 92 00

# TURF AND GRASSES

## PART 1 – GENERAL

### 1.1 SECTION INCLUDES

A. Seeding, planting grass, and fertilizing graded areas behind the structures, pipeline rights–of–way, roadway shoulders, and other disturbed areas.

B. Seed protection.

C. Maintaining seeded areas until final acceptance.

### 1.2 RELATED WORK

A. Civil and Landscape plans and specifications.

### 1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver grass seed in original containers showing analysis of seed mixture, percentage of pure seed, year of production, net weight, date of packaging, and location of packaging. Damaged packages are not acceptable. Store in cool, dry locations away from contaminants.

B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer. Damaged bags are not acceptable. Store in cool, dry locations away from contaminants.

C. Deliver sod on pallets.

D. All material shall be acceptable to Engineer prior to use.

### 1.4 PLANTING DATES

A. This specification provides for establishment of a permanent grass cover between the dates of March 1 and September 30. If finished earth grades are not completed in time to permit planting and establishment of permanent grass during the favorable season between dates specified above unless otherwise accepted, Contractor will be required to plant a temporary cover to protect new graded areas from erosion and to keep windborne dust to a minimum. The temporary cover shall be planted between October 1 and February 28 unless otherwise permitted.

### 1.5 MEASUREMENT AND PAYMENT

A. When the season or stage of project is such results of grassing work cannot be determined, conditional acceptance will be made on work completed. When conditional acceptance is made for items of work covered, Contractor shall be entitled to 50% of bid price for the actual work placed and shall receive remaining 50% of bid price when final acceptance is made. Conditional acceptance shall

not apply to the remaining items of work, and full bid price payment shall be made when work is acceptably placed and completed in accordance with specifications.

B. Payment for grassing will be made at contract unit price for the item "Turf and Grasses" and such payment shall constitute full compensation for furnishing and placing seed and fertilizer or sod where directed and protecting and maintaining seed and sod in all graded and disturbed areas.

## PART 2 – PRODUCTS

A. Contractor shall submit source and species certification documents to Engineer and Owner's Representative for review prior to installation. Supply complete information on all analysis/test methodologies and results; laboratory certifications, manufacturer's specifications, and agency approvals to the Landscape Architect/Project Engineer prior to placement of soil mixtures. In addition, provide the Landscape Architect/Project Engineer with thoroughly mixed sample of soil mixes for acceptance prior to placement. Landscape Contractor shall make modifications and improvements to soil mixes deemed necessary by the soil analysis to meet requirements specified here in before, and to ensure proper growing medium for plant material.

### 2.1 SEED

A. All seed shall conform to State Laws and requirements and regulations of the State Department of Agriculture.

B. The varieties of seed, as specified in Section 2.2, shall be individually packaged or bagged, and tagged to show name of seed, net weight, origin, germination, lot number, and other information required by the State Department of Agriculture.

C. Engineer reserves the right to test, reject, or accept all seed before seeding.

### 2.2 SEEDING SCHEDULE

A.

| SEED | RATE | PLANTING DATES |
|---|---|---|
| Bermuda | 15–lbs/acre | March 1 – September 30 |
| Rye | 75–lbs/acre | October 1 – February 28 |

### 2.3 FERTILIZER

A. Commercial fertilizer of accepted type, conforming to State fertilizer laws at the rate as recommended by soils test.

### 2.4 LIME

A. Agricultural grade, ground limestone at the rate as recommended by soils test.

### 2.5 SPRIG

A. Healthy living stems, stolons, or rhizomes and attached roots of locally adapted grass without adhering soil, including two to three nodes and from 4 to 6 inches long. Obtain from heavy, dense certified sod. Provide sprigs which have been grown under climatic conditions similar to those in the locality of project. Coordinate harvesting and planting operations to prevent exposure of sprigs to the sun for more than 30 minutes before covering and moistening. Sprigs showing signs of wilt, mold, containing weeds, or other detrimental material or are heat damaged will be rejected.

B. Varieties of sprig, as specified in section 2.6, shall be individually packaged or bagged, and tagged to show name of sprig, net weight, origin, and other information required by the State Department of Agriculture.

C. Sprigs shall be pure to variety specified and shall be free of other grass species, weeds or foreign matter.

D. Sprigs shall be harvested by digging (not collected above soil level), shredding sod, rototilling sod and raking, vericutting, or with a sprig harvester. Sprigs shall consist of mostly rhizomes and crowns with only a few green leaves.

## 2.6 SPRIGGING SCHEDULE

A.

| SPRIG | RATE | PLANTING DATES |
|---|---|---|
| 'Tifsport' Bermuda | 1,000 bushels/acre (Maximum 12 week grow–in) | April 1 – August 31 |
| Stabilize site with temporary grass seed | | September 1 – March 31 (See section 2.2) |

B. In areas where existing grass is to be matched, Contractor shall sprig at the rate and dates recommended by sprig distributor.

## 2.7 SOD

A. Sod shall be premium grade, densely rooted, good quality grass of the species and certified variety as shown on the plans, free from noxious weeds with no surface soil being visible. The sod shall be obtained from areas where the soil is reasonably fertile. Sod of specified species shall be grown from seed or sprig with not less than 95 percent germination, 85 percent pure seed, and not more than 0.5 percent weed seed. The sod shall be machine cut to a uniform soil thickness that shall contain practically all of the dense root system and not be less than 1–inch thick.

B. Before cutting, sod shall be mowed to a height of not less that 1–1/2–inches or more than 2–inches. Sod shall be cut in minimum uniform widths of 12–inches and lengths of 24 inches.

C. Sod shall be delivered to site in a fresh, moist condition with healthy green foliage.

It shall be unloaded from delivery trucks on pallets or in rolls and placed in final position within 24 hours of delivery. Sod shall be protected from wind and sun and shall not be allowed to dry out before planting.

D. Sod shall be strong enough to support its own weight and retain its size and shape when suspended vertically from a firm grasp on the upper 10 percent of the section.

### 2.8 ACCESSORIES

A. Straw Mulch: Oat or wheat straw, reasonably free from weeds, foreign matter detrimental to plant life, and in dry condition.

B. Excelsior Mulch: Excelsior mulch shall consist of wood fibers cut from sound, green timber. The average length of fibers shall be 4 to 6 inches. Cut shall be made in such a manner as to provide maximum strength of fiber, but at a slight angle to natural grain of the wood to cause splintering of fibers when weathering in order to provide adherence to each other and to soil.

C. Wood cellulose fiber shall be made from wood chip particles manufactured particularly for discharging uniformly on the ground surface when dispersed by a hydraulic water sprayer. It shall remain in uniform suspension in water under agitation and blend with grass seed and fertilizer to form a homogenous slurry. Mulch fibers shall intertwine physically to form a strong moisture holding mat on the ground surface and allow rainfall to percolate into underlying soil. The mulch shall be heat processed to contain no germination or growth–inhibiting factors. It shall be dyed (non–toxic) an appropriate color to facilitate metering of material.

### 2.9 PRODUCT REVIEW

A. Contractor shall provide the Engineer with a complete description of all products before ordering. The Engineer will review all products before they are ordered.

## PART 3 – EXECUTION

### 3.1 PREPARATION

A. Areas to be seeded shall be made smooth and uniform and shall conform to the finished grade indicated on plans.

B. Remove foreign materials, plants, roots, stones, and debris from surfaces to be seeded.

C. Grassing areas, if not loose, shall be loosened to a minimum depth of 3 inches before fertilizer, seed or sod is applied.

D. Amendments to soils shall be incorporated into loosened 3–inch top soil layer as recommended by soils tests.

E. Contractor shall provide Topsoil Analysis Tests performed by a State Agricultural Experiment Station, Soil and Water Conservation District, State University, or other

qualified private testing laboratory, as acceptable to Landscape Architect/Project Engineer. Soils test shall identify existing pH and nutrient levels, as well as recommended adjustments based on the type of grass to be installed.

## 3.2 STAND OF GRASS

A. Before acceptance of seeding, sodding, or sprigging is performed for the establishment of permanent vegetation, Contractor will be required to produce a satisfactory stand of perennial grass whose root system shall be developed sufficiently to survive dry periods and winter weather and be capable of re–establishment in spring.

B. Before acceptance of seeding is performed for the establishment of temporary vegetation, Contractor will be required to produce a stand of grass sufficient to control erosion for a given area and length of time before the next phase of construction or establishment of permanent vegetation is to commence.

## 3.3 SEEDING AND SPRIGGING DATES

A. Seeding and sprigging shall be performed during periods and at rates specified in their respective schedules. Seeding and sprigging work may, at discretion of Contractor, be performed throughout the year using schedule prescribed for given period. Seeding and sprigging work shall not be conducted when the ground is frozen or excessively wet. Contractor will be required to produce a satisfactory stand of grass regardless of the period of year work is performed.

## 3.4 APPLYING LIME AND FERTILIZER

A. Following advance preparation and placing selected material for shoulders and slopes, lime and fertilizer, if called for based on soil tests, shall be spread uniformly over the designated areas, and shall be thoroughly mixed with the soil to a depth of approximately 2 inches. Fertilizer and lime shall be applied at the rate recommended by required soils test. Unless otherwise provided, lime will not be applied for temporary seeding. In all cases where practicable, acceptable mechanical spreaders shall be used for spreading fertilizer. On steep slopes subject to slides and inaccessible to power equipment, the slopes shall be adequately scarified. Fertilizer may be applied on steep slopes by hydraulic methods as a mixture of fertilizer and seed. When fertilizer is applied with combination seed and fertilizer drills, no further incorporation will be necessary. The fertilizer and seed shall be applied together when Wood Cellulose Fiber Mulch is used. Any stones larger than 2–1/2 inches in any dimension, larger clods, roots, or other debris brought to the surface shall be removed.

## 3.5 SEEDING

A. Seed shall be sown within 24 hours following application of fertilizer and lime and preparation of the seedbed as specified in Section 3.4. Seed shall be uniformly sown at rate specified by the use of acceptable mechanical seed drills. Rotary hand

seeders, power sprayers or other satisfactory equipment may be used on steep slopes or on other areas inaccessible to seed drills.

B. Seeds shall be covered and lightly compacted by means of cultipacker or light roller if the drill does not perform this operation. On slopes inaccessible to compaction equipment, the seed shall be covered by dragging spiked chains, by light harrowing or by other satisfactory methods.

C. Apply water with fine spray immediately after each area has been sown.

D. Do not sow seed when ground is too dry, during windy periods or immediately following a rain.

E. If permitted by the special provisions, wood cellulose fiber mulch or excelsior fiber mulch may be used.

**3.6 SEED PROTECTION (STRAW MULCH)**

A. All seeded areas seeded with permanent grasses shall be uniformly mulched in a continuous blanket immediately following seeding and compacting operations, using at least 2 tons of straw per acre.

**3.7 SEED PROTECTION (EXCELSIOR MULCH)**

A. Seed shall be sown as specified in Section 3.5. Within 24 hours after covering of seed, excelsior mulch shall be uniformly applied at the rate of 2 tons per acre. The mulch may be applied hydraulically or by other acceptable methods. Should the mulch be placed in a dry condition, it shall be thoroughly wetted immediately after placing. Engineer may require light rolling of the mulch to form a tight mat.

**3.8 SEED PROTECTION (WOOD CELLULOSE FIBER MULCH)**

A. After the lime has been applied and ground prepared as specified in Section 3.4, wood cellulose fiber mulch shall be applied at a rate of 1,500 pounds per acre in a mixture of seed and fertilizer. Hydraulic equipment shall be used for application of fertilizer, seed, and slurry of the prepared wood pulp. This equipment shall have a built–in agitation system with an operating capacity sufficient to agitate, suspend, and homogeneously mix a slurry of the specified amount of fiber, fertilizer, seed, and water. The slurry distribution lines shall be large enough to prevent stoppage. The discharge line shall be equipped with a set of hydraulic spray nozzles which will provide an even distribution of slurry on various areas to be seeded. The slurry tank shall have a minimum capacity of 1,000 gallons.

Seed, fertilizer, wood pulp mulch, and water shall all be combined into the slurry tank for distribution of all ingredients in one operation by hydraulic seeding method specified herein. Materials shall be combined in a manner recommended by the manufacturer. The slurry mixture shall be regulated so amounts and rates of application shall result in a uniform application of all materials at rates not less than amount specified. Using the color of wood pulp as a guide, equipment operator shall spray prepared seedbed with a uniform visible coat. The slurry shall be applied in a sweeping motion, in an arched stream to fall like rain, allowing wood fibers to build upon each other until an even coat is achieved.

## 3.9 SPRIGGING

A. Sprigs shall be placed at the date and rates as shown in section 2.6. The sprigging method shall be by broadcast sprigging, hydroplanting or row planter. Sprigging procedure shall ensure even coverage.

B. Sprigs applied by broadcast over the site with a distributor or hydroseeder shall be planted at the rates listed in section 2.6. Cover broadcast sprigs with straw mulch immediately after broadcast and water in immediately (within 2 hours).

C. Sprigs installed by row planter creating a narrow furrow that covers 50 to 80% of the sprig with soil may use less sprig material. Rate shall be as recommended by sprig supplier to provide a solid stand of turf within the time required in Section 2.6. Water in immediately (within 1 hour).

## 3.10 SODDING

A. Sod shall be placed between March 1st and December 1st. However, if sod is to be placed during periods of temperatures over 90 degrees F., the Contractor shall take extra care for quick placement of sod with adequate, consistent watering necessary to ensure sod thrives as planted.

B. Sod shall be placed within 24 hours of cutting.

C. Place top elevation of sod 1/2 inch below adjoining paving or curbs.

D. All areas to be sodded shall be brought to the proper line grade or cross section as was existing prior to construction. Sod shall be placed so, upon completion, edges of sodded areas will be smooth and will conform to the proposed finished grade. Sod shall be laid smooth, edge to edge, with staggered joints. Sod shall be immediately pressed firmly into contact with the sod bed by tamping or rolling, to eliminate any air pockets. A true and even surface shall be provided, to insure knitting without displacement of the sod or deformation of the sodded areas surfaces. Do not stretch or overlap sod pieces. Following compaction, screened soil of good quality shall be used to fill all cracks. Excess soil shall be worked into the grass with rakes or other suitable equipment. On slopes steeper than 3 to 1, sod shall be fastened in place with suitable wood or metal pins to hold the sod in place. Any damage by erosion or other causes occurring after completion of grading operations shall be repaired, before commencing with the sodding operations.

E. Immediately before sodding, moisten topsoil with a fine spray to a minimum 1–inch depth. Sod shall not be laid on dry or powdery soil.

F. Sod shall be moist when laid and placed on moist ground. The sod shall be carefully placed by hand, beginning at the toe of slopes and working upwards. The length of strips shall be at right angles to flow of surface water. All joints shall be tightly butted and end joints shall be staggered at least 12 inches. Sod shall be immediately pressed firmly into the ground by tamping or rolling. Fill all joints between strips with fine screened soil. Sod on slopes shall be pegged with sod pegs to prevent movement.

G. Within two hours after sod has been placed, thoroughly water to a minimum depth of 4–inches. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove depressions and irregularities. Roll sodded areas with a roller not exceeding 150 lbs. per foot of roller width.

## PART 4 – MAINTENANCE, WARRANTY AND ACCEPTANCE

### 4.1 MAINTENANCE

A. Maintain grassed surfaces until final acceptance.

B. Maintenance shall consist of providing protection against traffic, watering to ensure uniform seed germination and to keep surface of soil damp, and repairing any areas damaged as a result of construction operations or erosion. Maintenance shall also include, but is not limited to, watering, weeding, cultivating, removal of dead material, lawn mowing, fertilizing, and other necessary operations.

C. The Contractor shall maintain all proposed plantings until the date of substantial completion issued by the Owner.

### 4.2 WARRANTY

A. All grassed areas shall be guaranteed by Contractor to be alive and healthy for a one–year period from date of substantial completion issued by the Owner. A final walk through with the Owner shall be conducted at end of warranty period to determine if any areas require replanting. At end of warranty period, sod shall show evidence of rooting to underlying soil and shall have no competitive weed growth from either the sod or from between sod joints.

B. Any grassed area which is dead or not showing satisfactory growth shall be replaced at Contractor's expense at the end of warranty period. All replacement shall be of original quality. Replacement required because of vandalism, excessive use, or other causes beyond the control of Contractor are not part of this contract.

### 4.3 ACCEPTANCE

A. Before acceptance of seeding performed for the establishment of permanent vegetation, Contractor will be required to produce a satisfactory stand of perennial grass whose root system shall be developed sufficiently to survive dry periods and winter weather and be capable of reestablishment in spring.

B. A minimum coverage of 80% density over 100% of the disturbed area is required for seeded areas before project acceptance. Sprig and sod areas shall have 95% coverage over 100% of the disturbed area prior project acceptance.

END OF SECTION

**INDEX TO**

**SECTION 33 10 00SC – WATER UTILITIES**

# SECTION 33 10 00SC

# WATER UTILITIES

## PART 1 – GENERAL

### 1.1 SECTION INCLUDES

A. Piping

B. Valves

C. Fittings

D. Connect to Existing System

E. All necessary appurtenances to convey potable water from the existing system to the location shown on the plans.

### 1.2 RELATED SECTIONS

A. Section 31 00 00 – Earthwork

B. Section 31 10 00 – Site Clearing

C. Section 32 92 00 – Turf and Grasses

### 1.3 OPTIONS

A. The bid form and specifications describe several pipe materials. Owner will select the one to be used. Where manufacturers of material or equipment are named in the specifications, Contractor may use equipment or materials of other manufacturers provided they are reviewed and accepted by Engineer as meeting specifications prior to ordering such equipment or materials.

### 1.4 REFERENCES (Latest Revision)

A. ASTM D 3740 – Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

B. ASTM E 329 – Agencies Engaged in Construction Inspection and/or Testing.

C. ANSI/AWWA C 153/A–21.53 – Ductile Iron Compact Fittings for Water Service.

D. ANSI/AWWA C 110/A21.10 – Ductile Iron and Gray Iron Fittings,

E. ANSI/AWWA C 150/A–21.50 – Thickness Design of Ductile Iron Pipe.

F. ANSI/AWWA C 151/A–21.51 – Ductile Iron Pipe, Centrifugally Cast, for Water, or other liquids.

G. ANSI/AWWA C 104/A–21.4 – Cement–Mortar Lining for Ductile Iron Pipe and Fittings for Water.

H. ASTM D 1784 – Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

I. ASTM D 2241 – Poly (Vinyl Chloride) (PVC) Pressure–Rated Pipe (SDR – Series).

J. ANSI/AWWA C 901 – Polyethylene (PE) Pressure Pipe and Tubing, 1/2 inch through 3–inches for Water Service.

K. ASTM D 2737 – Polyethylene (PE) Plastic Tubing.

L. ANSI/AWWA C 115/A21.15 – Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges.

M. ANSI/AWWA C 111/A21.11 – Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.

N. ASTM D 3139 – Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

O. ANSI/AWWA C 900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 inches through 12 inches, for Water Transmission and Distribution.

P. ANSI/AWWA C 500 – Metal–Seated Gate Valves for Water Supply Service.

Q. ANSI/AWWA C 509 – Resilient–Seated Gate Valves for Water Supply Service.

R. ANSI/AWWA C 502 – Dry–Barrel Fire Hydrants.

S. ANSI/AWWA C 800 – Underground Service Line Valves and Fittings.

T. ANSI/AWWA C 600 – Installation of Ductile Iron Water Mains and Their Appurtenances.

U. ANSI/AWWA C 605 – Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.

V. ASTM D 2774 – Underground Installation of Thermoplastic Pressure Piping.

W. ASTM D 6938 – In–Place Density and Water Content of Soil and Soil – Aggregate By Nuclear Methods (Shallow Depth).

X. ANSI/AWWA C 651 – Disinfecting Water Mains.

Y. ASTM D 1557 – Laboratory Compaction Characteristics of Soil Using Modified Effort.

Z. ANSI/AWWA C 504 – Rubber–Seated Butterfly Valves.

AA. ANSI B–18.2.2 – Square and Hex Bolts and Screws.

BB. ANSI B–18.2.2 – Square and Hex Nuts.

CC. ANSI/NSF Standard 61.

DD. ANSI/AWWA C200 – Steel Water Pipe – 6 inch (150 mm) and Larger.

EE. ASTM A 53 – Pipe, Steel, Black and Hot–Dipped, Zinc–Coated, Welded and Seamless.

FF. ANSI/AWWA C905 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14–inch through 48–inch (350 mm through 1,200 mm), for Water Transmission and Distribution.

GG. ANSI/AWWA C 512 – Air Release, Air/Vacuum, and Combination Valves for Waterworks Service.

HH. ANSI/AWWA C 515 – Reduced–Wall, Resilient–Seated Gate Valves for Water Supply Service.

II. ASTM A 139 – Electric–Fusion (Arc) – Welded Steel Pipe (NPS4 and Over).

**1.5 QUALITY ASSURANCE**

A. Materials – Contractor will furnish the Engineer and Owner a description of all material before ordering. Engineer will review the Contractor's submittals and provide in writing an acceptance or rejection of material.

B. Manufacturer – Material and equipment shall be standard products of a manufacturer who has manufactured them for a minimum of 2 years and who provides published data on quality and performance of the products.

C. Subcontractor – A subcontractor for any part of the work must have experience on similar work, and if required, furnish Engineer with a list of projects and Owners or Engineers who are familiar with its competence.

D. Design – If Contractor wishes to furnish devices, equipment, structures, and systems not designed by Engineer, these items shall be designed by either a Professional Engineer registered in the state of this project, or by someone Engineer accepts as qualified. If required, complete design calculations and assumptions shall be furnished to the Engineer or Owner before acceptance.

E. Testing Agencies – Soil testing shall be conducted by a testing laboratory which operates in accordance with ASTM D 3740 and E 329 latest revision and be acceptable to the Engineer prior to engagement. Mill certificates of tests on materials made by manufacturers will be accepted provided manufacturer maintains an adequate testing laboratory, makes regularly scheduled tests that are spot checked by an outside laboratory, and furnishes satisfactory certificates with name of entity making the test.

F. Hydrostatic tests on pipe shall be made by Contractor with equipment qualified by the Engineer. The Engineer or Project Representative reserves the right to

accept or reject testing equipment. Hydrostatic testing shall be conducted in the presence of Engineer or Project Representative and a representative of Water Supplier.

G. All pipe, fittings, packing, jointing materials, valves, and fire hydrants shall conform to Section C of the American Water Works Association (AWWA) Standards.

H. All materials and products which contact potable water must be third party certified as meeting the specifications of ANSI/NSF Standard 61.

**1.6 REQUIREMENTS OF REGULATORY AGENCIES**

A. Water mains shall be sterilized to meet requirements of the appropriate Health Department. Sterilization shall be in accordance with AWWA Standards C–651, latest revision.

B. Fire line sprinkler systems and dedicated fire lines shall be protected by an acceptable double check valve assembly. Water lines in high hazard categories shall be protected by an acceptable Reduced Pressure Zone (RPZ) Backflow Preventer.

C. Any pipe, solder, or flux which is used in the installation or repair of any public water system or in any plumbing in a residential or nonresidential facility which provides water, through connection to a public water system, for human consumption shall be lead free. Lead free is defined as not more than 0.2% lead with respect to solder and flux and not more than 8.0% lead with respect to pipes and pipe fittings. Leaded joints necessary for repair of cast iron pipes shall be exempt from the lead-free requirement.

D. No water pipe shall pass through or come in contact with any part of a sewer manhole. Water lines may come in contact with storm sewers or catch basins if there is no practical alternative, provided ductile iron is used, no joints of water line are within the storm sewer or catch basin, and joints are located as far as possible from storm sewer or catch basin.

E. Potable water lines shall not be laid less than 25 feet horizontally from any portion of a wastewater tile field or spray field, or shall be otherwise protected by a method acceptable to DHEC.

F. Where the minimum cover of 30 inches cannot be provided, pipe shall be steel, concrete, ductile iron, or other material and method acceptable to DHEC, and, when necessary, insulated to prevent freezing.

G. Air relief valves shall be provided in accordance with sound engineering practices at high points in water mains as required. Automatic air relief valves shall not be used in situations where flooding of the manhole or chamber may occur.

H. The open end of an air relief pipe from automatic valves or from a manually operated valve shall be extended to the top of pit and provided with a screened downward facing elbow.

I. Chambers, pits, or manholes containing valves, blow–off, meters, air release valves, or other such appurtenances to a distribution system, shall not be connected directly to any storm drain or sanitary sewer.

J. There shall be no connection between distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water or other contaminated materials may be discharged or drawn into the system.

K. Asbestos cement pipe shall not be used in potable water system except in the repair of existing asbestos cement lines.

L. Thermoplastic pipe shall not be used above grade.

M. Steel pipe shall not be allowed in water systems unless specified as in AWWA C200 or ASTM A53.

N. Water mains shall be installed out of contaminated areas, unless using piping materials protecting the system (i.e., Ductile Iron Pipe with chemical resistant gaskets). Route lines out of contaminated areas if possible.

O. Cross Connection Control (Backflow Prevention Devices):

1. There shall be no connection between the distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water or other contaminated materials may be discharged or drawn into the system.

2. No–by–passes shall be allowed, unless the bypass is also equipped with an equal, acceptable backflow prevention device.

3. Reduced pressure principal backflow prevention assemblies shall not be installed in any area location subject to possible flooding. This includes pits or vaults not provided with a gravity drain to the ground's surface capable of exceeding discharge rate of relief valve. Generally, if installed in a pit, drain line shall be 2 times the size of line entering backflow prevention device. The drain cannot empty into any type of ditch, storm drain, or sewer, which could flood water back into pit.

4. All piping up to inlet of the backflow prevention device must be suitable for potable water. The pipe must be AWWA or NSF approved. Black steel pipe cannot be used on inlet side of the device.

## 1.7 PRODUCT DELIVERY, STORAGE & HANDLING

A. Material shall be unloaded in a manner avoiding damage and shall be stored where it will be protected and will not be hazardous to traffic. Contractor shall repair any damage caused by the storage. Material shall be examined before installation and neither damaged nor deteriorated material shall be used in the work.

## 1.8 SEQUENCING AND SCHEDULING

A. Contractor shall arrange work so sections of mains between valves are tested, sterilized, pavement replaced, and the section placed in service as soon as reasonable after installation.

## 1.9 ALTERNATIVES

A. The intention of these specifications is to produce the best system for the Owner. If Contractor suggests alternative material, equipment or procedures will improve the results at no additional cost, Engineer and Owner will examine suggestion, and if it is accepted, it may be used. The basis upon which acceptance of an alternative will be given is its value to the Owner, and not for Contractor's convenience.

## 1.10 GUARANTEE

A. Contractor shall guarantee the quality of materials, equipment, and workmanship for a period of 12 months after acceptance. Defects discovered during this period shall be repaired by Contractor at no cost to the Owner.

## 1.11 EXISTING UTILITIES

A. All known utility facilities are shown schematically on plans, and are not necessarily accurate in location as to plan or elevation. Utilities such as service lines or unknown facilities not shown on plans will not relieve the Contractor of responsibility under this requirement. "Existing Utilities Facilities" means any utility existing on the project in its original, relocated, or newly installed position. Contractor will be held responsible for the cost of repairs to damaged underground facilities; even when such facilities are not shown on plans

B. The Contractor shall call for underground utility locations before starting work. Underground utilities location service can be contacted at 811 or 1–888–721–7877.

## 1.12 CONNECT NEW MAIN TO EXISTING SYSTEM

A. Contractor shall furnish necessary pipe and perform all excavation, dewatering, shoring, backfilling, etc., necessary to make the connection of a new main to existing water system. Contractor shall contact the Superintendent of Water Utility a minimum of 48 hours in advance of construction. Contractor shall be responsible for coordinating construction with the utility operator.

## 1.13 DAMAGE TO EXISTING WATER SYSTEM

A. Damage to any part of the existing water system by Contractor or Subcontractors, repaired by Utility Owner's forces, shall be charged to Contractor on basis of time and material, plus 30% for overhead and administration.

## 1.14 MEASUREMENT AND PAYMENT

A. Measurement – The length of mains, and branch lines to be paid for will be determined by measurement along the centerline of the various sizes and types of pipe actually furnished and installed, from the center of fitting, and from the center of the main to the end of the branch connection. No deduction will be made for the space occupied by valves and fittings.

B. Payment –

1. Pipe – Payment will be made at the contract unit price per linear foot for the various types and sizes of pipe that are actually placed, as shown on the plans, or as directed by the Engineer. Excavation, installation, backfill, compaction, testing, metal detector tape, tracing wire, and all other incidentals to installation of the mains shall be considered as subsidiary obligations of the Contractor for the completion of the line in place.

2. Fittings – Fittings for iron and plastic pipe in the distribution system will be paid for on the basis of the unit price per pound of ductile iron fittings at the weights listed in AWWA Specification C–153 for mechanical joint compact fittings. (Excluding Accessories.) No distinction will be made between the weight of compact ductile iron, cast iron or ductile iron fittings, unless the fittings used are not manufactured as compact fittings. Fittings not manufactured as compact fittings will be paid for on the basis of the unit price per pound of ductile iron fittings at the weights listed in AWWA C–110. P.V.C. fittings used for P.V.C. pipe, at the Contractor's option, will be considered a subsidiary obligation to the pipe and will not be measured for separate payment. Payment for P.V.C. fittings shall be included in the unit price per foot for P.V.C. The adapters necessary to connect to valves shall be considered a part of the line in which they are installed.

3. Valves – Payment will be made at the contract unit price for each size. Payment will include furnishing and installing the valve, valve boxes, extensions, or manholes.

4. Fire Hydrants – Payment will be made at the contract unit price. Payment will include the cost of furnishing, installing and connecting the hydrant, gravel sump, restrained joints, and backfilling. The 6 inch pipe from the main line to the hydrant will be paid for as 6 inch pipe. Gate valve and valve box will be paid for separately.

5. Cleaning and Disinfecting – No separate payment will be made for cleaning and disinfecting. Cleaning and disinfecting piping in the distribution system will be included in the lump sum and unit prices for the appropriate items.

6. House Service Connections – Payment will be made at the contract unit price. Payment will include the cost of furnishing and installing the tapping saddle, corporation stop, curb stop and marking stake at the

property line. The service pipe will be paid for at the contract unit price for each size specified.

7. Grassing – There will be no separate measurement or payment. Grassing shall be considered as a subsidiary obligation of the Contractor in the restoration of disturbed areas.

8. Metal Detector Tape – No separate payment will be made for tape. The cost of furnishing and placing metal detector tape shall be included in the contract unit price for installing pipe.

9. Connections to Existing Mains – Payment will be made at the contract unit price for each type connection and will include all equipment, labor, and materials required to locate, excavate, cut, connect, backfill, and compact.

10. Tapping Sleeves and Crosses – Payment will be made at the contract unit price. Payment will include all labor, materials, and equipment necessary to locate, excavate, furnish, and install the sleeve or cross, valve, valve boxes or manholes, tap the existing main, backfilling and compaction.

11. Remove and Replace Existing Pavement – Payment will be made on a square yard basis, and constructed in accordance with the detail shown.

12. Flush Valves – Payment will be made at the contract unit price. Payment will include furnishing and installing the ball valve, riser pipe and cap, valve or meter box, and the concrete collar.

13. Tracing Wire – No separate payment will be made for wire. The cost of furnishing and placing location wire shall be included in the contract unit price for installing pipe.

14. Restrained Joints – Payment will be made at the contract unit price for each size installed. Payment will include all labor, materials, and equipment necessary to furnish and install each restrained joint.

15. Air Release Valve in Manhole – Payment will be made at the contract unit price for each size. Payment will include furnishing and installing the air release valve, saddle, ball valve, manhole, frame, and cover.

16. Backflow Preventer Assembly – Payment will be made at the contract unit price for each size. Payment will include furnishing and installing the backflow preventer assembly, vault, cover, testing, and certification.

17. Casing – Payment will be made at the contract unit price per linear foot. Payment will include dewatering, excavation, providing steel pipe, installation, casing spacers, enclosure method, backfilling, compaction, testing, and all equipment, labor, and materials necessary to complete the work.

**1.15 TESTING**

A. Laboratory tests for moisture density relationship for fill materials shall be in accordance with ASTM D 1557, (Modified Proctor).

B. In place density tests in accordance with ASTM D 6938.

C. Testing laboratory shall operate in accordance with ASTM D 3740 and E 329 and be acceptable to the Engineer and Owner.

D. The testing laboratory and Project Engineer/Project Representative shall be given a minimum of 48 hours notice prior to taking any of the tests.

E. Testing Laboratory shall be selected by, engaged by and be the responsibility of the Owner. Testing Laboratory shall be responsible to the Owner and the Owner's Engineer. Payment for laboratory and all tests shall be by the Owner, except the Owner specifically reserves the right to deduct from the contractor's payment, the expense and charges of the Testing Laboratory when:

1. the contractor gives notice that his work is ready for inspection and testing, and the contractor fails to be ready for the test, and/or

2. the test of the contractor work products or materials fail, and retesting is required, and/or

3. the contractor abuses the services or interferes with the work of the testing laboratory in the conduct of this work.

F. Test results shall be furnished to the Engineer prior to continuing with associated or subsequent work.

## PART 2 – PRODUCTS

Products and materials used in the work shall conform to the following:

**2.1 GENERAL REQUIREMENTS**

A. All material or products that come into contact with drinking water shall be third party certified as meeting the specifications of the American National Institute/National Sanitation Foundation Standard 61, Drinking Water System Components – Health Effects. The American National Standards Institute shall accredit the certifying party.

B. All pipe, fittings, packing, jointing materials, valves, and fire hydrants shall conform to Section C of the AWWA Standards.

**2.2 PIPE**

A. Ductile Iron Pipe – Shall conform to ANSI A–21.50 (AWWA C–150) and ANSI A–21.51 (AWWA C–151). All pipe shall be Pressure Class 350 unless otherwise noted. It shall be cement lined in accordance with ANSI A–21.4 (AWWA C–104).

B. P.V.C. – All pipe shall be blue in color with factory marked homing lines. Pipe 4 inches through 12 inches shall conform to all requirements of AWWA C–900, DR 18, pressure class of 235 p.s.i. and shall have the following minimum wall thickness:

| | |
|---|---|
| 4 inches | 0.267 inches |
| 6 inches | 0.383 inches |
| 8 inches | 0.503 inches |
| 10 inches | 0.617 inches |
| 12 inches | 0.733 inches |

Pipe 14 inches through 18 inches in diameter shall conform to all the requirements of AWWA C 905, DR 18, pressure rating of 235 p.s.i.

Pipe with diameter less than 4 inches shall conform to all requirements of ASTM D–1784 and D–2241 (SDR 21). The pipe shall have a minimum pressure rating of 200 p.s.i. Certificates of conformance with the foregoing specifications shall be furnished with each lot of pipe supplied. All P.V.C. pipe shall bear the National Sanitation Foundation Seal of Approval.

C. Plastic Tubing – Tubing for service lines shall be:

Polyethylene Tubing: CTS PE 3408 conforming to all requirements of AWWA C–901 and ASTM D–2737 (SDR9). The tubing shall be copper tubing size and rated for a minimum working pressure of 200 p.s.i. Marking on the tubing shall include: nominal tubing pipe size; type of tubing material – PE 3408; SDR 9; pressure rating – 200 p.s.i.; ASTM D–2737; manufacturer's name and seal of the National Sanitation Foundation.

**2.3 JOINTS**

A. Flanged Joints – Shall conform to ANSI A–21.15 (AWWA C–115). Bolts shall conform to ANSI B–18.2.1 and nuts shall conform to ANSI B–18.2.2. Gaskets shall be rubber, either ring or full face, and shall be 1/8 inch thick. Gaskets shall conform to the dimensions recommended by AWWA C–115 latest revision.

B. Mechanical Joints – In ductile iron pipe shall conform to ANSI A–21.11 (AWWA C–111).

C. Push–On–Joints – In ductile iron pipes shall conform to ANSI A–21.11 (AWWA C–111).

D. Plastic Pipe – Joints in plastic pipe 4 inches and larger shall meet all requirements of AWWA C–900. Joints in plastic pipe 14 inches through 18 inches shall meet all

requirements of AWWA C905. Joints in plastic pipe with a diameter less than 4 inches shall conform to ASTM D–3139.

E. Restrained Joints – Restrained joints for pipe, valves and fittings shall be mechanical joints with ductile iron retainer glands equivalent to "Megalug" or push–on type joints equivalent to "Lok–Ring," "TR Flex," or "Super Lock" and shall have a minimum rated working pressure of 250 p.s.i. for ductile iron pipe and 100 p.s.i. with a minimum safety factor of 2:1 for PVC pipe. The joints shall be in accordance with the applicable portions of AWWA C–111. The manufacturer of the joints shall furnish certification, witnessed by an independent laboratory, that the joints furnished have been tested without signs of leakage or failure. Restrained joints shall be capable of being deflected after assembly.

F. Natural rubber or other material which will support microbiological growth may not be used for any gaskets, o–rings, and other products used for jointing pipes, setting meters and valves or other appurtenances which will expose such material to water.

**2.4 FITTINGS**

A. Fittings for Ductile Iron or Plastic Pipe – Shall be ductile iron, manufactured in accordance with ANSI A–21.53 (AWWA C–153). They shall be cement lined in accordance with ANSI A–21.4 (AWWA C–104). Fittings shall be designed to accommodate the type of pipe used.

B. Fittings for Flanged Pipe – Shall be manufactured in accordance with ANSI A–21.10 (AWWA C–110), Class 125 flanges.

C. Fittings for Plastic Pipe – Less than 4 inches shall be PVC with ring tite rubber joints conforming to ASTM D–3139.

**2.5 GATE VALVES**

A. Two Inches and Larger – Shall be cast iron or ductile iron body, bronze mounted, double disc or resilient wedge design, with non–rising stems, conforming to AWWA C–500, C–509, or C–515. Valves shall have a working pressure of 200 p.s.i. and be tested at 400 p.s.i.

Valves shall be furnished with "O" ring packing. Two "O" rings shall be located above the thrust collar and one "O" ring below. The thrust collar shall be permanently lubricated and have an anti–friction washer on top of the thrust collar.

Valves installed in pits or above ground shall be furnished with hand wheels. Buried valves shall be furnished with square operating nuts.

B. Smaller than 2 Inches – Shall be all brass, ball valve type. The pressure rating shall be 175 p.s.i.

C. Valve Boxes – Underground valves shall be installed in acceptable valve boxes. The valve boxes shall have a suitable base which does not damage the pipe, and shaft extension sections to cover and protect the valve and permit easy

access and operation. The box, cover, and any extensions needed shall be cast or ductile iron having a crushing strength of 1,500 pounds per linear foot. Valve boxes shall conform to the detail shown.

D. Valve Manholes –

1. Masonry – Shall be new whole brick of good quality laid in masonry mortar or cement mortar made of 1 part Portland cement and 2 parts clean sharp sand. Every brick shall be fully bedded in mortar. Manholes shall conform to the locations and details shown on the plans.

2. Precast Concrete – Shall be reinforced concrete constructed in accordance with ASTM C 478 and the details shown on the plans "Precast Concrete Manholes." The joints shall be tongue and groove sealed with flexible gaskets or mastic sealant. Gaskets shall be O–Ring or equivalent to Type A or B "Tylox" conforming to ASTM C 443. Mastic shall be equivalent to "Ram–nek" with primer. The primer shall be applied to all contact surfaces of the manhole joint at the factory in accordance with the manufacturer's instructions.

3. Frames and Covers – Shall conform to the details shown.

E. Flush valves – Shall conform to the details shown.

## 2.6 BUTTERFLY VALVES

A. All butterfly valves shall be of the tight–closing, rubber seated type, with rubber seat positively locking in place sealing against flow from either direction. No metal–to–metal seating surfaces will be permitted. Valves shall be bubble–tight at rated pressures with flow in either direction. Butterfly valves shall conform to ANSI/AWWA C504, Class 150B. Butterfly valves shall not be used on pipe smaller than 14–inches unless otherwise specified.

1. Valve body end connections for buried valves shall be installed using restrained joints equivalent to those manufactured by EBAA Iron, Inc.

2. Valve shafts shall be stainless steel and may consist of a one–piece unit or may be the "Stub Shaft" type. A stub shaft comprises two separate shafts inserted into the valve disc hubs. Each stub shaft shall be inserted into the valve disc hubs for a distance of at least 1 ½ shaft diameters.

3. Valve discs shall be solid ductile iron with an epoxy coating making it corrosion resistant. The thickness of the discs shall not exceed 2 ¼ times the shaft diameter.

4. Valve seats shall be natural or synthetic rubber providing 360 degrees uninterrupted seating. The resilient seat shall be adjustable or replaceable in the field without burning or grinding. The seat shall be molded over a stainless steel ring for support and secured to the disc by corrosion resistant, self-locking stainless steel screws.

5. All internal ferrous metal surfaces in the waterway shall be factory coated with a non–toxic, to–component, holiday–free, thermosetting epoxy to a nominal thickness of 4 mils.

6. All butterfly valves shall be manually operated. Operators shall be of the traveling nut, self–locking type and shall be designed to hold the valve in any intermediate position without creeping or fluttering. Operators shall be furnished with externally adjustable mechanical stop limiting devices. Valves shall have a 2 inch square operating nut and shall be installed with extension stem to extend the operating nut in accordance with the project details. The operator shall be integrally mounted on the valve mounting flange and shall have a gearing totally enclosed for buried service. Maximum force for operating nut shall be 40 pounds.

B. Valve Boxes – Underground valves shall be installed in approved valve boxes. The valve boxes shall have a suitable base that does not damage the pipe, and shaft extension sections to cover and protect the valve and permit easy access and operation. The cover, box, and any extensions needed shall be cast or ductile iron having a crushing strength of 1,500 pounds per linear foot. Valve boxes shall conform to the detail shown.

C. Valve Manholes –

1. Masonry – Shall be new whole brick of good quality laid in masonry mortar or cement made of one part Portland cement and two parts clean sharp sand. Every brick shall be fully bedded in mortar. Manholes shall conform to the locations and details shown on the plans.

2. Precast Concrete – Shall be reinforced concrete constructed in accordance with ASTM C 478 and the details shown on the plans "Precast Concrete Manholes." The joints shall be tongue and groove sealed with flexible gaskets or mastic sealant. Gaskets shall be O–Ring or equivalent to Type A or B "Tylox" conforming to ASTM C 443. Mastic shall be equivalent to "Ram–nek" with primer. The primer shall be applied to all contact surfaces of the manhole joint at the factory in accordance with the manufacturer's instructions.

## 2.7 AIR RELEASE, AIR/VACUUM AND COMBINATION AIR VALVES

A. Shall be designed for water service with a minimum working pressure of 100 p.s.i. The valve shall be constructed of a cast iron body, stainless steel or bronze trim, and stainless steel float. The inlet shall be 2 inches, 5/16 inch orifice, and a minimum venting capacity of 35 c.f.f.a.m. It shall conform to the detail shown on the drawings. Valves shall conform to AWWA C 512 and equivalent to Crispin or Valmatic.

## 2.8 FIRE HYDRANTS

A. General – Hydrants shall be manufacturer's current model design and construction. All units to be complete including joint assemblies. Physical characteristics and compositions of various metal used in the hydrant components shall meet the requirements as specified in AWWA C–502 latest revision. Hydrants shall be suitable for working pressure of 150 p.s.i.

B. Bonnet – Bonnet may have oil filled or dry reservoir. If oil filled, bonnet must have "O" ring packing so all operating parts are enclosed in a sealed oil bath. Oil filler plug shall be provided in bonnet to permit checking of oil level and adding oil when required. If dry type, hydrant top must have lubricating hole or nut for ease of lubrication. All parts must be removed through top of hydrant without moving entire barrel section from safety flange.

C. Nozzles and Caps – The hydrant shall have 2 ½ inch connections and 4 ½ inch steamer connection, National standard threads. Nozzles shall be bronze and have interlocking lugs to prevent blowout. [Nozzle caps shall be secured to fire hydrant with non–kinking type chain with chain loop on cap ends to permit free turning of caps.]

D. Seat Ring – Seat ring shall be bronze.

E. Drain Valves and Openings – Positive operating drain valves shall be provided to assure drainage of fire hydrant when the main valve is closed. Drain openings shall have bronze bushings.

F. Main Valve – Valve shall be designed to close with the pressure and remain closed. Valve shall be made from material resisting damage from rocks or other foreign matter. Valve shall have a full 5 ¼ –inch opening.

G. Barrel and Safety Flanges – Hydrants shall have a safety–type vertical barrel with 3–1/2 foot bury and be designed with safety flanges and/or bolts to protect the barrel and stem from damage and to eliminate flooding when hydrant is struck. Bury depth shall be cast on barrel of hydrant.

H. Operating Stop and Nut – Hydrant shall have a positive stop feature to permit opening of hydrant without over travel of stem. Operating nut shall be bronze, 1–1/2–inch, point to flat, pentagon.

I. Bolts and Nuts – Bolts, washers and nuts shall be corrosion resistant.

J. Inlet – Bottom inlet of hydrant shall be provided with mechanical joint connection as specified and shall be 6 inch nominal diameter.

K. Direction of Opening – Hydrant shall be designed to close "right" or clockwise and open "left" or counter–clockwise.

L. Coatings – All inside and outside portions of hydrant shall be coated in accordance with AWWA C–502. The exterior portion of hydrant above ground level shall be painted with two coats of best grade zinc chromate primer paint and with two coats of approved hydrant enamel. Color shall be Factory Safety Yellow unless otherwise designated by Owner.

M. Joint Assemblies – Complete joint assemblies consisting of gland, gasket, bolts, and nut shall be furnished for mechanical joint inlets.

**2.9 SERVICE CONNECTIONS**

A. Taps in pipe larger than 3 inches shall be made with a tapping machine. A corporation stop shall be installed at the connection to the main. The corporation stop shall be brass manufactured in conformance with AWWA C–800. Inlet and outlet threads shall conform to AWWA C–800.

Corporation stops shall be 1 inch equivalent to Mueller H–15008 or B–25008 with a stainless steel stiffener. Service saddles shall have 1 inch AWWA taps, equal to Ford Styles 202B or S70. Contractor shall adhere to pipe manufacturer's recommendations on maximum tap sizes for each main size.

B. Taps for services in PVC pipe 3 inches and smaller shall be equivalent to Romac Industries Style 306 Saddle or a PVC Tee. The connection shall be capable of withstanding internal water pressure continuously at 150 p.s.i. House service lines will be 1–inch polyethylene tubing with a curb stop at the property line. The end of the service lateral at the property line shall be marked with a 2 x 4 stake, 36 inches long with the top 6 inches above the ground and painted blue. The depth of the pipe shall be marked on the back of the stake. Location of service line must appear on the "as–built" information and record drawings.

**2.10 TAPPING SLEEVES**

A. Shall be mechanical joint type sized to fit the intercepted pipe. They shall have duck–tipped end gaskets and shall be equal to Mueller H–615/715 with a tapping valve attached. The outlet end of the valve shall have a joint suitable for the type of pipe to be used in the new branch. Sleeve shall be sized to fit the intercepted pipe without leaking.

**2.11 CURB STOPS**

A. At the end of the service line, where the meter is to be installed, a 1 inch brass ball valve shall be installed. The unconnected end shall be closed inside I.P. thread. All ball valves shall be ¼ turn valves and the full open and closed position shall be controlled by check lugs. The pressure rating shall be 175 p.s.i. The ball valves shall be equivalent to Ford Ball Valve No. B41–444W.

**2.12 BACKFLOW PREVENTER ASSEMBLY**

A. Reduced Pressure – Shall consist of two independently operating check valves, one differential relief valve located between the two check valves, two resilient seat gate valves, and four properly placed resilient seated test cocks. Backflow preventer 2 inches and smaller shall have a bronze valve body. Backflow preventer greater than 2 inches shall be ductile iron or stainless steel. All internal

parts in the check and relief valves shall be made of series 300 stainless steel or polymer materials suitable for potable water and rated for 175 p.s.i. working pressure. The assembly shall be constructed so all internal parts can be serviced or removed while in line. Assembly must be factory assembled and tested. Backflow preventer shall be equivalent to Febco Model 860 or Ames Model 4000 SS.

B. Double Check – Shall consist of two independently operating check valves, two resilient seat gate valves, and four properly placed resilient seated test cocks. Backflow preventer 2 inches and smaller shall have a bronze valve body. Backflow preventer greater than 2 inches shall be ductile iron or stainless steel. All internal parts in the check valves shall be made of Series 300 stainless steel or polymer materials suitable for potable water and rated for 175 p.s.i. working pressure. The assembly shall be constructed so all internal parts can be serviced or removed while in line. Assembly must be factory assembled and tested. Backflow preventer shall be equivalent to Febco Model 805 YD or Ames Model 2000 SS.

## 2.13 CASING

A. Casing pipe shall be steel conforming to ASTM A 139, yield point of 35,000 p.s.i., of the diameter shown on the contract drawings for each crossing. The minimum wall thickness shall be 0.25 inches.

## 2.14 CASING SPACERS

A. Casing spacers shall be bolt on style with a shell made in two sections of a minimum 14 gauge T–304 Stainless Steel. Connecting flanges shall be ribbed for extra strength. The shell shall be lined with a PVC liner. All nuts and bolts shall be T–304 Stainless Steel. Runners shall be made of Ultra High Molecular Weight Polymer with inherently high abrasion resistance and a low coefficient of friction. The combined height of supports and runners shall keep carrier pipe a minimum of 0.75 inches from casing pipe at all times. Casing Spacers shall be as manufactured by Cascade Waterworks Manufacturing Company, or accepted equivalent.

## 2.15 METAL DETECTOR TAPE

A. The tape shall consist of 0.35 mils thick solid foil core encased in a protective plastic jacket resistant to alkalis, acids, and other destructive elements found in the soil. The lamination bond shall be strong enough the layers cannot be separated by hand. Total composite thickness to be 5.0 mils. Foil core to be visible from unprinted side to ensure continuity. The tape shall have a minimum 3–inch width and a tensile strength of 35 lbs. per inch.

A continuous warning message indicating "potable water" repeated every 16 inches to 36 inches shall be imprinted on the tape surface. The tape shall contain an opaque color concentrate designating the color code appropriate to the line being buried (Water Systems – Safety Precaution Blue).

## 2.16 TRACING WIRE

A. Tracing wire shall be # 12 gauge insulated single strand copper wire.

### 2.17 PRODUCT REVIEW

A. Contractor shall provide the Engineer with a complete description of all products before ordering. The Engineer will review all products before they are ordered.

## PART 3 – EXECUTION

### 3.1 ON–SITE OBSERVATION

A. Owner's Representative or Engineer shall have the right to require any portion of work be completed in their presence. If any work is covered up after such instruction, it shall be exposed by the Contractor for observation. However, if Contractor notifies Engineer such work is scheduled, and Engineer fails to appear within 48 hours, the Contractor may proceed. All work completed and materials furnished shall be subject to review by the Engineer or Project Representative. Improper work shall be reconstructed. All materials which do not conform to requirements of specifications shall be removed from the work upon notice being received from Engineer for rejection of such materials. Engineer shall have the right to mark rejected materials to distinguish them as such.

Contractor shall give the Project Engineer or Project Representative a minimum of 48–hours notice for all required observations or tests.

It will also be required of Contractor to keep accurate, legible records of the location of all water lines, service laterals, valves, fittings, and appurtenances. These records will be prepared in accordance with the paragraph on "Record Data" in Special Conditions. Final payment to the Contractor will be withheld until all such information is received and accepted.

### 3.2 INSTALLATION

A. Ductile iron pipe shall be laid in accordance with AWWA C–600; Plastic pipe shall be laid in accordance with AWWA C 605, ASTM D 2774, UNI–Bell UNI–B 3 and the pipe manufacturer's recommendations. The standards are supplemented as follows:

1. Depth of Pipe – Contractor shall perform excavation of whatever substances are encountered to a depth providing a minimum cover over top of pipe of 36 inches from the existing or proposed finished grade, unless pipe material is steel, concrete, ductile iron, or other accepted material, and if exposed, should be insulated to prevent freezing.

2. Alignment and Grade – Water mains shall be laid and maintained to lines and grades established by the plans and specifications, with fittings, valves, and hydrants at required locations unless otherwise accepted by Owner. Valve–operating stems shall be oriented in a manner to allow proper operation. Hydrants shall be installed plumb.

a. Prior Investigation – Prior to excavation, investigation shall be made to the extent necessary to determine location of existing underground structures, utilities, and conflicts. Care shall be exercised by the Contractor during excavation to avoid damage to existing structures and utilities. Pipe manufacturer's recommendations shall be used when the watermain being installed is adjacent to a facility cathodically protected.

b. Unforeseen Obstructions – When obstructions not shown on plans are encountered during progress of work and interfere so an alteration of the plans is required, Owner will alter plans, or order a deviation in line and grade, or arrange for removal, relocation, or reconstruction of obstructions.

c. Clearance – When crossing existing pipelines or other structures, alignment and grade shall be adjusted as necessary, with the acceptance of Engineer, to provide clearance as required by federal, state, and local regulations or as deemed necessary by Engineer to prevent future damage or contamination.

3. Trench Construction – The trench shall be excavated to alignment, depth, and width specified or shown on plans and shall be in conformance with all federal, state, and local regulations for protection of workers.

4. Joint Restraint – All hydrants, bends, plugs, valves, caps and tees on 2 inch pipe and larger, shall be provided with stainless steel tie rods or joint restraints equivalent to Megalugs. Additional restraint shall be as indicated on the drawings.

5. Anchorage for Hydrants – A concrete block 1 foot x 1 foot x 2 feet shall be poured between back of hydrant and undisturbed earth of the trench side without covering weep holes and bolts. Joint restraints equivalent to Megalugs manufactured by EBAA Iron may be used in lieu of concrete blocking.

6. Hydrostatic and Leakage Tests – Ductile iron pipe shall be tested in accordance with AWWA Standard C 600, Section 5.2 – Hydrostatic Testing. Allowable leakage shall not exceed the formula $L = SDP^{1/2}/148{,}000$, in which L is allowable leakage in gallons per hour; S is length of pipe in feet tested; D is nominal diameter of pipe in inches; and P is average test pressure during leakage test in pounds per square inch gauge. Test shall be conducted for at least 2 hours and a pressure of 150 p.s.i. shall be maintained during the test. Fire lines shall be tested at 225 p.s.i. for the same duration.

   P.V.C. pipe shall be tested in accordance with AWWA Standard C 605, Section 7.3 – Hydrostatic Testing. Allowable leakage shall not exceed formula $Q = LDP^{1/2}/148{,}000$, in which Q is allowable leakage in gallons per hour; L is length of pipe in feet tested; D is nominal diameter of the pipe in inches; and P is average test pressure during leakage test in pounds per square inch gauge. Test shall be conducted for at least 2 hours and a

pressure of 150 p.s.i. shall be maintained during the test. Fire lines shall be tested at 225 p.s.i. for the same duration.

Should any test of pipe laid disclose leakage greater than the above specified, Contractor shall, at its own expense, locate and repair defective joints until leakage is within specified allowance. Contractor is responsible for notifying the Engineer 48 hours (minimum) prior to applying pressure for testing. Pressure test will be witnessed by Engineer or Project Representative. All visible leaks shall be repaired regardless of the leakage amount.

7. Bedding, Backfilling, and Compaction – Continuous and uniform bedding shall be provided for all buried pipe. All trenches and excavation shall be backfilled immediately after pipes are laid therein, unless other protection of the pipe line is directed. The backfilling material shall be selected and deposited with special reference to future safety of the pipes. The material shall be completely void of rocks, stones, bricks, roots, sticks, or any other debris causing damage to pipe and tubing or preventing proper compaction of backfill. Except where special methods of bedding and tamping are provided for, clean earth or sand shall be solidly tamped about pipe up to a level at least 2 feet above top of pipes, and shall be carefully deposited to uniform layers, each layer solidly tamped or rammed with proper tools to not injure or disturb the pipeline. The remainder of trench backfilling shall be carried on simultaneously on both sides of pipe in such manner preventing injurious side pressure. Material used shall be selected from excavations anywhere on site if any of the soil is suitable. Stones, other than crushed bedding, shall not come in contact with the pipe and shall not be within 6 inches of any pipe.

   Under traffic areas, the top 24 inches of backfill material shall be compacted to a density of not less than 98% of maximum laboratory density at optimum moisture as determined by ASTM D 6938. Below the 24 inch line, and including area around pipe, density shall not be less than 95% of maximum laboratory density, at optimum moisture. In areas other than traffic areas, the backfill shall be compacted to 90% of maximum laboratory density at optimum moisture.

   Whenever trenches have not been properly filled, or if settlement occurs, they shall be refilled, smoothed off, and finally made to conform to the ground surface. Backfilling shall be carefully performed, and the original surface restored to full satisfaction of Engineer immediately after installation.

   Where thermoplastic (PVC) pipe is installed, Contractor shall take precautions, in accordance with ASTM D–2774, during backfilling operations, not to create excessive side pressures, or horizontal or vertical deflection of the pipe, nor impair flow capacity.

8. New Service Connections – Contractor shall tap the main and install a service connection to each vacant lot or as directed by Engineer in accordance with detail shown on plans for Water Service Connections. Plastic tubing for service lines shall be installed in a manner preventing

abrupt changes or bends in any direction. Contractor shall exercise extreme caution to prevent crimping of the tubing during handling, storage, and installation. Tubing shall have an absolute positive connection to the water main to prevent leakage. Taps shall be made perpendicular to the main. A water service connection shall be marked on the curb with a "W." The mark shall be made with a branding iron on vertical face of curb and shall be a minimum of 1/4–inch in depth.

9. Detection Tape – Detection tape will be used over all pipe and tubing. The tape shall be laid 18 inches below finished grade.

10. Tracing Wire – Tracing wire will be installed on all water mains and water service laterals directly on top of the water line. The wire shall be secured to the pipe with tape or other acceptable methods at spacings of no more than 36 inches apart. Where water service laterals connect to water mains, the wire insulation shall be stripped so bare wires can and shall be jointed securely together and wrapped with a rubberized insulation tape. The insulated wire must maintain electrical continuity. The tracing wire shall also be stubbed up into each valve box and at each fire hydrant. Stub up connections shall be stripped, joined and wrapped as previously described for water service laterals. This tracing wire system shall be checked and tested by Contractor, in the presence of Engineer or water department, prior to acceptance of water main installation. All equipment, meters, detectors, etc., needed for testing shall be furnished by the Contractor.

11. Jacking and Boring – Steel casing of diameter shown on the plans shall be jacked and bored in location indicated. Joints between sections of the steel casing shall be of a continuous weld made by a certified welder. Jacking and boring shall be in accordance with the State Department of Transportation Standard Specifications. Carrier pipe shall be installed as shown on the detail. After carrier pipe has been installed, ends of the casing shall be sealed using a rubber enclosure and stainless steel straps or brick and mortar.

    Where work involves a highway, Resident Engineer of the State Department of Transportation shall be notified 3 days before crossing is started. Where the work involves a railroad, installation shall conform to requirements of AREA specifications. Division Superintendent of the Railroad shall be notified 3 days prior to beginning work. Before commencing work within right–of–way of railroads or highways, Contractor shall verify the Owner has obtained required permits.

12. Lubricants – Lubricate pipe before jointing per manufacturer's recommendations using acceptable lubricants. Lubricants that will support microbiological growth shall not be used. Vegetable shortening shall not be used to lubricate joints.

13. Hydrant drains shall not be connected to or located within 10–feet of sanitary sewers. No flushing device shall be directly connected to any sewer.

14. Pipe for above water crossings shall be adequately supported and anchored, protected from damage and freezing, and accessible for repair or replacement.

15. Underwater line crossings shall have a minimum 2 feet of cover over the pipe. When crossing water courses greater than fifteen 15 feet in width, the following shall be provided:

    a. The pipe material and joints shall be designed appropriately.

    b. Valves shall be located on both sides of crossing so the section can be isolated for testing or repair. Valves shall be easily accessible and not subject to flooding.

    c. A blow–off shall be provided on the side opposite the supply, sized in accordance with State Drinking Regulation Section R.61–58.4(D)(7). Direct blow–off away from streams, over ground.

    d. Provide ductile iron pipe with mechanical joints for any lines installed in rock.

**3.3 AIR RELEASE, AIR/VACUUM AND COMBINATION AIR VALVES**

A. Valves shall be installed in locations as shown on the contract drawings. The Contractor shall verify high points in the water line and notify Engineer of differing conditions from the drawings.

B. Valves shall be opened during initial filling of the water main. Valves shall be closed during hydrostatic testing. Once tested and the system is accepted for operation, valves shall be opened when water lines are put on line.

**3.4 CONNECTIONS OF WATER MAINS**

A. Any physical connection of untested water mains with existing water mains is prohibited except when acceptable backflow prevention devices have been installed and checked by Engineer or Engineer's Representative.

1. Any new water main to be tested must be capped and restrained with retaining glands or thrust blocks to prevent blow out or leakage during the pressure testing.

2. Water for filling or flushing a new water main will be obtained through a Temporary Jumper Connection to the existing main. Appropriate taps of sufficient size must be made at the end of new system to allow air to escape during filling sequence.

3. This physical tie–in with the existing system must be physically disconnected after sufficient water for hydrostatic testing and disinfection has been obtained.

4. Once the new water system has demonstrated adequate hydrostatic testing and has been flushed and chlorinated in accordance with

paragraph 3.5, the new system or main will then be subjected to bacteriological testing.

5. Permanent connection to the new system must be made with clean materials. The connection may be made with either solid or split ductile iron sleeves. Any connection with stainless steel or similar metal full circle clamps is prohibited. Once connection has been made, the new system must be flushed using water from existing system to insure adequate flow and velocity into new water system.

**3.5 DISINFECTION**

A. After hydrostatic and leakage tests, have been completed, water pipes shall be disinfected in accordance with AWWA C 651 and Regulations of the local Health Department.

All new mains shall be thoroughly flushed then chlorinated with not less than fifty parts per million (50 ppm) of available chlorine. Chlorine gas or 70% high–test calcium hypochlorite can be used. Water from existing distribution system or other source of supply should be controlled to flow slowly into the newly laid pipeline during application of chlorine. The solution shall be retained in pipeline for not less than 24 hours and a chlorine residual of 25 ppm shall be available at this time. Then system shall be flushed with potable water and the sampling program started. Prior to sampling, the chlorine residual must be reduced to normal system residual levels or be non–detectable in those systems not chlorinating. Normal system residual should be between 0.2 and 0.8 ppm. The chlorine residual shall be measured and reported. If the membrane filter method of analysis is used for coliform analysis, non–coliform growth must also be reported. If non–coliform growth is greater than eighty colonies per one hundred milliliters, the sample result is invalid and must be repeated.

A minimum of two samples from each sampling site shall be collected for total coliform analysis. The number of sites depends on amount of new construction, but must include all dead end lines, be representative of water in newly constructed mains, and shall be collected a minimum of every 1,200 linear feet. Each set of samples shall be taken at least 24 hours apart after disinfection and tested by a State approved lab and shall indicate bacteriological satisfactory water. Contractor shall submit results to the Engineer.

**3.6 PARTIAL ACCEPTANCE OF THE WORK**

A. Owner reserves right to accept and use any portion of the work. Engineer shall have power to direct on what line Contractor shall work and the order thereof.

**3.7 GRASSING**

A. Grassing of areas disturbed during construction shall be in accordance with the Section 32 92 00 "Turf and Grasses."

**3.8 SEPARATION BETWEEN WATER AND SANITARY SEWER OR FORCE MAIN**

A. Water mains shall be laid at least 10 feet horizontally from any existing or proposed sanitary sewer or force main. Deviation may be allowed for installation

of the water main closer to a sanitary sewer or force main, provided water main is laid in a separate trench, where bottom of water main is at least 18–inches above top of sanitary sewer or force main. Water mains crossing sanitary sewers or force mains shall be laid to provide a minimum vertical distance of 18 inches between the invert of water main and top of sanitary sewer or force main line; both water and sanitary sewer or force main lines must be ductile iron when laid in violation of separation requirements. At all water and sanitary sewer or force main crossings, one full length of water pipe shall be located so both joints will be as far from the sanitary sewer or force main as possible.

B. When it is impossible to obtain distances specified in Section R.61–58.4(D)(12)(a) and (b) of the State Primary Drinking Water Regulations, an alternate, SCDHEC accepted design may be allowed. The alternate design must:

1. maximize distances between the water main and sewer line and joints of each;

2. use materials which meet requirements cited in Section R.61–58.4(D)(1) of the State Primary Drinking Water Regulations for sewer line; and

3. Allow enough distance to make repairs to one of the lines without damaging other.

## 3.9 REMOVE AND REPLACE PAVEMENT

A. Pavement shall only be removed after prior written authorization by the Owner. Pavement removed and replaced shall be constructed in accordance with latest specifications of the State Department of Transportation. Traffic shall be maintained and controlled per State Department of Transportation regulations.

Edges of the pavement shall be cut to a neat straight line with a masonry saw. Backfill shall be compacted and tested and a concrete base course of 5,000 p.s.i. placed on compacted fill as shown in the details. The concrete base shall be placed within 24 hours after water line is installed. A temporary wearing surface may be used provided it presents a smooth surface. The final wearing surface shall be 1–1/2 inches asphaltic concrete, Type C.

## 3.10 FIELD QUALITY CONTROL

A. Soil and density tests shall be made by a testing laboratory acceptable to Engineer. Laboratory tests of the soil shall be made in accordance with ASTM D 1557. In–place density tests shall be made in accordance with ASTM D 6938. Results of tests shall be furnished to the Engineer.

The minimum number of tests required shall be:

Backfill over pipe
in traffic areas. . . . . 1 per 100 linear feet or less for each 4 feet of depth or portion thereof.

Backfill over pipe
in non–traffic areas. . . . .1 per 500 linear feet or less for each 4 feet of depth or portion thereof.

The minimum percent of backfill compaction, in accordance to ASTM D1557, shall be the following:

In traffic Areas. . . . . 98% of maximum laboratory density.

In non–traffic Areas. . .90% of maximum laboratory density, unless otherwise accepted by the Engineer.

END OF SECTION

**INDEX TO**

**SECTION 33 40 00 – STORM DRAINAGE UTILITIES**

# SECTION 33 40 00

# STORM DRAINAGE UTILITIES

## PART 1 – GENERAL

### 1.1 SECTION INCLUDES

A. Construction of pipes, drainage inlets, manholes, headwalls, and various drainage structures.

### 1.2 RELATED SECTIONS

A. Section 03 00 00 –Concrete

B. Section 33 30 00 – Sanitary Sewerage Utilities

### 1.3 OPTIONS

A. The bid form and specifications describe several pipe materials. Owner will select the one to be used. Where manufacturers of material or equipment are named in the specifications, Contractor may use equipment or materials of other manufacturers provided they are reviewed and accepted by Engineer as equivalent to those specified.

### 1.4 REFERENCES (Latest Revision)

A. ASTM D 3740 – Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

B. ASTM E 329 – Agencies Engaged in Construction Inspection and/or Testing.

C. ASTM C 76 – Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

D. ASTM C 443 – Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

E. ASTM B 745/B 745M – Corrugated Aluminum Pipe for Sewers and Drains.

F. ASTM D 1056 – Flexible Cellular Materials – Sponge or Expanded Rubber.

G. ASTM F 2306/F 2306M – 12 to 60–Inch (300 to 1,500 mm) Annular Corrugated Profile–Wall Polyethylene (PE) Pipe and Fittings for Gravity–Flow Storm Sewer and Subsurface Drainage Applications.

H. ASTM D 1751 – Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non–extruding and Resilient Bituminous Types).

I. ASTM D 1752 – Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

J. ASTM D 2321 – Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications.

K. ASTM C 150 – Portland Cement.

L. ASTM C 144 – Aggregate for Masonry Mortar.

M. ASTM C 207 – Hydrated Lime for Masonry Purposes.

N. ASTM C 62 – Building Brick (Solid Masonry Units Made From Clay or Shale).

O. ASTM C 55 – Concrete Brick.

P. ASTM C 478 – Precast Reinforced Concrete Manhole Sections.

Q. ASTM C 1433 – Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers.

R. ASTM D 1557 – Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

S. ASTM D 6938 – In Place Density and Water Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth).

T. ASTM F 405 – Corrugated Polyethylene (PE) Tubing and Fittings.

U. ASTM C 913 – Precast Concrete Water and Wastewater Structures.

V. ASTM D 3212 – Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

W. ASTM F 477 – Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

X. AASHTO M 294 – Corrugated Polyethylene Pipe, 300 to 1500–mm Diameter.

Y. ASTM F667 – Large Diameter Corrugated Polyethylene Pipe and Fittings.

**1.5 QUALITY ASSURANCE**

A. Material Review – Contractor will furnish the Engineer and Owner a description of all material before ordering. Engineer will review the Contractor's submittals and provide in writing an acceptance or rejection of material.

B. Manufacturer – Material and equipment shall be standard products of a manufacturer who has manufactured them for a minimum of 2 years and provides published data on their quality and performance.

C. Subcontractor – A subcontractor for any part of the work must have experience on similar work, and if required, furnish Engineer with a list of projects and Owners or Engineers who are familiar with their competence.

D. Design – Devices, equipment, structures and systems not designed by Engineer and Contractor wishes to furnish, shall be designed by either a Registered Professional Engineer or by someone the Engineer accepts as qualified. If required, complete design calculations and assumptions shall be furnished to the Engineer or Owner before ordering.

E. Testing Agencies – Soil tests shall be taken by a testing laboratory operating in accordance to ASTM D–3740 and E–329 and be acceptable to the Engineer prior to engagement. Mill certificates of tests on materials made by manufacturers will be accepted provided the manufacturer maintains an adequate testing laboratory, makes regularly scheduled tests, spot checked by an outside laboratory and furnishes satisfactory certificates.

## 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Material shall be unloaded in a manner avoiding damage and shall be stored where it will be protected and will not be hazardous to traffic. Contractor shall repair any damage caused by the storage. Material shall be examined before installation. Neither damaged nor deteriorated material shall be used in the work.

## 1.7 SEQUENCING AND SCHEDULING

A. Contractor shall arrange work so sections of pipes between structures are backfilled, checked, pavement replaced and the section placed in service as soon as reasonable after installation.

## 1.8 ALTERNATIVES

A. The intention of these specifications is to produce the best system for the Owner. If Contractor suggests alternate material, equipment or procedures will improve results at no additional cost, the Engineer and Owner will examine suggestion, and if accepted, it may be used. The basis upon which acceptance of an alternate will be given is its value to Owner and not for Contractor's convenience.

## 1.9 GUARANTEE

A. Contractor shall guarantee quality of materials, equipment and workmanship for a minimum period of 12 months or as required by the local governing agency after acceptance. Defects discovered during this period shall be repaired by Contractor at no cost to the Owner.

## 1.10 EXISTING UTILITIES

A. All known utility facilities are shown schematically on the construction drawings, and are not necessarily accurate in location as to plan or elevation. Utilities such as service lines or unknown facilities not shown, will not relieve the Contractor of responsibility under this requirement. "Existing Utilities Facilities" means any utility existing on the project in its original, relocated or newly installed position. Contractor will be held responsible for cost of repairs to damaged underground facilities; even when such facilities are not shown on the drawings.

B. The Contractor shall call for underground utility locations before starting work. Underground utilities location service can be contacted at 1–888–721–7877 (SC) or 811.

## 1.11 MEASUREMENT AND PAYMENT

A. Pipe Culverts and Storm Drains – Length of pipe will be paid for on a linear foot basis, as measured along the centerline, from end of pipe to end of pipe, end of pipe to center of structure or center of structure to center of structure. Payment of which will constitute full payment for all pipe, joints, filter fabric and bedding, including trenching, dewatering, excavation, backfill and compaction, surface clean–up, and all incidental labor and material necessary to complete the construction of pipe as required by this section of specifications.

B. Drainage Structures – Payment will be made on a contract unit price basis. Payment will constitute full payment for all dewatering, excavation, formwork, precast concrete, backfill, compaction, frames, gratings or covers, concrete, brick and all miscellaneous materials, surface clean–up and labor necessary to complete the construction.

C. Headwalls – Payment will be made on a contract unit price of each type. Payment will constitute full compensation for dewatering, excavation, formwork, all materials, and incidentals necessary to complete the construction.

D. Sheeting and Bracing – Will not be measured for direct payment. All costs and charges in connection therewith shall be reflected and included in the item of work to which it pertains.

E. Subgrade Drain – Payment will be made at the contract unit price per linear foot. Payment will constitute full payment for trenching, furnishing and installing perforated drain pipe with sock, furnishing and placing fine aggregate, proper backfilling, surface cleanup, acceptable connection to structures, and all work necessary to make the installation complete.

F. Stone Foundation – Will be measured by using the length and depth for which stone is ordered by Engineer, times a width of 4 feet wider than outside diameter of pipe barrel. Payment will include the cost of removing and disposing of the unsuitable material and furnishing and placing stone.

G. Sand Foundation – Will be measured by using the length and depth for which sand is ordered by Engineer, times a width of 4 feet wider than outside diameter of pipe barrel. Payment will include the cost of removing and disposing of the unsuitable material and furnishing and placing sand.

H. Borrow – Borrow material will be measured at the site by truck count, measuring capacity of truck if full, or estimating quantity if not full. The width of trench in which borrow is placed shall be limited to 4 feet wider than outside diameter of pipe barrel. If additional width is excavated, it shall be backfilled at Contractor's expense and a deduction of the extra quantity determined by truck count. Payment will include furnishing, hauling, placing, and compacting "borrow"

material. Payment will also include disposing of unsuitable material in an area furnished by the Contractor.

I. Ditch and Swale Excavation – Excavations required for the construction of new ditches or swales and regrading of existing ditches or swales will be paid for per linear foot of ditch or swale excavated.

J. Connect Pipe to Existing Structures – Payment will be made at the contract unit price for each pipe size connected. For precast structures, payment shall include cost of dewatering, excavation, coring, installing and grouting in pipe, backfilling, compaction and all work necessary to complete the connection. For brick structures, payment shall include cost of dewatering, excavation, cutting a hole, installing and grouting in pipe, backfilling, compaction and all work necessary to complete the connection.

K. Pipe Video – Payment will be made at the contract unit price per linear foot. Payment will include all equipment, labor, and materials necessary to televise and video record 50% of pipes under roadways as chosen by the Engineer. Contractor shall provide Engineer with one copy of the video recording.

**1.12 TESTING**

A. Laboratory tests for moisture density relationship for fill materials shall be in accordance with ASTM D 1557, (Modified Proctor).

B. In place density tests in accordance with ASTM D 1556 or ASTM D 6938.

C. Testing laboratory shall operate in accordance with ASTM D 3740 and E 329 and be acceptable to the Engineer.

D. Testing laboratory and Project Engineer/Project Representative shall be given a minimum of 48–hours notice prior to taking any tests.

E. Owner shall select and engage the testing laboratory. Testing laboratory shall be responsible to the Owner and Owner's Engineer. Payment for laboratory and all tests shall be by Owner, except Owner specifically reserves the right to deduct from Contractor's payment, expenses and charges of testing laboratory when:

1. Contractor gives notice work is ready for inspection and testing, and fails to be ready for the test, and/or

2. testing of the Contractor's work, products, or materials fail, and retesting is required, and/or

3. Contractor abuses the services or interferes with work of testing laboratory in conduct of this work.

F. Test results shall be furnished to the Engineer prior to continuing with associated or subsequent work.

## PART 2 – PRODUCTS

### 2.1 PIPE

A. Concrete Pipe – Shall be reinforced Class III, Class IV, or Class V and shall conform to ASTM Specification C–76. Pipe less than 48 inch inside diameter shall be manufactured without lifting holes. Joints shall be either 'O' ring watertight flexible rubber, or tongue and groove as indicated on the plans. Gasketed single offset joints may be used in lieu of 'O' ring joints if acceptable to the Engineer.

1. 'O' Ring Joints – Shall be water tight flexible rubber gasket and shall meet ASTM Specification C–443.

2. Gasketed single offset joint shall be soil tight and shall meet ASTM Specification C–443.

3. Tongue and groove joints shall utilize mastic sealant and the exterior shall be wrapped with geotextile material.

B. Corrugated Aluminum Alloy Pipe – Shall conform to ASTM B745. Pipe may be annular or helical.

1. Joints – Coupling bands shall be one piece lap–type, having a width conforming to the pipe manufacturer's recommendations. They shall be of the angle lug, rod and lug, or U–bolt type. The type, size and gauge of bands and size of angles, bolts and rods shall be as specified in applicable standards or specifications for pipe. Exterior rivet heads in longitudinal seam under coupling band shall be countersunk or rivets shall be omitted and the seam welded.

2. Gaskets – Gaskets shall be made of 3/8 inch thick by 6–1/2 inch minimum width closed cell expanded synthetic rubber, fabricated in the form of a cylinder with a diameter approximately 10% less than nominal pipe size. The gasket material shall conform to requirements of ASTM D1056, Grade Number SBE–43.

3. Bends – Where specified, shall be shop fabricated to angles and dimensions shown on the construction drawings.

C. Polyethylene – Shall be high density polyethylene corrugated pipe having an integrally formed smooth interior, equivalent to Advanced Drainage Systems N–12WT, N–12STIB or Hancor Blue Seal or Sure–Lok ST. Pipe shall conform to ASTM F667 and F2306.

1. Joints – Pipe shall be joined using an integral bell and spigot joint meeting ASTM F2306 specifications. The joint shall be soil and water tight and gaskets, when applicable, shall meet requirements of ASTM F477. A joint lubricant supplied by manufacturer shall be used on the gasket and bell during assembly.

D. Subgrade Drain – Shall be heavy duty corrugated polyethylene perforated pipe manufactured by Advanced Drainage Systems (ADS) or equivalent and shall conform to ASTM F–405.

## 2.2 DRAINAGE STRUCTURES

A. Details – See plans.

B. Concrete – Reinforced and non–reinforced.

1. Minimum compressive strength = 3,000 p.s.i. at 28 days.

2. Reinforcing shall be covered by a minimum 1 inch of concrete for top slabs and 1–1/2 inches for walls and bases and 3 inches where concrete is deposited directly against the ground.

3. Expansion joint filler materials shall conform to ASTM D 1751 or D 1752.

C. Mortar – Connection of pipe and drainage structures shall be composed of one part by volume of Portland cement and two parts of sand. The Portland cement shall conform to ASTM C–150, Type I or II. The sand shall conform to ASTM C–144 and shall be of an accepted gradation. Hydrated lime may be added to the mixture of sand and cement in an amount equal to 25% of cement volume used. Hydrated lime shall conform to ASTM C–207, Type S. Quantity of water in the mixture shall be sufficient to produce a workable mortar, but shall in no case exceed 7 gallons of water per sack of cement. Water shall be clean and free of harmful acids, alkalies and organic impurities. The mortar shall be used within 30 minutes from time ingredients are mixed with water.

D. Brick Masonry – Brick shall conform to ASTM Specification C–62, Grade SW or C–55, Grade S. Mortar for jointing and plastering shall consist of one part Portland cement and two parts fine sand. Lime may be added to the mortar in an amount not more than 25% of the cement volume used. Joints shall be completely filled and shall be smooth and free from surplus mortar on the inside of structure. Brick structures shall be plastered with 1/2 inch of mortar over entire outside surface of the walls. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course, and for round structures, brick shall be laid radially with every sixth course a stretcher course.

E. Precast – Shall be constructed in accordance with ASTM C–478, C–913, or C–1433 and conform to details on the project drawings.

1. Joints – Shall be tongue and groove sealed with flexible gaskets or mastic sealant. Gaskets shall be O–Ring or Type A or B "Tylox" conforming to ASTM C443 and mastic shall be "Ram–nek" or equivalent with primer. Primer shall be applied to all contact surfaces of manhole joints at the factory in accordance with manufacturer's instructions.

2. Steps – Shall be polypropylene equivalent to M.A. Industries, Type PS–1 or PS–1–PF. Steps shall be installed at the manhole factory and in

accordance with recommendations of step manufacturer. Manholes will not be acceptable if steps are not installed accordingly.

3. Leaks – No leaks in the manhole will be acceptable. All repairs made from inside the manhole shall be made with mortar composed of one part portland cement and two parts clean sand; mixing liquid shall be straight bonding agent equivalent to "Acryl 60."

F. Frame, cover & grating shall conform to details shown on the project drawings. Grates in pavement and in other flush–mounted type surfaces shall be of a "bicycle–safe" configuration consisting of 45 degree diagonal bars or slotted grates with a maximum clear opening of 1 inch and a maximum length of 9–inches. In any case, the long dimension of openings should be located transverse to direction of traffic when possible.

## 2.3 FILTER FABRIC

A. Shall be a non–woven heat–bonded fiber of polypropylene and nylon filaments equivalent to Mirafi 140 N. The fabric shall be finished so filaments will retain their relative position with respect to each other. Fabric shall contain stabilizers and/or inhibitors added to the base plastic to make filaments resistant to deterioration due to ultraviolet and/or heat exposure. The product shall be free of flaws, rips, holes, or defects.

## 2.4 OMITTED

## 2.5 SOILS AND STONE AGGREGATES

A. Stone aggregate shall be clean crushed granite or concrete meeting the gradation requirements of grade No. 57.

B. Soils used for bedding, haunching, and initial backfill shall be as shown in the following table and shall meet requirements and classifications of ASTM D2321 and ASTM D2487.

| ***Class*** | ***Type*** | ***Soil Group Symbol D 2487*** | ***Description*** | ***Percentage Passing Sieve Sizes*** | | |
|---|---|---|---|---|---|---|
| | | | | ***1–1/2 inch (40 mm)*** | ***No. 4 (4.75 mm)*** | ***No. 200 (0.075 mm)*** |
| *IB* | *Manufactured, Processed Aggregates; dense–graded, clean.* | *None* | *Angular, crushed stone (or other Class 1A materials) and stone/sand mixtures with gradations selected to minimize migration of adjacent soils; contain little or no fines.* | *100%* | *≤50%* | *<5%* |
| *II* | *Coarse – Grained Soils, clean* | *GW* | *Well–graded gravels and gravel–sand mixtures; little or no fines.* | *100%* | *<50% of "Coarse Fraction "* | *<5%* |
| | | *GP* | *Poorly–graded gravels and gravel–sand mixtures; little or no* | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | *fines.* | | | |
| | | *SW* | *Well–graded sands and gravelly sands; little or no fines.* | | *>50% of "Coarse Fraction"* | |
| | | *SP* | *Poorly–graded sands and gravelly sands; little or no fines.* | | | |
| | *Coarse–Grained Soils; borderline clean to w/fines.* | *Eg. GW–GC, SP–SM.* | *Sands and gravels that are borderline between clean and with fines.* | *100%* | *Varies* | *5% to 12%* |
| *III* | *Coarse–Grained Soils with Fines* | *GM* | *Silty gravels, gravel–sand–silt mixtures.* | *100%* | *<50% of "Coarse Fraction"* | *5%* |
| | | *GC* | *Clayey gravels, gravel–sand–clay mixtures.* | | | |
| | | *SM* | *Silty sands, sand–silt mixtures.* | | *>50% of "Coarse Fraction"* | |
| | | *SC* | *Clayey sands, sand–clay mixtures.* | | | |
| *IVA* | *Fine–grained soils (inorganic)* | *ML* | *Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, silts with slight plasticity.* | *100%* | *100%* | *>50%* |
| | | *CL* | *Inorganic clays of low to medium plasticity, gravely clays, sandy clays, silty clays, lean clays.* | | | |

### 2.6 PRODUCT REVIEW

A. Contractor shall provide the Engineer with a complete description of all products before ordering. Engineer will review all products by the submittal of shop drawings before they are ordered.

## PART 3 – EXECUTION

### 3.1 ON SITE OBSERVATIONS OF WORK

A. The line, grade, deflection, and infiltration of storm sewers shall be tested by Contractor under direction of Engineer. Owner's Representative or Engineer will have the right to require any portion of work be completed in their presence and if work is covered up after such instruction, it shall be exposed by Contractor for observation. However, if Contractor notifies Engineer such work is scheduled and the Engineer fails to appear within 48–hours, Contractor may proceed. All work completed and material furnished shall be subject to review by the Engineer or Project Representative. All improper work shall be reconstructed. All materials not conforming to requirements of specifications shall be removed from the work upon notice being received from Engineer for rejection of such materials. Engineer shall have the right to mark rejected materials to distinguish them as such.

Contractor shall give the Project Engineer or Project Representative a minimum of 48–hours notice for all required observations or tests. Storm sewers shall be dry for

observation by the Engineer. Lines under water shall be pumped out by Contractor prior to observation, at no additional cost to the Owner.

It will also be required of Contractor to keep accurate, legible records of the location of all storm sewer lines and appurtenances. These records will be prepared in accordance with paragraph on "Record Data and Drawings" in the Special Conditions. Final payment to the Contractor will be withheld until all such information is received and accepted.

**3.2 EXCAVATION FOR PIPE AND STRUCTURES**

A. Excavated material shall be piled a sufficient distance from the trench banks to avoid overloading to prevent slides or cave–ins.

B. Remove from site all material not required or suitable for backfill.

C. Grade as necessary to prevent water from flowing into excavations.

D. Remove all water accumulating in the excavation, from surface flow, seepage, or otherwise, by pumping or other acceptable method.

E. Sheeting, bracing or shoring shall be used as necessary for protection of the work and safety of personnel.

**3.3 TRENCHING FOR PIPE**

A. Trenching for Pipe – The width of trenches at any point below top of pipe shall be not greater than outside diameter of pipe plus 4 feet to permit satisfactory jointing and thorough bedding, haunching, backfilling and compacting under and around pipes. Sheeting and bracing where required shall be placed within the trench width as specified. Care shall be taken not to over–excavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures shall be necessary. Cost of this re–design and increased cost of pipe or installation shall be borne by Contractor without additional cost to the Owner. When installing pipe in a positive projecting embankment installation, the embankment shall be installed to an elevation of at least 1 foot above top of pipe for a width of five pipe diameters on each side of pipe before installation of pipe.

B. Removal of Unsuitable Material – Where wet or otherwise unstable soil, incapable of supporting the pipe is encountered in bottom of trench, such material shall be removed to depth required and replaced to proper grade with stone or sand foundation as determined by Engineer. This foundation shall be compacted to 95% modified proctor.

**3.4 PROTECTION OF UTILITY LINES**

A. Existing utility lines shown on drawings or locations of which are made known to the Contractor prior to excavation, and are to be retained, as well as utility lines constructed during excavation operations, shall be protected from damage during excavation and backfilling, and if damaged, shall be repaired at Contractor's expense. If the Contractor damages any existing utility lines not

shown on drawings or locations of which are not known to Contractor, report thereof shall be made immediately. If Engineer determines repairs shall be made by Contractor, such repairs will be ordered under the clause in GENERAL CONDITIONS of contract entitled "CHANGES." When utility lines to be removed are encountered within the area of operations, Contractor shall notify Engineer in ample time for necessary measures taken to prevent interruption of service.

## 3.5 FOUNDATION AND BEDDING

A. Stone Foundation – Where the subgrade of pipe is unsuitable material, Contractor shall remove unsuitable material to a depth determined by Engineer or Geotechnical Consultant and furnish and place stone foundation in trench to stabilize subgrade.

B. Sand Foundation – Where the character of soil is unsuitable, even though dewatered, additional excavation to a depth determined by Engineer or Geotechnical Consultant shall be made and replaced with clean sand furnished by Contractor.

C. Bedding for pipe shall provide a firm surface of uniform density throughout the entire length of pipe. Before laying pipe, trench bottom shall be de–watered by the use of well points. Where well points will not remove the water, Contractor shall construct sumps and use pumps to remove all water from bedding surface. Pipe shall be carefully bedded in stone accurately shaped and rounded to conform to lowest 1/3 outside portion of circular pipe, or lower curved portion of arch pipe for the entire length of pipe. Bell holes and depressions for joints shall be only of such length, depth, and width as required for properly making the particular type joint.

D. Concrete Pipe:

1. Materials for bedding concrete pipe shall be either Class II, Class III, or Class IB if processed, to minimize migration of adjacent material.

2. Depth of bedding shall be equal to 1/24 the outer diameter of pipe or 3 inches, whichever is greater.

3. Bedding area under the center of pipe, for a width 1/3 outer diameter of pipe, known as middle bedding, shall be loosely placed. Remainder of bedding for full width of the trench shall be compacted to a minimum density of 85% for Class II bedding and 90% for Class III bedding as determined by ASTM D1557.

E. Polyethylene and Corrugated Aluminum Alloy Pipe

1. Materials for bedding polyethylene and corrugated aluminum alloy pipe shall be either Class II, Class III, or Class IB if processed to minimize migration of adjacent materials.

2. Depth of bedding shall be equal to 1/10 the outer diameter of pipe or a minimum of 6 inches, whichever is greater.

3. Bedding area under the center of pipe, for a width 1/3 outer diameter of pipe, known as middle bedding, shall be loosely placed. Remainder of bedding for full width of the trench shall be compacted to a minimum density of 90% for Class II bedding and 95% for Class III bedding.

## 3.6 HAUNCHING, INITIAL BACKFILL, AND FINAL BACKFILL

A. Haunching – After the bedding has been prepared and pipe is installed, Class II or Class III soil shall be placed along both sides of pipe, in layers not exceeding 6 inches in compacted depth. Care shall be taken to insure thorough compaction and fill under haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers and rammers. Haunching shall extend up to the spring line of pipe and be compacted to following densities:

1. RCP: Minimum density shall be 90% as determined by ASTM D1557.

2. HDPE and Corrugated Aluminum Alloy Pipe: Minimum density shall be 95% as determined by ASTM D1557.

B. Initial Backfill – HDPE and corrugated aluminum alloy pipe require initial backfill material of either Class II or Class III soils to be placed from the spring line to a minimum of 6 inches above top of pipe in 6 inch lifts. This initial backfill shall be compacted to a minimum density of 95% as determined by ASTM D1557. Reinforced concrete pipe does not specifically require initial backfill. Initial backfill for reinforced concrete pipe can be the same as final backfill.

C. Final Backfill – For all pipes, it should extend to the surface and shall be select materials compacted to a minimum of 98% as determined by ASTM D1557 if pipe is under pavement. If pipe is in grassed areas final backfill may be native materials compacted to a minimum density of 90% as determined by ASTM D1557.

## 3.7 PLACING PIPE

A. Each pipe shall be carefully examined before being laid, and defective or damaged pipe shall not be used. Pipe lines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe be laid in water, and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. All pipe in place shall have been checked before backfilling. When storm drain pipe terminates in a new ditch, headwall or end section, together with ditch pavement, if specified, shall be constructed immediately as called for on the plans. Ditch slopes and disturbed earth areas shall be grassed and mulched as required. Contractor will be responsible for maintaining these newly constructed ditches and take immediate action subject to acceptance, keeping erosion of the ditch bottom and slopes to a minimum during life of contract. No additional compensation will be given to Contractor for the required diversion of drainage and/or dewatering of trenches. Grassing the trench backfill shall conform to requirements of Section 32 92 00 – "Turf and Grasses."

B. Concrete Pipe: Laying shall proceed upgrade with spigot ends of bell and spigot pipe and tongue ends of tongue and groove pipe pointing in the direction of flow. Place pipe in trench with the invert conforming to required elevations, slopes and alignment. Provide bell holes in pipe bedding in order to insure uniform pipe support. Fill all voids under the pipe by working in backfill material.

C. Corrugated Aluminum Pipe: Shall be laid with separate sections joined firmly together, with outside laps of circumferential joints pointing upstream and with longitudinal laps on the side. Lifting lugs, where used, shall be placed to facilitate moving the pipe without damage to exterior or interior coatings. Place pipe in trench with the invert conforming to required elevations, slopes and alignment. Fill all voids under the pipe by working in backfill material.

D. Polyethylene Pipe – Laying shall proceed upgrade with spigot ends of bell and spigot pipe pointing in the direction of flow. Place pipe in trench with the invert conforming to required elevations, slopes, and alignment. Provide bell holes in pipe bedding in order to ensure uniform pipe support. Fill all voids under the pipe by working in bedding material. Pipe shall be installed in accordance with ASTM D–2321.

E. Subgrade Drain Tubing – Shall be laid as detailed on construction drawings with the invert conforming to required elevations and alignment.

**3.8 JOINTS IN PIPES**

A. Concrete Pipe – Joints in concrete pipe shall be either 'O' ring watertight flexible rubber or tongue and groove as indicated on the plans. Gasketed, single offset joints may be used if accepted by the Engineer. Maintain pipe alignment and prevent infiltration of fill material at joints during installation.

1. 'O' ring and single offset joints shall meet the requirements of ASTM C443. They shall utilize either a rubber gasket with a circular cross section or a rectangular cross section. Gaskets shall have no more than one splice, except two splices of the gasket will be permitted if nominal diameter of pipe exceeds 54 inches. Manufacturer's recommendations and requirements shall be followed.

2. Tongue and groove joints shall utilize a bituminous mastic such as Ram–Nek or accepted equivalent. The joint surfaces shall be primed according to manufacturer's recommendations. Care shall be taken to ensure mastic material completely and uniformly seals the joint.

3. All tongue and groove joints shall receive one layer of filter fabric completely around exterior of the joint. Filter fabric shall be a minimum of 2 feet wide, centered on the joint, and overlapped a minimum of 1 foot.

B. Corrugated Aluminum Pipe – Maintain pipe alignment and prevent infiltration of fill material at joints during installation.

1. Installation of Gaskets – Shall be in accordance with recommendations of the manufacturer in regard to use of lubricants and cements and other special installation requirements. Gasket shall be placed over one end of

a section of pipe for half the width of a gasket. The other half shall be doubled over end of same pipe. When adjoining section of pipe is in place, the double–over half of gasket shall then be rolled over the adjoining section. Any unevenness in overlap shall be corrected so gasket covers ends of pipe sections equally. Connecting bands shall then be centered over the adjoining sections of pipe, and rods or bolts placed in position and nuts tightened. The band shall be tightened evenly. Tension shall be kept on rods or bolts and gasket shall be closely observed to see it is seating properly in the corrugations.

2. Installation of Filter Fabric at Joint – After the connecting band has been tightened; Contractor shall place one layer of filter fabric completely around exterior of joint, a minimum of 2 feet wide, centered on joint, and overlapped a minimum of 1 foot.

C. Polyethylene Pipe – Maintain pipe alignment and prevent infiltration of fill material at joints during installation

1. Joints shall be gasketed soil–tight and water–tight bell and spigot meeting ASTM F2306. Gaskets shall meet the requirements of ASTM F477. A joint lubricant supplied by manufacturer shall be used on the gasket and bell during assembly. Spigot end of pipe shall be inserted into bell using methods recommended by the manufacturer. Pipe shall be kept true to line and grade during assembly.

2. Installation of Filter Fabric at Joint – All polyethylene pipe joints shall receive one layer of filter fabric completely around exterior of the joint. Filter fabric shall be a minimum of 2 feet wide, centered on the joint, and overlapped a minimum of 1 foot.

D. Subgrade Drain Tubing – Joints shall be joined using snap couplings. When installing sock wrapped pipe, overlap sock ends over coupling and secure with polyethylene tape.

## 3.9 FIELD QUALITY CONTROL

A. Soil and density tests shall be made by a testing laboratory acceptable to the Engineer. Laboratory tests of the soil shall be made in accordance with ASTM D 1557. In–place density tests shall be made in accordance with ASTM D 6938. Results of tests shall be furnished to the Engineer.

The minimum number of tests required shall be:

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|---|---|
| Haunching and Initial Backfill in all areas…. | 1 per 100–linear feet of pipe, minimum of one per run of pipe for both the haunching and initial backfill zones. |
| Final Backfill over pipe in traffic areas……. | 1 per 100–linear feet or less for each 4–feet of depth or portion thereof. |
| Final Backfill over pipe | |

in non–traffic areas….. 1 per 500–linear feet or less for each 6–feet of depth or portion thereof.

The minimum percent of compaction of the backfill material (in accordance to ASTM D1557) shall be the following:

In traffic Areas. . . . . 98% of maximum laboratory density.

In non–traffic Areas . . . 90% of maximum laboratory density, unless otherwise accepted by the Engineer.

B. It is the Contractor's responsibility to assure backfill is sufficient to limit pipe deflection to no more than 5%. When flexible pipe is used, a deflection test shall be made by the Contractor on entire length of installed pipeline, not less than 30–days after completion of all backfill and placement of any fill. Deflection shall be determined by use of a deflection device or by use of a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. The ball, cylinder, or circular sections shall have a diameter, or minor diameter as applicable, of 95% of inside pipe diameter. The ball, cylinder, or circular sections shall be of a homogeneous material throughout, shall have a density greater than 1.0 as related to water at 39.2 degrees F, and shall have a surface brinell hardness of not less than 150. The device shall be center bored and through bolted with a 1/4 inch minimum diameter steel shaft having a yield strength of 70,000 p.s.i. or more, with eyes at each end for attaching pulling cables. The eye shall be suitably backed with flange or heavy washer; a pull exerted on opposite end of shaft shall produce compression throughout remote end of ball, cylinder, or circular section. Circular sections shall be spaced so the distance from external faces of front and back sections shall equal or exceed diameter of circular section. Failure of the ball, cylinder, or circular section to pass freely through a pipe run, either by being pulled through by hand or by being flushed through with water, shall be cause for rejection of a run. When a deflection device is used for the test in lieu of a ball, cylinder, or circular sections described, such device shall be given acceptance prior to use. Device shall be sensitive to 1.0% of pipe diameter being measured and shall be accurate to 1.0% of the indicated dimension. Installed pipe showing deflections greater than 5% of normal pipe diameter shall be retested by a run from the opposite direction. If retest also fails, the suspect pipe shall be repaired or replaced at no cost to Owner.

C. 50% of pipes under roadways shall be televised and video recorded. The video observation shall include a complete pan view of each joint. If the video observation indicates problems, further televising may be required. Additional televising and video recording will be at no additional cost to the Owner.

## 3.10 DRAINAGE STRUCTURES

A. Drainage structures shall be constructed of materials specified for each type and in accordance with details shown on the drawings.

## 3.11 REMOVE AND REPLACE PAVEMENT

A. Pavement shall only be removed after prior written authorization by the Owner. Pavement removed and replaced shall be constructed in accordance with latest specifications of the State Department of Transportation. Traffic shall be maintained and controlled per State Department of Transportation regulations.

**3.12 CONNECT PIPE TO EXISTING STRUCTURES**

A. Contractor shall connect pipe to the existing structure where indicated. For brick or precast structures, a hole not more than 4 inches larger than outside diameter of new pipe shall be cut or cored neatly in the structure, new pipe laid so it is flush with inside face of structure, and annular space around pipe filled with a damp, expanding mortar or grout to make a watertight seal.

END OF SECTION